FUSION 8

TOOL REFERENCE MANUAL

September 2016

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3D Tools

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Alembic Mesh 3D [ABC]

There are two way to import Alembic files: Using the File > Import > Alembic menu option or manually adding an AlembicMesh3D tool to the flow. The first method is strongly recommended.

The Alembic format allows for arbitrary user data to be stored within the file. Fusion ignores most of this metadata for various reasons. No conventions have been defined yet for how this metadata is named and metadata might change between different ABC exporters. When the Alembic file is imported through the menu option, the transforms are read into splines and into the inputs on the tools, which get saved with the comp.

This means that when re-loading the comp, the transforms are loaded from the comp and not the Alembic file. The meshes are handled differently; they are always reloaded from the Alembic file.

Controls
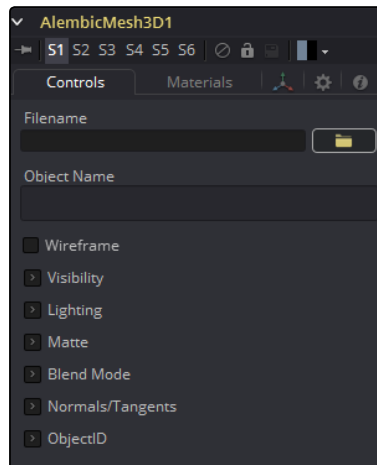
Filename
The name of the imported Alembic file.

Object Name
This input shows the name of the mesh from the Alembic file that is being imported. If this field is blank, then the entire contents of the FBX geometry will be imported as a single mesh. This input is not editable by the user; it is set by Fusion when importing Alembic files via the File > Import > Alembic utility.

Sampling Rate

The framerate is set when importing the file. It can be altered using this slider to create effects like slow motion.

Dump File

Opens the resulting ASCII in the preferred text editor.
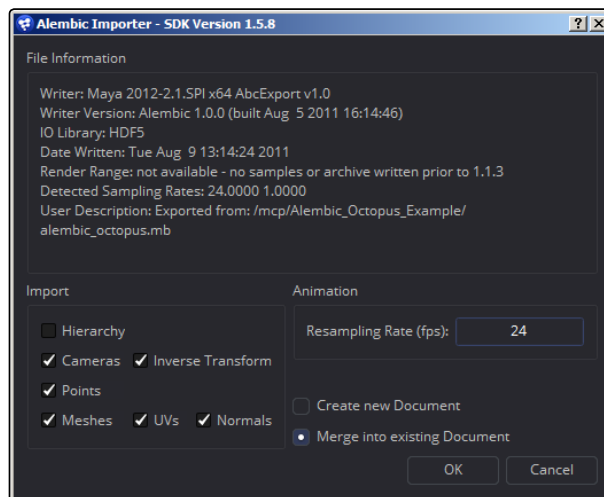
Alembic import dialog

→ Writer: The name of the plug-in/application that created/wrote out the Alembic file

→ Writer Version: The version of the Alembic sdk that was used to write out the Alembic file

→ RenderRange: This gives you an idea of the duration of the animation in the Alembic file in seconds

→ DetectedSamplingRates: Fusion examines the framerates in the file and reports them here. This is useful to determine the value at which to set the Resampling Rate.

Hierarchy

If disabled, the transforms in the Alembic file are flattened down into the cameras and meshes. This results in a number of meshes/cameras connected to a single merge node in Fusion. When enabled, you get the full parenting hierarchy.

Orphaned transforms

Transforms that do not parent a mesh or camera will not be imported if this option is unchecked. For example, if you have a skeleton and associated mesh model, the model will be imported as an Alembic mesh and the skeleton will be imported as a tree of merge3Ds. Disabling this option causes the merge3Ds not to be imported.

Cameras

Near/Far/Apertures/Angles of View/Plane of Focus are imported. The resolution Gate Fit may be imported; it depends if the Writer correctly tagged the resolution Gate Fit metadata. If your camera does not import correctly, you should check to see if Camera3D.ResolutionGateFit is set correctly. Stereo information is not imported.

InverseTransform

Imports the Inverse Transform (World to Model) for cameras.

Points

Alembic supports a Points type. This is a collection of 3D points without orientation. Some 3D apps export particles as points, but keep in mind the direction and orientation of the particles are lost; you just get positions. It very well may be possible that the exocortex Alembic plug-ins write out extra user data that contains orientation.

Meshes

Optionally import UVs and normals.

ResamplingRate

When an Alembic animation is exported, it is stored on disk in seconds, not in frames. When the Alembic data is brought into Fusion, you need to supply a framerate with which to resample the animation. Ideally, you should choose the same framerate that it was exported with so your samples match up with the original samples. Detected Sampling Rates can give an idea of what to pick if unsure.

Lights

Import currently not supported. There is no universal convention on Alembic light schemas.

Materials

Import currently not supported. There is no universal convention on Alembic material schemas.

Curves

Import currently not supported.

Multiple UVs

Import currently not supported. There is no universal convention yet.

Velocities

Import currently not supported.

Cyclic/Acyclic sampling

Currently not implemented. Uniform sampling, which is the most common mode, works fine. We recommend the use of FBX for lights/cameras/materials and Alembic for meshes only. If cameras and Alembic work for you, then go for it. The reason is that our Alembic plug-in doesn't support lights/materials, but FBX has good support. Alembic import of cameras has problems with Resolution Gate Fit and doesn't import stereo options.

Bender 3D [3BN]

The Bender 3D tool is used to bend, taper, twist or shear the geometry in a 3D scene based upon its bounding box. It takes a 3D scene as input and outputs a modified 3D scene. Only the geometry in the scene is modified. Any lights, cameras or materials are passed through unaffected.

The Bender tool does not produce new vertices in the geometry; only existing vertices in the geometry are altered. As a result, when applying the Bender 3D tool to primitives created in Fusion, it is a good idea to increase the value of the Subdivision controls in the original primitives to give a higher quality result.

External Inputs

The following inputs appear on the tools tile in the Flow Editor.

→ Bender3D.SceneInput
    [gold, required] This input expects a 3D scene.

Controls Tab
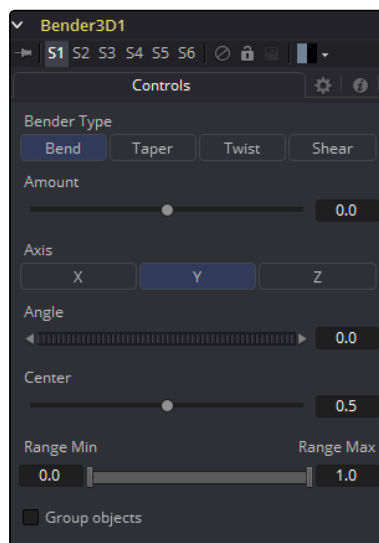
Bender Type

Use the Bender Type to select the type of deformation to apply to the geometry. There are four modes available: Bend, Taper, Twist and Shear.

Amount

Adjust the Amount slider to change the strength of the deformation.

Axis

The Axis control determines the axis along which the deformation is applied and has a different meaning depending on the type of deformation. When bending, this determines the axis that is bent, in conjunction with the Angle control. In other cases, the deform is applied around the specified axis.

Angle

The Angle thumbwheel control determines what direction about the axis that a bend or shear is applied. It is not visible for taper or twist deformations.

Range

The Range control can be used to limit the effect of a deformation to a small portion of the geometry. The Range control is not visible when the Bender Type is set to Shear.

Group Objects

When this is checked, all the objects in the input scene are grouped together into a single object and that object is deformed around the common center, instead of deforming each component object individually.

Camera 3D [3Cm]

The Camera 3D tool generates a virtual camera through which the 3D environment can be viewed. It closely emulates the settings used in both real and virtual cameras in an effort to make matching the cameras used in other scene elements as seamless as possible.

The camera should be added to the scene using a Merge 3D tool. Displaying a camera tool directly in the Viewer shows only an empty scene; there is nothing for the camera to see. To view the scene through the camera, view the scene from the Merge 3D tool that introduces the camera, or any tool downstream of that Merge 3D. Then right click in the view and select Camera > Cameraname from the contextual menu. Right clicking on the axis label found in the bottom corner will display the Camera sub-menu directly.

The aspect of the Viewer may be different from the aspect of the camera, so that the view through the camera interactively may not match the true boundaries of the image which will actually be rendered by the Renderer 3D tool. To assist you in framing the shot, guides can be enabled that represent the portion of the view the camera actually sees. Right click in the Viewer and select an option from the Guides > Frame Format sub-menu. The default option will use the format enabled in the Composition > Frame Format preferences. To toggle the guides on or off select Guides > Show Guides from the Viewers contextual menu, or use the Command-G (Mac OS X) or Ctrl-G (Windows) keyboard shortcut when the view is active.

The Camera 3D tool can also be used to perform Camera Projection, where a 2D image is projected through the camera into 3D space. This can be done as a simple Image Plane aligned with the camera, or as an actual projection, similar to the behavior of the Projector 3D tool, with the added advantage of being aligned exactly with the camera. The Image Plane, Projection and Materials tabs will not appear until a 2D image is connected to the Camera 3D tool in the Flow Editor.

The Camera tool has built in stereoscopic features. They offer control over eye separation and convergence distance. The camera for the right eye can be replaced using a separate camera tool connected to the green input. Additionally the plane of focus control for depth of field rendering is also available here.

If you add a camera by means of dragging the 3Cm icon from the toolbar onto the 3D view, it will automatically merge it with the scene you are viewing. In addition, it will be automatically set to the current viewpoint, and the view will be set to look through the new camera. Alternatively, it is possible to copy the current viewpoint to a camera (or Spotlight or any other object) by means of the Copy PoV To option in the Viewer's contextual menu, under the Camera submenu.

External Inputs

The following inputs appear on the tools tile in the Flow Editor.
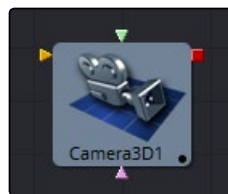
→ Camera3D.SceneInput

[gold, required] This input expects a 3D scene.

→ Camera3D.RightStereoCamera

[green, optional] This input should be connected to another Camera 3D tool. It is used to override the internal camera used for the right eye in stereoscopic renders and Viewers.

→ Camera3D.ImageInput

[magenta, optional] This input expects a 2D image. The image is used as a texture when camera projection is enabled, as well as when the camera's image plane controls are used to produce parented planar geometry linked to the camera's field of view.

Controls

The options in this tab are used to set the camera's clipping, field of view, focal length and stereoscopic properties.
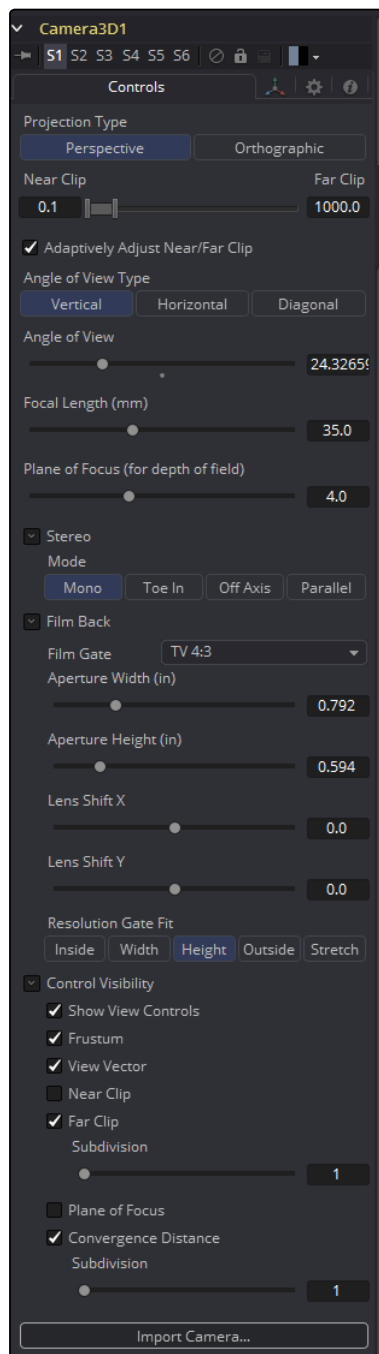
Projection Type

Use the Projection Type button to choose between Perspective and Orthographic cameras. Generally, real world cameras are perspective cameras. An orthographic camera uses parallel orthographic projection, a technique where the view plane is perpendicular to the viewing direction. This produces a parallel camera output that is undistorted by perspective.

Orthographic cameras only present controls for the near and far clipping planes, and a control to set the viewing volume.

Near/Far Clip

The clipping plane is used to limit what geometry in a scene is rendered based on the object's distance from the camera's focal point. This is useful for ensuring that objects which are extremely close to the camera are not rendered and for optimizing a render to exclude objects that are too far away to be useful in the final rendering.

The default perspective camera ignores this setting unless the the Adaptively Adjust Near/Far Clip checkbox control below is disabled.

The values are expressed in units, so a far clipping plane of 20 means that any object more than 20 units distant from the camera will be invisible to the camera. A near clipping plane of 0.1 means that any object closer than 0.1 units will also be invisible.

Note: A smaller range between the near and far clipping planes allows greater accuracy in all depth calculations. If a scene begins to render strange artifacts on distant objects, try increasing the distance for the Near Clip plane.

Adaptively Adjust Near/Far Clip

When selected, the Renderer will automatically adjust the camera's near/far clipping plane to match the extents of the scene. This setting overrides the values of the Near and Far clip range control described above. This option is not available for orthographic cameras.

Viewing Volume Size

The Viewing Volume Size control only appears when the Projection Type is set to Orthographic. It determines the size of the box that makes up the camera's field of view.

The Z distance of an orthographic camera from the objects it sees does not affect the scale of those objects, only the viewing size does.

Angle of View Type

Use the Angle of View Type button array to choose how the camera's angle of view is measured. Some applications use vertical measurements, some use horizontal and others use diagonal measurements. Changing the Angle of View type will cause the Angle of View control below to recalculate.

Angle of View

Angle of View defines the area of the scene that can be viewed through the camera. Generally, the human eye can see much more of a scene than a camera, and various lenses record different degrees of the total image. A large value produces a wider angle of view and a smaller value produces a narrower, or more tightly focused, angle of view.

The angle of view and focal length controls are directly related. Smaller focal lengths produce a wider angle of view, so changing one control automatically changes the other to match.

Focal Length

In the real world, a lens' Focal Length is the distance from the center of the lens to the film plane. The shorter the focal length, the closer the focal plane is to the back of the lens. The focal length is measured in millimeters. The angle of view and focal length controls are directly related. Smaller focal lengths produce a wider angle of view, so changing one control automatically changes the other to match.

The relationship between focal length and angle of view is angle = 2 * arctan[aperture / 2 / focal_length].

Use the vertical aperture size to get the vertical angle of view and the horizontal aperture size to get the horizontal angle of view.

Plane of Focus (for Depth of Field)

This value is used by the OpenGL renderer to calculate depth of field. It defines the distance to a virtual target in front of the camera.

Stereo Method

Allows you to adjust your stereoscopic method to your preferred working model.

Toe in

Both cameras point at a single focal point. Though the result is stereoscopic, the vertical parallax introduced by this method can cause discomfort by the audience.
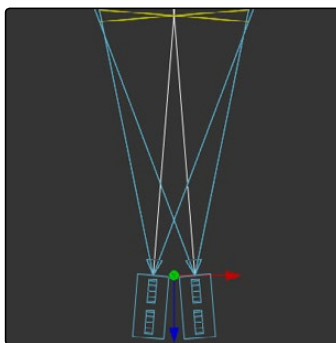
Off Axis

Often regarded as the correct way to create stereo pairs, this is the default method in Fusion. Off Axis introduces no vertical parallax, thus creating less stressful stereo images.
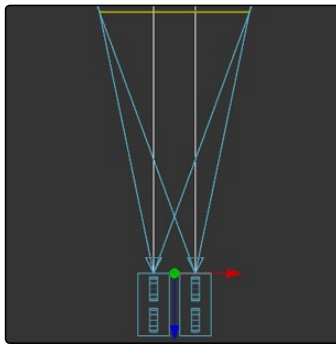
Parallel

The cameras are shifted Parallel to each other. Since this is a purely parallel shift, there is no Convergence Distance control. Parallel introduces no vertical parallax, thus creating less stressful stereo images.
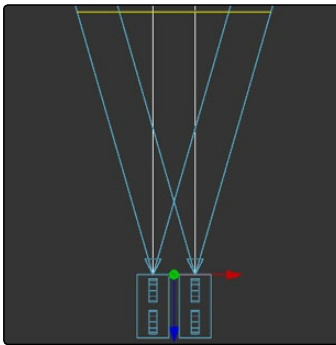
Eye Separation

Defines the distance between both stereo cameras. If the Eye Separation is set to a value larger than 0, controls for each camera will be shown in the Viewer when this tool is selected. There is no Convergence Distance control in Parallel mode.

Convergence Distance

This control sets the stereoscopic convergence distance, defined as a point located along the Z-axis of the camera that determines where both left and right eye cameras converge.

Film Back

Film Gate

The Film Gate menu shows a list of preset camera types. Selecting one of the options will automatically set the aperture width and aperture height to match the selected camera type.

Aperture Width/Height

The Aperture Width and Height sliders control the dimensions of the camera's aperture, or the portion of the camera that lets light in on a real world camera. In video and film cameras, the aperture is the mask opening that defines the area of each frame exposed. Aperture is generally measured in inches, which are the units used for this control.

Resolution Gate Fit

Determines how the film gate is fit within the resolution gate. This only has an effect when the aspect of the film gate is not the same aspect as the output image. This setting corresponds to the Maya Fit Resolution Gate. The modes Overscan, Horizontal, Vertical and Fill correspond to Inside, Width, Height and Outside.

→ Inside: The image source will be scaled uniformly until one of its dimensions (X or Y) fits the inside dimensions of the Mask. Depending on the relative dimensions of image source and Mask Background, either the image source's width or height may be cropped to fit the respective dimension of the Mask.

→ Width: The image source will be scaled uniformly until its width (X) fits the width of the Mask. Depending on the relative dimensions of image source and Mask, the image source's Y-dimension might not fit the Mask's Y-dimension, resulting in either cropping of the image source in Y or the image source not covering the Mask's height entirely.

→ Height: The image source will be scaled uniformly until its height (Y) fits the height of the Mask. Depending on the relative dimensions of image source and Mask, the image source's X-dimension might not fit the Mask's X-dimension, resulting in either cropping of the image source in X or the image source not covering the Mask's width entirely.

→ Outside: The image source will be scaled uniformly until one of its dimensions (X or Y) fits the outside dimensions of the Mask. Depending on the relative dimensions of image source and Mask, either the image source's width or height may be cropped or not fit the respective dimension of the Mask.

→ Stretch: The image source will be stretched in X and Y to accommodate the full dimensions of the generated Mask. This might lead to visible distortions of the image source.

Control Visibility

Allows you to selectively activate the on screen controls that are displayed along with the camera.

→ Frustrum: Displays the actual viewing cone of the camera.

→ View Vector: Displays a white line inside the viewing cone, which can be used to determine the shift when in Parallel mode.

→ Near Clip: The Near clipping plane. This plane can be subdivided for better visibility.

→ Far Clip: The Far clipping plane. This plane can be subdivided for better visibility.

→ Plane of Focus: The Plane of Focus according to the respective slider explained above. This plane can be subdivided for better visibility.

→ Convergence Distance: The point of convergence when using Stereo mode. This plane can be subdivided for better visibility.

Import Camera

The Import Camera button displays a dialog to import a camera from another application. It supports the following file types:

*LightWave Scene	.lws
*Max Scene	.ase
*Maya Ascii Scene	.ma
*dotXSI	.xsi

Image

When a 2D image is connected to the camera, an Image Plane is created that is always oriented so that the image fills the camera's field of view. The Image Plane tab is hidden until a 2D image is connected to the Camera 3D's input on the flow.

With the exception of the controls listed below, the options presented in this tab are identical to those presented in the Image Plane tools control tab. Consult that tools documentation for a detailed description.
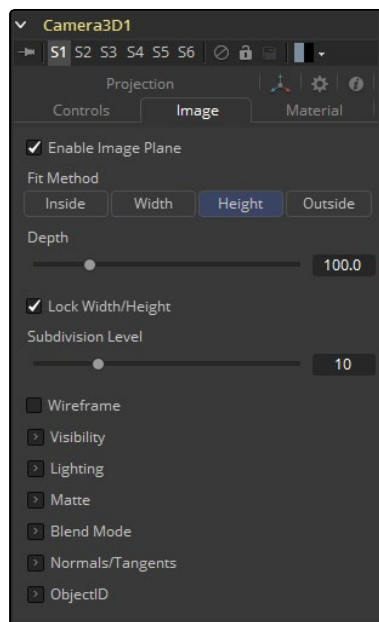
Enable Image Plane

Use this checkbox to enable or disable the creation of the Image Plane.

Fill Method

Describes how to deal with the input image if the camera has a different aspect ratio.

→ Inside: The image source will be scaled uniformly until one of its dimensions (X or Y) fits the inside dimensions of the Mask. Depending on the relative dimensions of image source and Mask Background, either the image source's width or height may be cropped to fit the respective dimension of the Mask.

→ Width: The image source will be scaled uniformly until its width (X) fits the width of the Mask. Depending on the relative dimensions of image source and Mask, the image source's Y-dimension might not fit the Mask's Y-dimension, resulting in either cropping of the image source in Y or the image source not covering the Mask's height entirely.

→ Height: The image source will be scaled uniformly until its height (Y) fits the height of the Mask. Depending on the relative dimensions of image source and Mask, the image source's X-dimension might not fit the Mask's X-dimension, resulting in either cropping of the image source in X or the image source not covering the Mask's width entirely.

→ Outside: The image source will be scaled uniformly until one of its dimensions (X or Y) fits the outside dimensions of the Mask. Depending on the relative dimensions of image source and Mask, either the image source's width or height may be cropped or not fit the respective dimension of the Mask.

→ Depth: The Depth slider controls the image plane's distance from the camera.

Projection

If a 2D image is connected to the camera it becomes possible to project the image into the scene. A projection is different from an image plane in that the projection will fall onto the geometry in the scene exactly as if there was a physical projector present in the scene. The image is projected as light, which means the Renderer must be set to enable lighting for the projection to be visible.

See the Projector 3D tool for additional information.
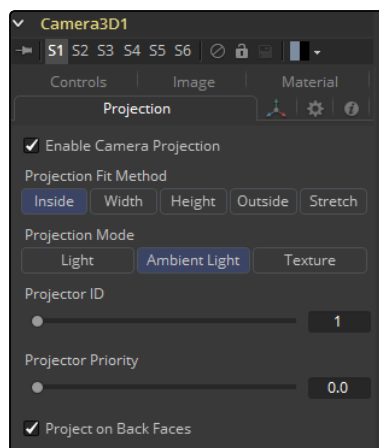
Enable Camera Projection
Select this checkbox to enable projection of the 2D image connected to the Camera tool.

Projection Fit Method
This button array can be used to select the method used to match the aspect of projected image to the camera's Field of View.

Projection Mode
> → Light: Defines the projection as a spotlight.

> → Ambient Light: Defines the projection as an ambient light.

> → Texture: Allows a projection which can be relighted using other lights. Needs a Catcher tool connected to the appropriate input ports of the specific material.

Tips for Camera 3D

When importing a camera from a 3D application that will also be used as a projector, make sure that the Fit Resolution Gate options on the main Controls tab as well as the Projection tab are in sync. Only the first one will automatically be set to what the 3D app was using. The latter might have to be adjusted manually.

The camera's image plane isn't just a virtual guide for you in the Viewers. It's actual geometry that you can also project onto. You need to use a Replace Material tool after your Camera node.

To achieve real Parallel Stereo mode you can:

> Connect an additional external (right) camera to "Right Stereo Camera" input of your camera.

> Create separate left and right cameras

> Set the ConvergenceDistance slider to a very large value of 999999999.

Rendering with Overscan from Fusion's 3D Space

If you want to render an image with overscan you also have to modify your scene's Camera3D. Since overscan settings aren't exported along with camera data from 3D applications, this is also necessary for cameras you've imported via .fbx or .ma files. The solution is to increase the film back's width and height by the factor necessary to account for extra pixels on each side.

Cube 3D [3C$_B$]

The Cube 3D tool is a basic primitive geometry type capable of generating a simple cube. The tool also provides six additional image inputs that can be used to map a texture onto the six faces of the cube. Cubes are often used as shadow casting objects and for environment maps. For other basic primitives, see the Shape 3D tool.

External Inputs

> → Cube3D.SceneInput
> [orange, optional] This input expects a scene from a 3D tool output.

> → Cube3D.NameMaterialInput
> These 6 inputs are used to define the materials applied to the six faces of the cube. They will accept either a 2D image or a 3D material as valid.

Controls
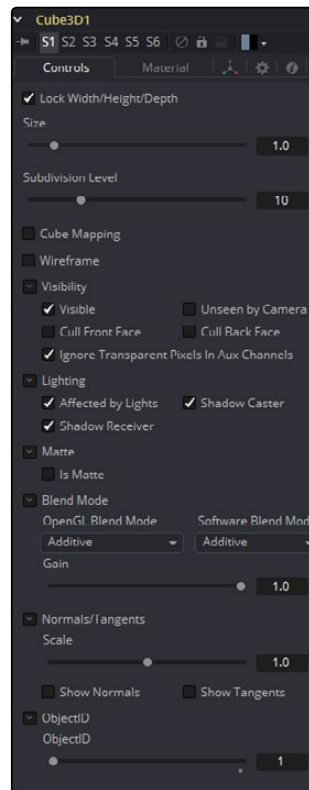
Lock Width/Height/Depth

This checkbox locks the Width, Height and Depth dimensions of the cube together, so that they are always the same size. When selected, only a Size control is displayed, otherwise separate Width, Height and Depth sliders are shown.

Size or Width/Height/Depth

If the Lock checkbox is selected then only the Size is shown, otherwise separate sliders are displayed for Width, Height and Depth. The Size and Width sliders are the same control renamed, so any animation applied to Size will also be applied to Width when the controls are unlocked.

Subdivision Level

Use the Subdivision Level slider to set the number of subdivisions used when creating the image plane.

If the Open GL viewer and renderer are set to Vertex lighting, the more subdivisions in the mesh, the more vertices will be available to represent the lighting. For this reason, high subdivisions can be useful when working interactively with lights.

Cube Mapping

Enabling the Cube Mapping checkbox causes the cube to wrap its first texture across all six faces using a standard cubic mapping technique. This approach expects a texture laid out in the shape of a cross.

Wireframe

Enabling this checkbox will cause the Mesh to render only the Wireframe for the object when rendering with the OpenGL renderer.

Visibility

→ **Visible:** If the Visibility checkbox is not selected, the object will not be visible in the Viewers, nor will it be rendered into the output image by the Renderer 3D tool. A non-visible object does not cast shadows.

→ **Unseen by Cameras:** If the unseen by cameras checkbox is selected, the object will be visible in the Viewers (unless the Visible checkbox is turned off), except when viewed through a camera. The object will not be rendered into the output image by the Renderer 3D tool. Shadows cast by an unseen object will still be visible when rendered by the Software renderer, though not by the OpenGL renderer.

→ **Cull Front Face/Back Face:** Use these options to cull (eliminate) rendering and display of certain polygons in the geometry. If Cull Back Face is selected, all polygons facing away from the camera not be rendered, and will not cast shadows. If Cull Front Face is selected, all polygons facing toward the camera will likewise be dropped. Selecting both checkboxes has the same effect as deselecting the Visible checkbox.

→ **Ignore Transparent Pixels in Aux Channels:** In previous versions of Fusion, transparent pixels were rejected by the Software/GL renderers. To be more specific, the Software renderer rejected pixels with R=G=B=A=0 and the GL renderer rejected pixels with A=0. This is now optional. The reason you might want to do this is to get aux channels (e.g., Normals, Z, UVs) for the transparent areas. For example, suppose in post you want to replace the texture on a 3D element that is transparent in certain areas with a texture that is transparent in different areas, then it would be useful to have transparent areas set aux channels (in particular UVs). As another example, suppose you are doing post DoF. You will probably not want the Z channel to be set on transparent areas, as this will give you a false depth. Also, keep in mind that this rejection is based on the final pixel color including lighting, if it is on. So if you have a specular highlight on a clear glass material, this checkbox will not affect it.

Lighting

→ **Affected by Lights:** If this checkbox is not selected, lights in the scene will not affect the object, it will not receive nor cast shadows, and it will be shown at the full brightness of its color, texture or material.

→ **Shadow Caster:** If this checkbox is not enabled, the object will not cast shadows on other objects in the scene.

→ **Shadow Receiver:** If this checkbox is not enabled, the object will not receive shadows cast by other objects in the scene.

Matte

Enabling the Is Matte option will apply a special texture to this object, causing this object to not only become invisible to the camera, but also making everything that appears directly behind the camera invisible as well. This option will override all textures. See the Matte Objects section of the 3D chapter for more information.

→ **Is Matte:** When activated, objects whose pixels fall behind the matte object's pixels in Z do not get rendered.

→ **Opaque Alpha:** Sets the alpha value of the matte object to 1. This checkbox is only visible when the Is Matte option is enabled.

→ **Infinite Z:** Sets the value in the Z channel to infinite. This checkbox is only visible when the Is Matte option is enabled.

Blend Mode

A Blend mode specifies which method will be used by the Renderer when combining this object with the rest of the scene. The Blend modes are essentially identical to those listed in the section for the 2D Merge tool. For a detailed explanation of each mode, see the section for that tool.

The blending modes were originally designed for use with 2D images. Using them in a lit 3D environment can produce undesirable results. For best results, use the Apply modes in unlit 3D scenes rendered in software.

→ **OpenGL Blend Mode:** Use this menu to select the blending mode that will be used when the geometry is processed by the OpenGL renderer. This is also the mode used when viewing the object in the Viewers. Currently the OpenGL renderer supports three blending modes.

→ **Software Blend Mode:** Use this menu to select the blending mode that will be used when the geometry is processed by the Software renderer. Currently, the Software renderer supports all of the modes described in the Merge tool documentation, except for the Dissolve mode.

Material Tab

The options which appear in this tab determine the appearance of the geometry created by this tool. Since these controls are identical on all tools that generate geometry, these controls are fully described in the Common 3D Controls section of this documentation.

If an external 3D material is connected to the tool tile's material input, then the controls in this tab will be replaced with the "Using External Material" label.

Transform Tab

The options which appear in this tab determine the position of the geometry created by this tool. Since these controls are identical on all tools that generate geometry, these controls are fully described in the Common 3D Controls section of this documentation.

Custom Vertex 3D [3Cv]

This is a custom tool for 3D geometry that can be used to do per vertex manipulations, for example on an image plane like: (px, py, sin(10*(px^2 + py^2) + n1)). Other vertex attributes like normals, vertex color, texture coordinates, tangents, and velocity can be modified as well.
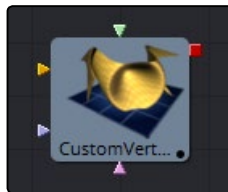
Note: Modifying the X, Y and Z positions of a 3D object does not modify the normals/tangents. You can use a ReplaceNormals tool afterwards to recompute the normals/tangents.

Note: Not all geometry has all vertex attributes. For example, most Fusion geometry does not have vertex colors, with the exception of particles and some imported FBX/Alembic meshes.

No geometry has envcoord currently. Only particles have velocities. If a stream is not present on the input geometry it is assumed to have a default value.

These default values are:

Tangentu (tux, tuy, tuz)	(1,0,0)
Tangentv (tvx, tvy, tvz)	(0,1,0)
Normals (nx, ny, nz)	(0,0,1)
Vertexcolor (vcr, vcg, vcb, vca)	(1,1,1,1)
Velocity (vx, vy, vz)	(0,0,0)
Envcoord (eu, ev, ew)	(0,0,0)
Texcoord (tu, tv, tw)	(0,0,0)

Note: Missing streams on the input geometry are created if the expression for a stream is non-trivial. The values for the streams will be as given in the above point. For example, if the input geometry does not have normals, then the values of (nx, ny, nz) will always be (0,0,1). To change this, you could use a ReplaceNormals tool beforehand to generate them.

Controls
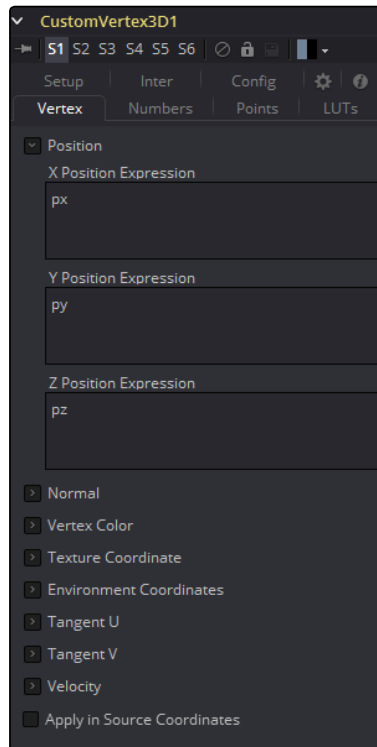
Displace 3D [3DI]

The Displace 3D tool is used to displace the vertices of an object along their normals based upon a reference image. The texture coordinates on the geometry are used to determine where to sample the image.

When using Displace 3D, keep in mind that it will only displace existing vertices and will not tessellate objects. To obtain a more detailed displacement, increase the subdivision amount for the geometry that is being displaced. Note that the pixels in the displacement image may contain negative values.

Passing a particle system through a Displace 3D tool will disable the Always Face Camera option set in the pEmitter. Particles are not treated as point-like objects; each of the four particle vertices are individually displaced, which may or may not be the preferred outcome.

External Inputs
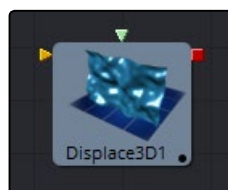
→ Displace3D.SceneInput

[orange, required] This input expects to receive a 3D scene.

→ Displace3D.Input

[green, optional] This input expects a 2D image to be used as the displacement map. If no image is provided this tool will effectively pass the scene straight through to its output.

Controls
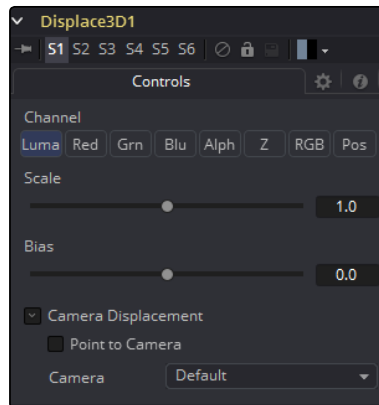
Channel

Determines which channel of the image is connected to Displace3D. Input is used to displace the geometry.

Scale and Bias

Use these sliders to scale (magnify) and bias (offset) the displacement. The bias is applied first and the scale afterwards.

Camera Displacement

Point to Camera

When the Point to Camera checkbox is enabled, each vertex is displaced towards the camera rather than along its normal. One possible use of this option is for displacing a camera's image plane. The displaced camera image plane would appear unchanged when viewed through the camera, but is deformed in 3D space allowing one to comp in other 3D layers that correctly interact in Z.

Camera

This drop down box is used to select which camera Viewer in the scene is used to determine the camera displacement when the Point to Camera option is selected.
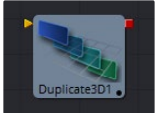
Duplicate 3D [3Dᴘ]

The Duplicate 3D tool can be used to quickly duplicate any geometry in a scene, applying a successive transformation to each, and creating repeating patterns and complex arrays of objects. The options in the Jitter tab allow for non-uniform transformations, such as random positioning or sizes.

External Inputs
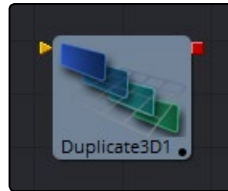
→ Duplicate3D.SceneInput

[orange, required] This input expects a 3D scene.
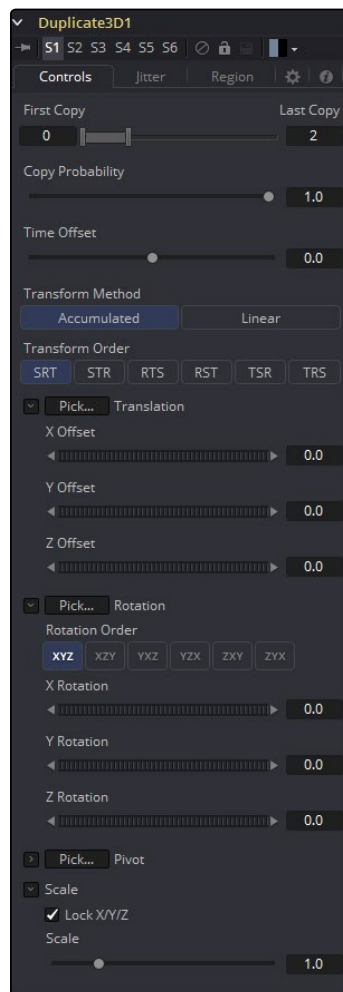
Controls

First/Last Copy

Use this range control to set how many copies of the geometry to make. Each copy is a copy of the last copy so, if this control is set to [0,3], the parent is copied, then the copy is copied, then the copy of the copy is copied, and so on. This allows for some interesting effects when transformations are applied to each copy using the controls below.

Using a value for both the First Copy and the Last Copy will show only the original input. Setting the First Copy to a value greater than 0 will exclude the original input and show only the copies.

Time Offset

Use the Time Offset slider to offset any animations that are applied to the source geometry by a set amount per copy. For example, set the value to -1.0 and use a cube set to rotate on the Y-axis as the source. The first copy will show the animation from a frame earlier. The second copy will show animation from a frame before that, and so forth. This can be used with great effect on textured planes, for example, where successive frames of a clip can be shown.

Transform Method

Accumulated

When set to Accumulated, each object copy starts at the position of the previous object and is transformed from there. The result is transformed again for the next copy.
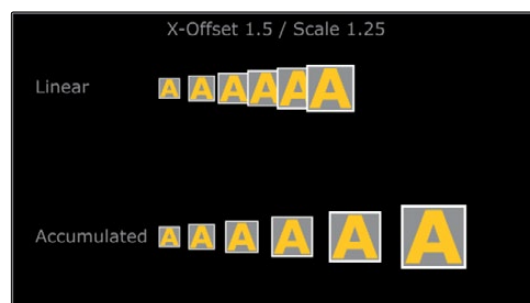
Linear

When set to Linear, transforms are multiplied by the number of the copy, and the total scale, rotation and translation are applied in turn, independent of the other copies.
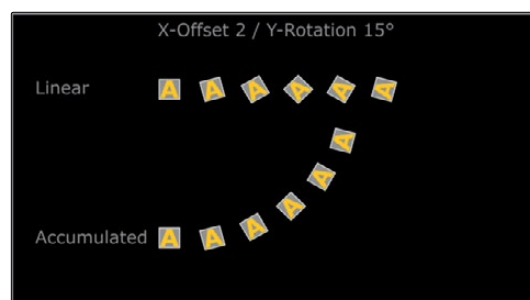
Transform Order

With these buttons, the order in which the transforms are calculated can be set. It defaults to Scale-Rotation-Transform (SRT).

Using different orders will result in different positions of your final objects.

XYZ Offset

These three sliders tell the tool how much offset to apply to each copy. An X offset of 1 would offset each copy 1 unit along the X-axis from the last copy.

Rotation Order

These buttons can be used to set the order in which rotations are applied to the geometry. Setting the rotation order to XYZ would apply the rotation on the X-axis first, followed by the Y-axis rotation, then the Z-axis rotation.

XYZ Rotation

These three Rotation sliders tell the tool how much rotation to apply to each copy.

XYZ Pivot

The pivot controls determine the position of the pivot point used when rotating each copy.

Lock XYZ

When the Lock XYZ checkbox is selected any adjustment to the duplicate scale will be applied to all three axes simultaneously. If this checkbox is disabled the scale slider will be replaced with individual sliders for the X, Y and Z scale.

Scale

The scale controls tell Duplicate how much scaling to apply to each copy.
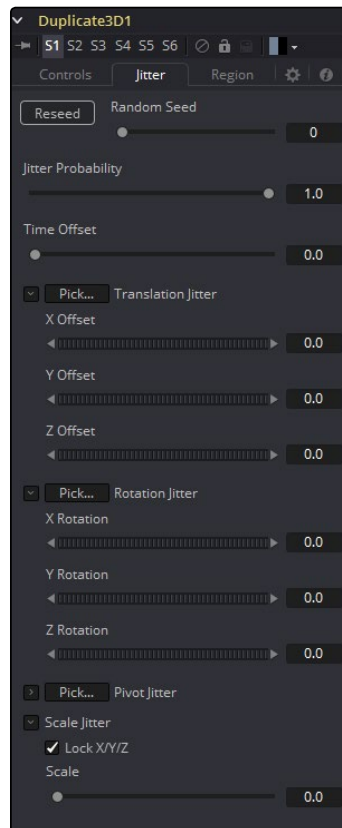
Jitter

Random Seed/Randomize

The Random Seed is used to 'seed' the amount of jitter applied to the duplicated objects. Two Duplicate tools with identical settings but different random seeds will produce two completely different results. Click on the Randomize button to assign a random seed value.

Time Offset

Use the Time Offset slider to offset any animations that are applied to the source geometry by a set amount per copy. For example, set the value to -1.0 and use a cube set to rotate on the Y-axis as the source. The first copy will show the animation from a frame earlier. The second copy will show animation from a frame before that, and so forth. This can be used with great effect on textured planes, for example, where successive frames of a clip can be shown.

Translation XYZ Jitter

Use these three controls to adjust the amount of variation in the Translation of the duplicated objects.

Rotation XYZ Jitter

Use these three controls to adjust the amount of variation in the Rotation of the duplicated objects.

Pivot XYZ Jitter

Use these three controls to adjust the amount of variation in the Rotational Pivot Center of the duplicated objects. This affects only the additional jitter rotation, not the rotation produced by the Rotation settings in the Controls tab.

Scale XYZ Jitter

Use this control to adjust the amount of variation in the scale of the duplicated objects. Uncheck the Lock XYZ checkbox to adjust the scale variation independently on all three axes.

FBX Exporter 3D [FBX]

The FBX Exporter provides a method of exporting a Fusion 3D scene to the FBX scene interchange format. Each node in Fusion is a single object in the exported file. Objects, lights and cameras will use the name of the node that created them. The tool can be set to export a single file for the entire scene, or to output one frame per file.

In addition to the FBX format, this tool can also export to the 3D Studio's .3ds, Collada's .dae, Autocad's .dxf and the Alias .obj formats.

External Inputs

→ FBXExporter.Input

    [orange, required] This input expects a 3D scene.
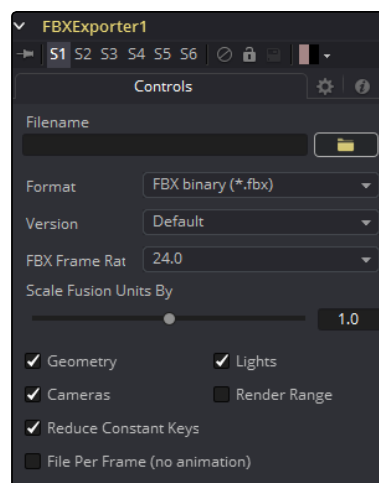
Controls

Filename

This file browser control can be used to set the file which will be output by the tool. Click on the yellow folder icon to open a file browser dialog.

Format

This control is used to set the Format of the output file. It is possible to export the following file formats:

FBX ascii	(*.fbx)
FBX 5.0 binary	(*.fbx)
Autocad DXF	(*.dxf)
3D Studio 3Ds	(*.3ds)
Alias OBJ	(*.obj)
Collada DAE	(*.dae)

Not all of the formats support all of the features of this tool. For example, the obj format does not handle animation.

Version

The Version drop down menu shows the available versions for the Format selected by the control above. The menu's contents will change dynamically to reflect the available versions for that format. If the selected format only provides a single option, this menu will be hidden.

Choosing Default for the FBX formats uses FBX200611.

Geometry/Lights/Cameras

These three checkbox controls determine whether the tool will attempt to export the named scene element. For example, deselecting Geometry and Lights but leaving Cameras selected would output only the cameras currently in the scene.

Reduce Constant Keys

Enabling this option will automatically remove keyframes if the adjacent keyframes have the same value.

File Per Frame (No Animation)

Enabling this option will force the tool to export one file per frame, resulting in a sequence of numbered files. This will disable the export of animation.

Set Sequence Start

Normally, Fusion will use the render range of a composition to determine the numeric sequence used when rendering a file sequence to disk. Enable this checkbox to reveal the Sequence Start Frame control to set the number of the first frame in the sequence to a custom value.

Sequence Start Frame

This thumbwheel control can be used to set an explicit start frame for the number sequence applied to the rendered filenames. For example, if Global Start is set to 1 and frames 1 - 30 are rendered, files will normally be numbered 0001 - 0030. If the Sequence Start Frame is set to 100, the rendered output would be numbered from 100-131.
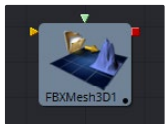
FBX Mesh 3D [FBX]

The FBXMesh3D tool is used to import polygonal geometry from scene files that are saved using the FilmBox (FBX) format. It is also able to import geometry from OBJ, 3DS, DAE and DXF scene files. This provides a method for working with more complex geometry than is available using Fusion's built-in primitives.

When importing geometry with this tool, all of the geometry contained in the FBX file will be combined into one mesh with a single pivot and transformation. The FBXMesh tool will ignore any animation applied to the geometry.

The File > Import > FBX utility can be used to import an FBX and create individual tools for each camera, light and mesh contained in the file. This utility can also be used to preserve the animation of the objects.

If the Global > General > Auto Clip Browse option is enabled (default) then adding this tool to a composition from the toolbars or menus will automatically display a file browser.

External Inputs

→ FBXMesh3D.SceneInput

[orange, required] This input expects a 3D scene as its input.

→ FBXMesh.MaterialInput

[green, optional] This input will accept either a 2D image or a 3D material. If a 2D image is provided, it will be used as a diffuse texture map for the basic material built into the tool. If a 3D material is connected, then the basic material will be disabled.
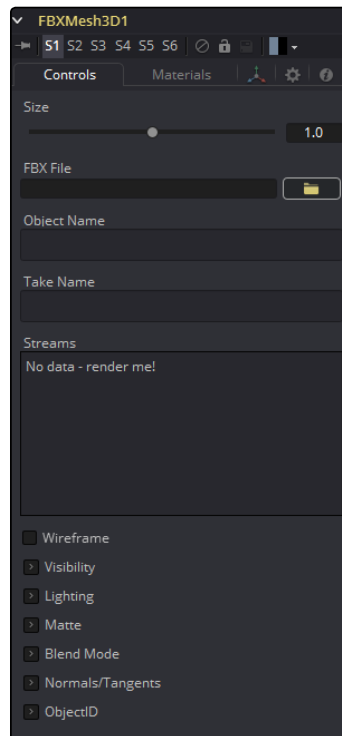
Controls

Size

The size slider controls the size of the FBX geometry that is imported. FBX meshes have a tendency to be much larger than Fusion's default unit scale, so this control is useful for scaling the imported geometry to match the Fusion environment.

FBX File

This control shows the filename of the currently loaded FBX. Click on the icon of the yellow folder to open a file browser that can be used to locate an FBX file. Despite the tool's name, this tool is also able to load a variety of other formats.

FBX ascii	(*.fbx)
FBX 5.0 binary	(*.fbx)
Autocad DXF	(*.dxf)
3D Studio 3Ds	(*.3ds)
Alias OBJ	(*.obj)
Collada DAE	(*.dae)

Object Name

This input shows the name of the mesh from the FBX file that is being imported. If this field is blank, then the entire contents of the FBX geometry will be imported as a single mesh. This input is not editable by the user; it is set by Fusion when importing FBX files via the File > Import > FBX utility.

Take Name

This input shows the name of the animation take to use from the FBX file. If this field is blank, then no animations will be imported. This input is not editable by the user; it is set by fusion when importing FBX files via the File > Import > FBX utility.

Wireframe

Enabling this checkbox will cause the mesh to render only the Wireframe for the object. Currently, only the OpenGL renderer supports wireframe rendering.

Visibility

→ **Visible:** If the visibility checkbox is not selected, the object will not be visible in the Viewers, nor will it be rendered into the output image by the Renderer 3D tool. A non-visible object does not cast shadows.

→ **Unseen by Cameras:** If the Unseen by Cameras checkbox is selected, the object will be visible in the Viewers (unless the Visible checkbox is turned off), except when viewed through a camera. The object will not be rendered into the output image by the Renderer 3D tool. Shadows cast by an Unseen object will still be visible when rendered by the Software renderer, though not by the OpenGL renderer.

→ **Cull Front Face/Back Face:** Use these options to cull (eliminate) rendering and display of certain polygons in the geometry. If Cull Back Face is selected, all polygons facing away from the camera not be rendered, and will not cast shadows. If Cull Front Face is selected, all polygons facing toward the camera will likewise be dropped. Selecting both checkboxes has the same effect as deselecting the Visible checkbox.

→ **Ignore Transparent Pixels in Aux Channels:** In previous versions of Fusion, transparent pixels were rejected by the Software/GL renderers. To be more specific the Software renderer rejected pixels with R=G=B=A=0 and the GL renderer rejected pixels with A=0. This is now optional. The reason you might want to do this is to get aux channels (e.g., Normals, Z, UVs) for the transparent areas. For example, suppose in post you want to replace the texture on a 3D element that is transparent in certain areas with a texture that is transparent in different areas, then it would be useful to have transparent areas set aux channels (in particular UVs). As another example, suppose you are doing post DoF. You will probably not want the Z channel to be set on transparent areas, as this will give you a false depth. Also keep in mind that this rejection is based on the final pixel color including lighting, if it is on. So if you have a specular highlight on a clear glass material, this checkbox will not affect it.

Lighting

→ **Affected by Lights:** If this checkbox is not selected, lights in the scene will not affect the object, it will not receive nor cast shadows, and it will be shown at the full brightness of its color, texture or material.

→ **Shadow Caster:** If this checkbox is not enabled, the object will not cast shadows on other objects in the scene.

→ **Shadow Receiver:** If this checkbox is not enabled, the object will not receive shadows cast by other objects in the scene.

Matte

Enabling the Is Matte option will apply a special texture to this object, causing this object to not only become invisible to the camera, but also making everything that appears directly behind the camera invisible as well. This option will override all textures. See the Matte Objects section of the 3D chapter for more information.

→ **Is Matte:** When activated, objects whose pixels fall behind the matte object's pixels in Z do not get rendered.

→ **Opaque Alpha:** Sets the alpha value of the matte object to 1. This checkbox is only visible when the Is Matte option is enabled.

→ **Infinite Z:** Sets the value in the Z channel to infinite. This checkbox is only visible when the Is Matte option is enabled.

Blend Mode

A Blend mode specifies which method will be used by the Renderer when combining this object with the rest of the scene. The blend modes are essentially identical to those listed in the section for the 2D Merge tool. For a detailed explanation of each mode see the section for that tool.

The blending modes were originally designed for use with 2D images. Using them in a lit 3D environment can produce undesirable results. For best results use the Apply modes in unlit 3D scenes rendered in software.

→ **OpenGL Blend Mode:** Use this menu to select the blending mode that will be used when the geometry is processed by the OpenGL renderer. This is also the mode used when viewing the object in the Viewer. Currently the OpenGL renderer supports three blending modes.

→ **Software Blend Mode:** Use this menu to select the blending mode that will be used when the geometry is processed by the Software renderer. Currently the Software renderer supports all of the modes described in the Merge tool documentation, except for the Dissolve mode.

Material Tab

The options that appear in this tab determine the appearance of the geometry created by this tool. Since these controls are identical on all tools that generate geometry, these controls are fully described in the Common 3D Controls section of this documentation.

If an external 3D material is connected to the tool tile's material input, then the controls in this tab would be replaced with the Using External Material label.

Transform Tab

The options that appear in this tab determine the position of the geometry created by this tool. Since these controls are identical on all tools that generate geometry, these controls are fully described in the Common 3D Controls section of this documentation.

Fog 3D [3Fo]

The Fog 3D tool applies depth cue based Fog to the scene. It is the 3D version of the Fog tool in the Deep Pixel category. It is designed to work completely in 3D space and takes full advantage of antialiasing and depth of field effects during rendering.

The Fog 3D tool essentially re-textures the geometry in the scene by applying a color correction based on the object's distance from the camera. An optional density texture image can be used to apply variation to the correction.

External Inputs

→ Fog3D.SceneInput

[orange, required] This input expects a 3D scene.

→ Fog3D.DensityTexture

[green, optional] This input expects a 2D image. The color of the fog created by this tool is multiplied by the pixels in the image. When creating the image for the density texture, keep in mind that the texture is effectively projected onto the scene from the camera.

Controls
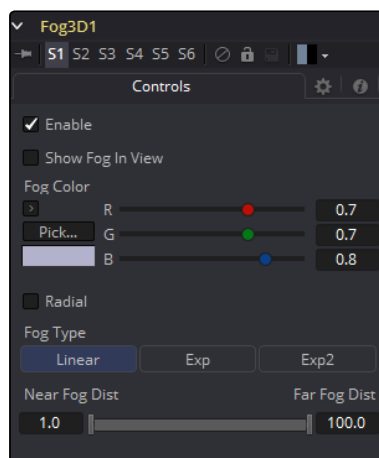
Enable

Use this checkbox to enable or disable the tool.

Show Fog in View

By default, the fog created by this tool is only visible when the scene is viewed using a Camera tool. When this checkbox is enabled, the fog becomes visible in the scene from all points of view.

Color

This control can be used to set the color of the fog. The color is also multiplied by the densitytexture image, if one has been provided.

Radial

By default, the fog is done based upon the perpendicular distance to a plane (parallel with the near plane) passing through the eye point. When the Radial option is checked, the radial distance to the

eye point is used instead of the perpendicular distance. The problem with perpendicular distance fog is that when you move the camera about, as objects on the left or right side of the frustum move into the center, they become less fogged even though they remain the same distance from the eye. Radial fog fixes this. Sometimes Radial fog is not desirable. For example, if you are fogging an object that is close to the camera, like an image plane, the center of the image plane could be unfogged while the edges could be fully fogged.
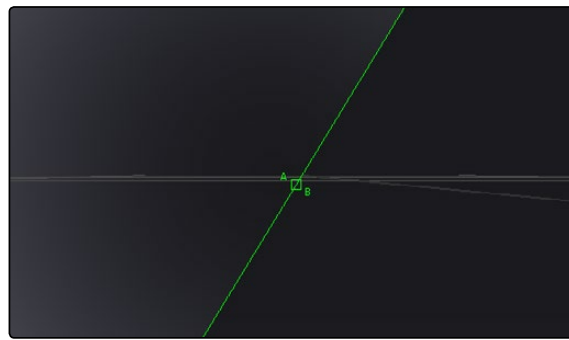
Fog type
This control is used to determine the type of falloff applied to the fog.

> → Linear: Defines a linear falloff for the fog.

> → Exp: Creates an exponential nonlinear falloff.

> → Exp2: Creates an stronger exponential falloff.

Near/Far Fog Distance
This control expresses the Range of the fog in the scene as units of distance from the camera. The Near Distance determines where the fog starts, while the Far Distance sets the point where the fog has its maximum effect. Fog is cumulative, so the further an object is from the camera, the thicker the fog should appear.

Image Plane 3D [3Iᴍ]

The Image Plane tool produces 2D planar geometry in 3D space. The most common use of the tool is to represent 2D images in the 3D space. An image input on the tool's tile provides the texture for the rectangle from another source in the composition. The aspect of the Image Plane is determined by the aspect of the image used for its diffuse texture. If planar geometry whose dimensions are not relative to the texture image is required, then use a Shape 3D tool instead.

External Inputs

→ Imageplane3D.SceneInput

[orange, optional] This input expects a 3D scene. As this tool creates geometry, it is not required.

→ Imageplane3D.MaterialInput

[green, optional] This input will accept either a 2D image or a 3D material. If a 2D image is provided, it will be used as a diffuse texture map for the basic material built into the tool. If a 3D material is connected, then the basic material will be disabled.
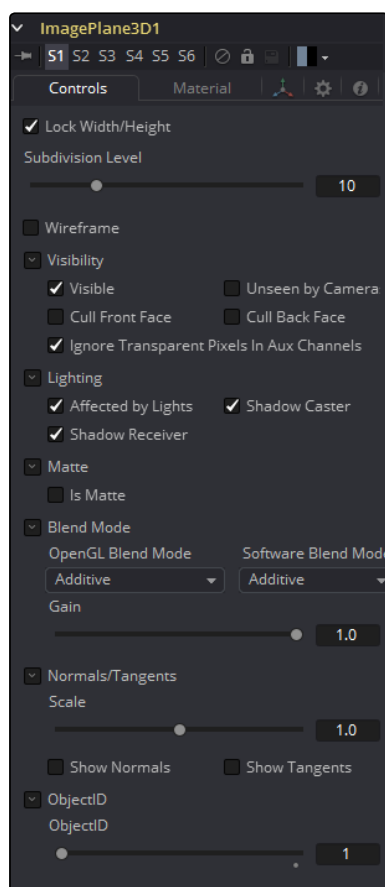
Controls

Lock Width/Height

When checked, the subdivision of the plane will be applied evenly in X and Y. When unchecked, there are two sliders for individual control of the subdivisions in X and Y. Defaults to on.

Subdivision Level

Use the Subdivision Level slider to set the number of subdivisions used when creating the image plane. If the Open GL viewer and renderer are set to Vertex lighting, the more subdivisions in the mesh, the more vertices will be available to represent the lighting. For this reason, high subdivisions can be useful when working interactively with lights.

Wireframe

Enabling this checkbox will cause the Mesh to render only the wireframe for the object when using the OpenGL renderer.

Visibility

→ **Visible:** If the Visibility checkbox is not selected, the object will not be visible in the Viewer, nor will it be rendered into the output image by the Renderer 3D tool. A non-visible object does not cast shadows.

→ **Unseen by Cameras:** If the Unseen by Cameras checkbox is selected, the object will be visible in the Viewers (unless the Visible checkbox is turned off), except when viewed through a camera. The object will not be rendered into the output image by the Renderer 3D tool. Shadows cast by an Unseen object will still be visible when rendered by the Software renderer, though not by the OpenGL renderer.

→ **Cull Front Face/Back Face:** Use these options to cull (eliminate) rendering and display of certain polygons in the geometry. If Cull Back Face is selected, all polygons facing away from the camera not be rendered, and will not cast shadows. If Cull Front Face is selected, all polygons facing toward the camera will likewise be dropped. Selecting both checkboxes has the same effect as deselecting the Visible checkbox.

→ **Ignore Transparent Pixels in Aux Channels:** In previous versions of Fusion, transparent pixels were rejected by the Software/GL renderers. To be more specific, the Software renderer rejected pixels with R=G=B=A=0 and the GL renderer rejected pixels with A=0. This is now optional. The reason you might want to do this is to get aux channels (e.g., Normals, Z, UVs) for the transparent areas. For example, suppose in post you want to replace the texture on a 3D element that is transparent in certain areas with a texture that is transparent in different areas. then it would be useful to have transparent areas set aux channels (in particular UVs). As another example suppose you are doing post DoF. You will probably not want the Z channel to be set on transparent areas, as this will give you a false depth. Also keep in mind that this rejection is based on the final pixel color including lighting, if it is on. So if you have a specular highlight on a clear glass material, this checkbox will not affect it.

Lighting

→ **Affected by Lights:** If this checkbox is not selected, lights in the scene will not affect the object, it will not receive nor cast shadows, and it will be shown at the full brightness of its color, texture or material.

→ **Shadow Caster:** If this checkbox is not enabled, the object will not cast shadows on other objects in the scene.

→ **Shadow Receiver:** If this checkbox is not enabled, the object will not receive shadows cast by other objects in the scene.

Matte

Enabling the Is Matte option will apply a special texture to this object, causing this object to not only become invisible to the camera, but also making everything that appears directly behind the camera invisible as well. This option will override all textures. See the Matte Objects section of the 3D chapter for more information.

→ **Is Matte:** When activated, objects whose pixels fall behind the matte objects pixels in Z do not get rendered.

→ **Opaque Alpha:** Sets the alpha value of the matte object to 1. This checkbox is only visible when the Is Matte option is enabled.

→ **Infinite Z:** Sets the value in the Z channel to infinite. This checkbox is only visible when the Is Matte option is enabled.

Blend Mode

A Blend mode specifies which method will be used by the Renderer when combining this object with the rest of the scene. The Blend modes are essentially identical to those listed in the section for the 2D Merge tool. For a detailed explanation of each mode, see the section for that tool.

The blending modes were originally designed for use with 2D images. Using them in a lit 3D environment can produce undesirable results. For best results use the apply modes in unlit 3D scenes rendered in software.

→ **OpenGL Blend Mode:** Use this menu to select the blending mode that will be used when the geometry is processed by the OpenGL renderer. This is also the mode used when displaying the object in the Viewers. Currently the OpenGL renderer supports three blending modes.

→ **Software Blend Mode:** Use this menu to select the blending mode that will be used when the geometry is processed by the Software renderer. Currently the Software renderer supports all of the modes described in the Merge tool documentation except for the Dissolve mode.

Material Tab

The options that appear in this tab determine the appearance of the geometry created by this tool. Since these controls are identical on all tools that generate geometry, these controls are fully described in the Common 3D Controls section of this documentation.

If an external 3D material is connected to the tool tile's material input, then the controls in this tab would be replaced with the Using External Material label.

Transform Tab

The options that appear in this tab determine the position of the geometry created by this tool. Since these controls are identical on all tools that generate geometry, these controls are fully described in the Common 3D Controls section of this documentation.

Locator 3D [3Lo]

The Locator 3D tool's purpose is to transform a point in 3D space to 2D coordinates that other tools can use as part of expressions or modifiers.

When the Locator is provided with a camera and the dimensions of the output image, it will transform the coordinates of a 3D control into 2D screen space. The 2D position is exposed as a numeric output which can be connected to/from other tools. For example, to connect the center

of an ellipse to the 2D position of the Locator, right-click on the Mask center control and select Connect To > Locator 3D > Position.

The scene provided to the Locator's input must contain the camera through which the coordinates are projected. As a result, the best practice is to place the Locator after the merge that introduces the camera to the scene.

If an object is connected to the Locator tool's second input, the Locator will be positioned at the object's center, and the Transformation tab's Offset XYZ sliders will function in the object's local coordinate space rather than global scene space. This is useful for tracking an object's position regardless of any additional transformations applied further downstream.

External Inputs
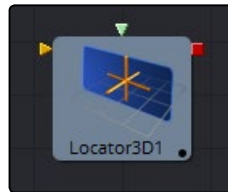
→ Locator3D.SceneInput
   [orange, required] This input expects a 3D scene.

→ Locator3D.Target
   [green, optional] This input expects a 3D scene. When provided, the transform center of the scene is used to set the position of the Locator. The transformation controls for the Locator become offsets from this position.

Controls
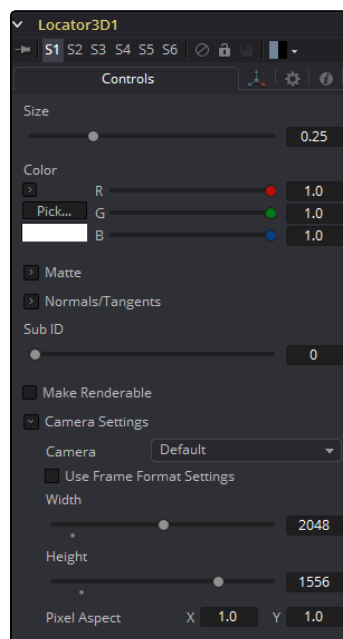
Size

The size slider is used to set the size of the Locator's onscreen crosshair.

Color

A basic Color control is used to set the color of the Locator's onscreen crosshair.

Matte

Enabling the Is Matte option will apply a special texture to this object, causing this object to not only become invisible to the camera, but also making everything that appears directly behind the camera invisible as well. This option will override all textures. See the Matte Objects section of the 3D chapter for more information.

→ Is Matte: When activated, objects whose pixels fall behind the matte object's pixels in Z do not get rendered.

→ Opaque Alpha: Sets the alpha value of the matte object to 1. This checkbox is only visible when the Is Matte option is enabled.

→ Infinite Z: Sets the value in the Z channel to infinite. This checkbox is only visible when the Is Matte option is enabled.

→ Sub ID: The Sub ID slider can be used to select an individual sub-element of certain geometry, such as an individual character produced by a Text 3D tool, or a specific copy created by a Duplicate 3D tool.

→ Make Renderable: Defines if the Locator is rendered as a visible object by the OpenGL renderer. The Software renderer is not currently capable of rendering lines, and hence will ignore this option.

→ Unseen by Camera: This checkbox control appears when the Make Renderable option is selected. If the Unseen by Camera checkbox is selected, the Locator will be visible in the Viewers, but not rendered into the output image by the Renderer 3D tool.

Controls

Camera

This drop down control is used to select the Camera in the scene that defines the screen space used for 3D to 2D coordinate transformation.

Use Frame Format Settings

Select this checkbox to override the width, height and pixel aspect controls, and force them to use the values defined in the composition's Frame Format preferences instead.

Width, Height and Pixel Aspect

In order for the Locator to generate a correct 2D transformation, it must know the dimensions and aspect of the image. These controls should be set to the same dimensions as the image produced by a renderer associated with the camera specified above. Right-clicking on these controls will display a contextual menu containing the frame formats configured in the composition's preferences.

Merge 3D [3Mg]

The Merge 3D tool is used to combine separate 3D elements into the same 3D environment.

For example, with a scene that is created with an image plane, a camera and a light, the camera would not be able to see the image plane and the light would not affect the image plane until all three objects are introduced into the same environment using the Merge 3D tool.

The tool tile displays only two inputs at first, but as each input is connected a new input will appear on the tool, assuring there is always one free to add a new element into the scene.

The Merge provides the standard transformation controls found on most tools in Fusion's 3D suite. Unlike those tools, changes made to the translation, rotation or scale of the merge affect all of the objects connected to the merge. This behavior forms the basis for all parenting in Fusion's 3D environment.

External Inputs
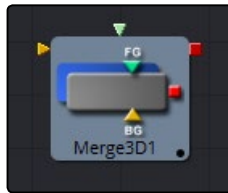
→ Merge3D.SceneInput[#]

[any, see description] These inputs expect a 3D scene. When the tool is constructed it will display two inputs. There is no limit to the number of inputs this tool can accept. The tool dynamically adds more inputs as needed, ensuring that there is always at least one input available for connection.

Controls
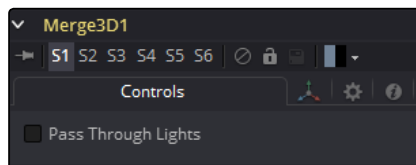
Pass Through Lights

When the Pass Through Lights checkbox is selected, lights will be passed through the merge into its output so they can affect downstream elements. Normally, the lights are not passed downstream to affect the rest of the scene. This is frequently used to ensure projections are not applied to geometry introduced later in the scene.
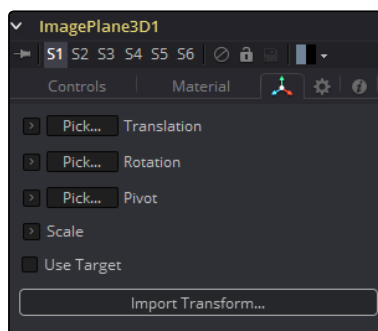
Transform Tab
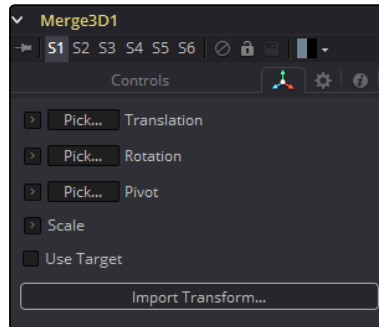
The options that appear in this tab determine the position of the geometry created by this tool. Since these controls are identical on all tools that generate geometry, these controls are fully described in the Common 3D Controls section of this documentation.
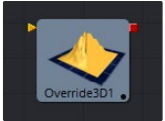
Override 3D [3Ov]

The Override tool lets you change object-specific options for every object in a 3D scene simultaneously. This is useful, for example, when you wish to set every object in the input scene to render as a wireframe. Additionally, this tool is the only way to set the wireframe, visibility, lighting, matte and ID options for 3D particle systems and the Text 3D tool.

It is frequently used in conjunction with the Replace Material tool to produce isolated passes. For example, a scene can be branched out to an Override tool which turns off the Affected by Lights property of each tool, then connected to a Replace Material tool that applies a Falloff shader to produce a falloff pass of the scene.

External Inputs
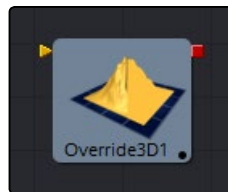
→ Override3D.SceneInput
    [orange, required] This input expects a 3D scene.

Controls

The philosophy of the controls found in the Override tool is fairly straightforward. First, you select the option to override using the Do [Option] checkbox. That will reveal a control that can be used to set the value of the option itself. The individual options are not documented here; a full description of each can be found in any geometry creation tool, such as the Image Plane, Cube or Shape tools.
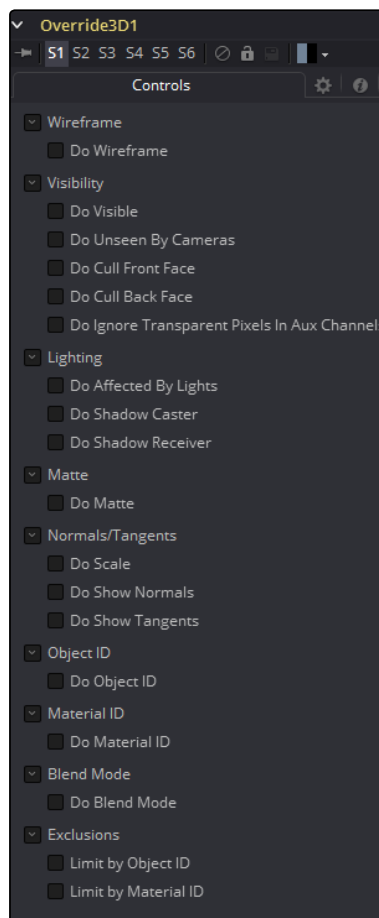
Do [option]

Enables the override for this option.

[Option]

If the Do [option] checkbox is enabled, then the control for the property itself becomes visible. The control values of the properties for all upstream objects are overridden by the new value.

Point Cloud 3D [3PC]

A Point Cloud is generally a large number of nulls created by 3D tracking or modeling software. When produced by 3D tracking software the points typically represent each of the patterns tracked to create the 3D camera path. These point clouds can be used to identify a ground plane and to orient other 3D elements with the tracked image. The Point Cloud 3D tool creates a point cloud by importing a 3D scene

External Inputs

→ Pointcloud3DSceneInput

[orange, required] This input expects a 3D scene.
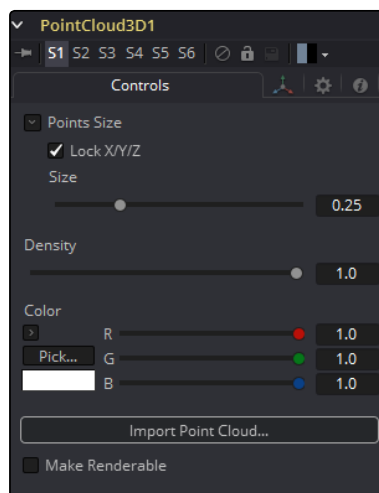
Controls

Lock X/Y/Z

Deselect this checkbox to provide individual control over the size of the X, Y and Z arms of the points in the cloud.

Size X/Y/Z

These sliders can be used to increase the size of the onscreen crosshairs used to represent each point.

Density

This slider defines the probability of displaying a specific point. If the value is 1, then all points are displayed. A value of 0.2 shows only every fifth point.

Color

Use the standard Color control to set the color of onscreen crosshair controls.

Import Point Cloud

The Import Point Cloud button displays a dialog to import a point cloud from another application. Supported filetypes are:

* Alias's Maya	.ma
* 3DS Max ASCII Scene Export	.ase
* NewTek's LightWave	.lws
* Softimage XSI's	.xsi.

Make Renderable

Determines if the point cloud is visible in the OpenGL viewport, and in final renderings made by the OpenGL renderer. The Software renderer does not currently support rendering of visible crosshairs for this tool.

Unseen by Camera

This checkbox control appears when the Make Renderable option is selected. If the Unseen by Cameras checkbox is selected, the point cloud will be visible in the Viewers, but not rendered into the output image by the Renderer 3D tool.

Onscreen Contextual Menu
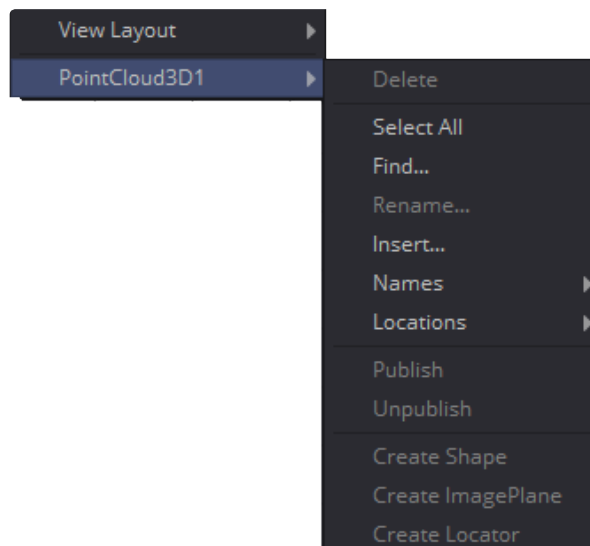
Frequently, one or more of the points in an imported point cloud will have been manually assigned in order to track the position of a specific feature. These points usually have names that distinguish them from the rest of the points in the cloud. To see the current name for a point, hover the mouse pointer directly over a point, and after a moment a small popup will appear with the name of the point.

When the Point Cloud 3D tool is selected, a submenu will be added to the display Viewer's contextual menu with several options that make it simple to locate, rename and separate these points from the rest of the point cloud. The contextual menu contains the following options:

Find

Selecting this option from the display Viewer contextual menu will open a dialog that can be used to search for and select a point by name. Each point that matches the pattern will be selected.

Rename

Rename one or more points by selecting Rename from the contextual menu. Type the new name into the dialog that appears and hit enter. The point will now have that name, with a four-digit number added to the end. For example, the name window will be window0000 and multiple points would be window0000, window0001, etc. Names must be valid Fusion identifiers (i.e., no spaces allowed, and the name cannot start with a number).

Delete

Selecting this option will delete the currently selected points.

Publish

Normally, the exact position of a point in the cloud is not exposed. To expose the position, select one or more points then select the publish option from this contextual menu. This will add a coordinate control to the control panel for each published point that displays the point's current location.

Additional toolbar and shortcuts
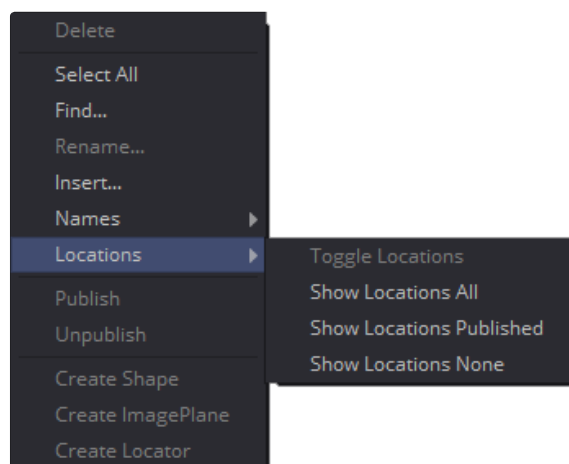
Delete Selected Points	Del
Select All	Shift+A
Find Points	Shift+F
Rename Selected Points	F2
Create New Point	Shift+C
Toggle Names on None/Selected/Published/All Points	Shift+N
Toggle Locations on None/Selected/Published/All Points	Shift+L
Publish Selected Points	Shift+P
Unpublish Selected Points	Shift+U
Create a Shape at Selected Points	Shift+S
Create and Fit an ImagePlane to Selected Points	Shift+I
Create a Locator at Selected Points	Shift+O
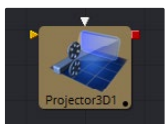
Projector 3D [3Pᴊ]

The Projector 3D tool is used to project an image upon 3D geometry. This can be useful in many ways: texturing objects with multiple layers, applying a texture across multiple separate objects, projecting background shots from the camera's viewpoint, image-based rendering techniques and much more. The Projector tool is just one of several tools capable of projecting images and textures. Each method has advantages and disadvantages. See the Projection section of the 3D chapter for more information about each approach.

Projected textures can be allowed to "slide" across the object if the object moves relative to the Projector 3D, or alternatively, by grouping the two together with a Merge 3D they can be moved as one and the texture will remain locked to the object.

The Projector 3D tool's capabilities and restrictions are best understood if the Projector is considered to be a variant on the Spotlight tool. The fact that the Projector 3D tool is actually a light has several important consequences when used in Light or Ambient Light projection mode:

→ Lighting must be turned on for the results of the projection to be visible.

→ The light emitted from the projector is treated as diffuse/specular light. This means that it will be affected by the surface normals and can cause specular highlights. If this is undesirable, set Projector 3D to project into the Ambient Light channel.

→ Enabling Shadows will cause Projector 3D to cast shadows.

→ Just as with other lights, the light emitted by a Projector 3D will only affect objects that feed into the first Merge 3D that is downstream of the Projector 3D tool on the flow. Enabling Merge 3D's Pass Through Lights checkbox will allow the projection to light objects further downstream.

→ The light emitted by a Projector 3D is controlled by the Lighting options settings on objects and the Receives Lighting options on materials.

→ Alpha values in the projected image will not clip geometry in Light or Ambient Light mode. Use Texture mode instead.

→ If two projections overlap, their light contributions will be added together.

To project re-lightable textures or textures for non-diffuse color channels (like Specular Intensity or Bump), use the Texture projection mode instead:

→ Projections in Texture mode will only strike objects that use the output of the Catcher tool for all or part of the material applied to that object.

→ Texture mode projections will clip the geometry according to the alpha channel of the projected image.

See the section for the Catcher tool for additional details.

The Camera 3D tool also provides a projection feature, and should be used when the projection is meant to match a camera, as this tool has more control over aperture, film back, and clip planes. Projector 3D was designed to be used as a custom light in 3D scenes for layering and texturing. The projector provides better control over light intensity, color, decay and shadows.

When using projectors in an OpenGL view or in the OpenGL renderer, the lighting must be set to Per-pixel (the default) in order to see the results of the projection in the main view. The Per-pixel lighting mode requires a certain level of shader support from your graphics card. Even if the graphics card does not support pixel shading, the projection will still be visible when using the Software renderer.

External Inputs
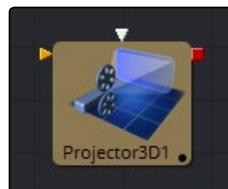
→ Projector3D.SceneInput

[orange, optional] This input expects a 3D scene. If a scene is connected to this input, then transformations applied to the spotlight will also affect the rest of the scene.

→ Projector3D.ProjectiveImage

[white, optional] This input expects a 2D image to be used for the projection.

Controls
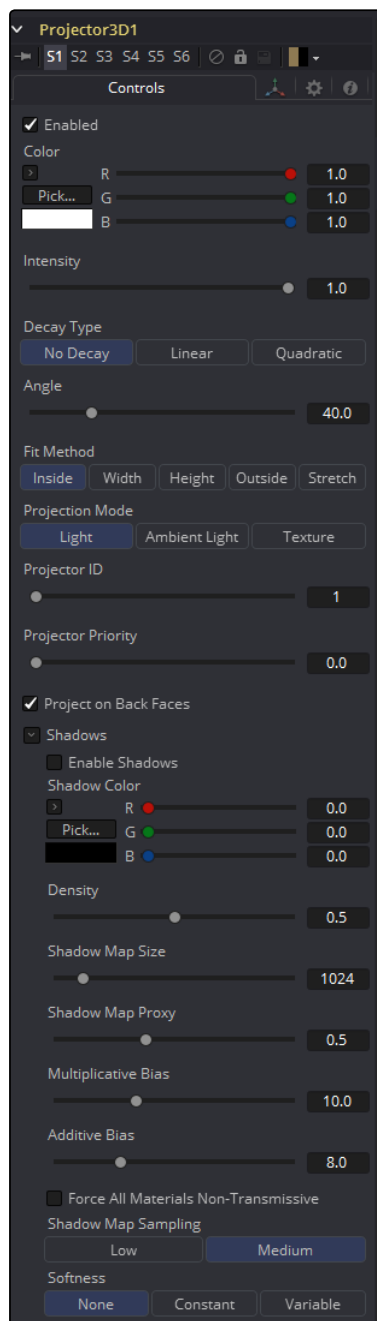
Enabled

When this checkbox is selected the projector affects the scene. Clear the checkbox to turn it off.

Color

The input image is multiplied by this color before projected into the scene.

Intensity

Use this slider to set the Intensity of the projection when the Light and Ambient Light projection modes are used. In Texture mode this option scales the Color values of the texture after multiplication by the color.

Decay Type

A projector defaults to No Falloff, meaning that its light has equal intensity on geometry regardless of the distance from the projector to the geometry. To cause the intensity to fall off with distance, set the Decay type to either Linear or Quadratic modes.

Angle

The Cone Angle of the tool refers to the width of the cone where the projector emits its full intensity. The larger the angle, the wider the cone angle, up to a limit of 90 degrees.

Fit Method

The Fit Method determines how the projection is fit within the projection cone.

The first thing to know is that although this documentation may call it a 'cone,' the Projector3D tool and the Camera3D tools do not project actual cones; its more of a pyramid of light with its apex at the camera/projector. The Projector3D tool always projects a square pyramid of light, i.e., its X and Y angles of view are the same. The pyramid of light projected by the Camera3D tool can be non-square depending on what the Film Back is set to in the camera. The aspect of the image connected into the Projector3D/Camera3D does not affect the X/Y angles of the pyramid, but rather the image is scaled to fit into the pyramid based upon the fit options.

When both the aspect of the pyramid (AovY/AovX) and the aspect of the image (height * pixelAspectY)/(width * pixelAspectX) are the same, there is no need for the fit options, and in this case, the fit options all do the same thing. However, when the aspect of the image and the pyramid (as determined by the Film Back settings in Camera3D) are different, the fit options become important.

For example, 'Fit by Width' will fit the width of the image across the width of the Camera3D pyramid. In this case, if the image has a greater aspect ratio than the aspect of the pyramid, some of the projection will extend vertically outside of the pyramid.

There are five options:

→ **Inside:** The image is uniformly scaled so that its largest dimension fits inside the cone. Another way to think about this is that it scales the image as big as possible subject to the restriction that the image is fully contained within the pyramid of the light. This means, for example, that nothing outside the pyramid of light will ever receive any projected light.

→ **Width:** The image is uniformly scaled so that its width fits inside the cone. Note that the image could still extend outside the cone in its height direction.

→ **Height:** The image is uniformly scaled so that its height fits inside the cone. Note that the image could still extend outside the cone in its width direction.

→ **Outside:** The image is uniformly scaled so that its smallest dimension fits inside the cone. Another way to think about this is that it scales the image as small as possible subject to the restriction that the image covers the entire pyramid (i.e., the pyramid is fully contained within the image). This means that any pixel of any object inside the pyramid of light will always get illuminated.

→ **Stretch:** The image is non-uniformly scaled, so it exactly covers the cone of the projector.

Projection Mode

→ **Light:** Projects the texture as a diffuse/specular light.

→ **Ambient Light:** Uses an ambient light for the projection.

Texture

When used in conjunction with the Catcher tool, this mode allows re-lightable texture projections. The projection will only strike objects that use the catcher material as part of their material shaders.

One useful trick is to connect a Catcher tool to the Specular Texture input on a 3D Material tool (such as a Blinn). This will cause any object using the Blinn material to receive the projection as part of the specular highlight. This technique can be used in any material input that uses texture maps, such as the Specular and Reflection maps.

Shadows

Since the projector is based on a spotlight, it is also capable of casting shadows using shadow maps. The controls under this reveal are used to define the size and behavior of the shadow map.

Enable Shadows

The Enable Shadows checkbox should be selected if the light is to produce shadows. This defaults to selected.

Shadow Color

Use this standard Color control to set the color of the shadow. This defaults to black (0, 0, 0).

Density

The Shadow Density determines how opaque the shadow will be. A density of 1.0 will produce a completely transparent shadow, whereas lower values make the shadow transparent.

Shadow Map Size

The Shadow Map Size control determines the size of the bitmap used to create the shadow map. Larger values will produce more detailed shadow maps at the expense of memory and performance.

Shadow Map Proxy

Shadow Map Proxy determines the size of the shadow map used for proxy and auto proxy calculations. A value of 0.5 would use a 50% shadow map.

Multiplicative/Additive Bias

Shadows are essentially textures applied to objects in the scene, so there will occasionally be Z-fighting, where the portions of the object that should be receiving the shadows render over top of the shadow instead.

Biasing works by adding a small depth offset to move the shadow away from the surface it is shadowing, eliminating the Z-fighting. Too little bias and the objects can self-shadow themselves. Too much bias and the shadow can become separated from the surface.

Make adjustments to the multiplicative bias first, then fine tune the result using the additive bias control.

Force All Materials Non-Transmissive

Normally, a RGBAZ shadowmap is used when rendering shadows. By enabling this option you are forcing the renderer to use a Z-only shadowmap. This can result in significantly faster shadow rendering while using a fifth as much memory. The disadvantage is that you can no longer cast 'stained-glass' like shadows.

Shadow Map Sampling

Sets the quality for sampling of the shadow map.

Softness

Soft edges in shadows are produced by filtering the shadowmap when it is sampled. Fusion has three separate filtering methods available when rendering shadows which produce different effects.

→ **None:** Shadows will have a hard edge. No filtering of the shadowmap is done at all. The advantage of this method is that you only have to sample one pixel in the shadowmap, so it is fast.

→ **Constant:** Shadows edges will have a constant softness. A filter with a constant width is used when sampling the shadowmap. Adjusting the Constant Softness slider controls the size of the filter. Note that the larger you make the filter, the longer it will take to render the shadows.

→ **Variable:** The softness of shadow edges will grow the further away the shadow receiver is from the shadow caster. The variable softness is achieved by changing the size of the filter based on the distance between the receiver and caster. When this option is selected, the Softness Falloff, Min Softness and Max Softness sliders appear.

Constant Softness

If the Softness is set to constant, then this slider will appear. It can be used to set the overall softness of the shadow.

Softness Falloff

The Softness Falloff slider appears when the Softness is set to variable. This slider controls how fast the softness of shadow edges grows with distance. To be more precise, it controls how fast the shadowmap filter size grows based upon the distance between shadow caster and receiver. Its affect is mediated by the values of the Min and Max Softness sliders.

Min Softness

The Min Softness slider appears when the Softness is set to variable. This slider controls the Minimum Softness of the shadow. The closer the shadow is to the object casting the shadow, the sharper it will be up to the limit set by this slider.

Max Softness

The Max Softness slider appears when the Softness is set to variable. This slider controls the Maximum Softness of the shadow. The further the shadow is from the object casting the shadow, the softer it will be up to the limit set by this slider

Transform Tab

The options that appear in this tab determine the position of the geometry created by this tool. Since these controls are identical on all tools that generate geometry, these controls are fully described in the Common 3D Controls section of this documentation.

Renderer 3D [3RN]

The Renderer 3D tool converts the 3D environment into a 2D image using either a default perspective camera, or one of the cameras found in the scene. Every 3D scene in a composition should terminate with at least one Render 3D tool. The Renderer tool can use either of the Software or OpenGL render engines to produce the resulting image. Additional render engines may also be available via third party plug-ins.

The Software render engine uses the system's CPU only to produce the rendered images. It is usually much slower than the OpenGL render engine, but produces consistent results on all machines making it essential for renders that involve network rendering. The Software mode is required to produce soft shadows, and generally supports all available illumination, texture, and material features.

The OpenGL render engine employs the GPU processor on the graphics card to accelerate the rendering of the 2D images. The output may vary slightly from system to system, depending on the exact graphics card installed. The graphics card driver can also affect the results from the OpenGL renderer. The OpenGL render engines speed makes it possible to provide customized supersampling and realistic 3D depth of field options. The OpenGL renderer cannot generate soft shadows. For soft shadows, the Software renderer is recommended.

Like most tools, the Renderer's motion blur settings can be found under the Common Control tab. Be aware that scenes containing one or more particle systems will require that the Motion Blur settings on the pRender tools exactly match the settings on the Renderer 3D tool. Otherwise, the subframe renders will conflict producing unexpected (and incorrect) results.

Note: The GL renderer respects the Color Depth option in the Image tab of the Renderer3D tool. This can cause slowdowns on certain graphics cards when rendering to int16 or float32.

External Inputs

→ Renderer3D.SceneInput
[orange, required] This input expects a 3D scene.

→ Renderer3D.EffectMask
[violet, optional] This input uses a single or four channel 2D image to mask the output of the tool.

Controls
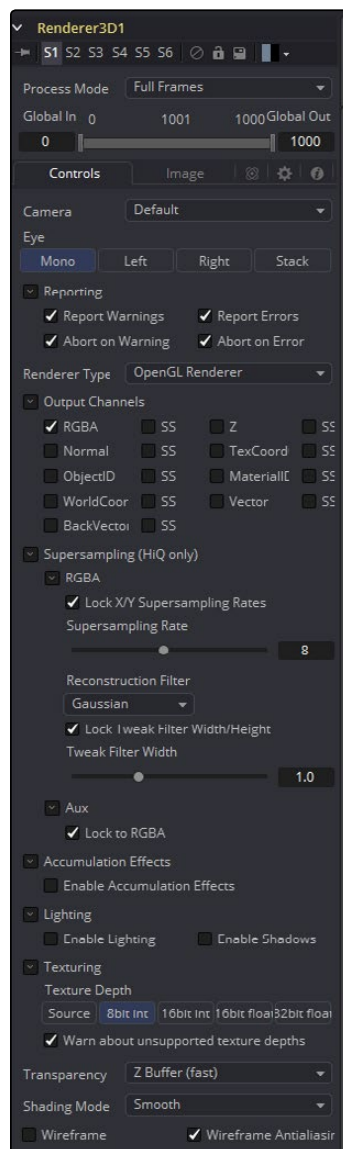
Camera

The camera drop down list is used to select which camera from the scene is used when rendering. The default option is Default, which will use the first camera found in the scene. If no camera is located, the default perspective view will be used instead.

Eye

The Eye control tells the tool how to render the image in stereoscopic projects. The Mono option will ignore the stereoscopic settings in the camera. The Left and Right options will translate the camera using the stereo Separation and Convergence options defined in the camera to produce either left or right eye outputs.

Reporting

The first two checkboxes in this reveal can be used to determine whether the tool will print warnings and errors produced while rendering to the console. The second row of checkboxes tells the tool whether it should abort rendering when a warning or error is encountered. The default for this tool enables all four checkboxes.

Renderer Type

This drop down menu lists the available render engines. Fusion provides two: the Software and OpenGL render engines (described above), and additional renderers can be added via third party plug-ins.

All of the controls found below this drop down menu are added by the render engine. They may change depending on the options available to each renderer. As a result, each renderer is described in its own section below.

Software Controls

Output Channels

In addition to the usual Red, Green, Blue and Alpha channels, the Software renderer can also embed the following channels into the image. Enabling additional channels will consume additional memory and processing time, so these should be used only when required.

→ **RGBA:** This option tells the renderer to produce the Red, Green, Blue and Alpha color channels of the image. These channels are required and they cannot be disabled .

→ **Z:** This option enables rendering of the Z-channel. The pixels in the Z-channel contain a value that represents the distance of each pixel from the camera. Note that the Z-channel values cannot include anti-aliasing. In pixels where multiple depths overlap, the frontmost depth value is used for this pixel.

→ **Coverage:** This option enables rendering of the Coverage channel. The Coverage channel contains information about which pixels in the Z-buffer provide coverage (are overlapping with other objects). This helps tools that use the Z-buffer to provide a small degree of antialiasing. The value of the pixels in this channel indicates, as a percentage, how much of the pixel is composed of the foreground object.

→ **BgColor:** This option enables rendering of the BgColor channel. This channel contains the color values from objects behind the pixels described in the Coverage channel.

→ **Normal:** This option enables rendering of the X, Y and Z Normals channels. These three channels contain pixel values that indicate the orientation (direction) of each pixel in the 3D space. A color channel containing values in a range from [-1,1] represents each axis.

→ **TexCoord:** This option enables rendering of the U and V mapping coordinate channels. The pixels in these channels contain the texture coordinates of the pixel. Although texture coordinates are processed internally within the 3D system as 3-component UVW, Fusion images only store UV components. These components are mapped into the Red and Green color channel.

→ ObjectID: This option enables rendering of the ObjectID channel. Each object in the 3D environment can be assigned a numeric identifier when it is created. The pixels in this floating-point image channel contain the values assigned to the objects that produced the pixel. Empty pixels have an ID of 0, and the channel supports values as high as 65534. Multiple objects can share a single Object ID. This buffer is useful for extracting mattes based on the shapes of objects in the scene.

→ MaterialID: This option enables rendering of the MaterialID channel. Each material in the 3D environment can be assigned a numeric identifier when it is created. The pixels in this floating-point image channel contain the values assigned to the materials that produced the pixel. Empty pixels have an ID of 0, and the channel supports values as high as 65534. Multiple materials can share a single Material ID. This buffer is useful for extracting mattes based on a texture; for example, a mask containing all of the pixels that comprise a brick texture.

Lighting

Enable lighting
When the Enable Lighting checkbox is selected, objects will be lit by any lights in the scene. If no lights are present, all objects will be black.

Enable Shadows
When the Enable Shadows checkbox is selected, the renderer will produce shadows, at the cost of some speed.

OpenGL Controls
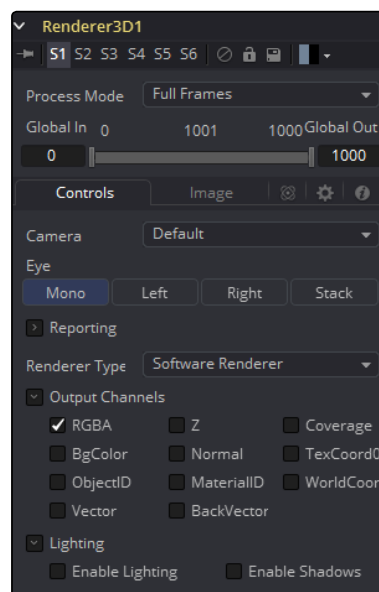
Output channels

In addition to the usual Red, Green, Blue and Alpha channels, the OpenGL render engine can also embed the following channels into the image. Enabling additional channels will consume additional memory and processing time, so these should be used only when required.

→ RGBA: This option tells the renderer to produce the Red, Green, Blue and Alpha color channels of the image. These channels are required and they cannot be disabled.

→ Z: This option enables rendering of the Z-channel. The pixels in the Z-channel contain a value that represents the distance of each pixel from the camera. Note that the Z-channel values cannot include anti-aliasing. In pixels where multiple depths overlap, the frontmost depth value is used for this pixel.

→ Normal: This option enables rendering of the X, Y and Z Normals channels. These three channels contain pixel values that indicate the orientation (direction) of each pixel in the 3D space. A color channel containing values in a range from [-1,1] is represented by each axis.

→ TexCoord: This option enables rendering of the U and V mapping coordinate channels. The pixels in these channels contain the texture coordinates of the pixel. Although texture coordinates are processed internally within the 3D system as 3-component UVW, Fusion images only store UV components. These components are mapped into the Red and Green color channel.

→ ObjectID: This option enables rendering of the ObjectID channel. Each object in the 3D environment can be assigned a numeric identifier when it is created. The pixels in this floating-point image channel contain the values assigned to the objects that produced the pixel. Empty pixels have an ID of 0, and the channel supports values as high as 65534. Multiple objects can share a single Object ID. This buffer is useful for extracting mattes based on the shapes of objects in the scene.

→ MaterialID: This option enables rendering of the MaterialID channel. Each material in the 3D environment can be assigned a numeric identifier when it is created. The pixels in this floating-point image channel contain the values assigned to the materials that produced the pixel. Empty pixels have an ID of 0, and the channel supports values as high as 65534. Multiple materials can share a single Material ID. This buffer is useful for extracting mattes based on a texture; for example, a mask containing all of the pixels that comprise a brick texture.

Supersampling

Supersampling can be enabled for each channel by means of the SS tickbox. It produces an output image with higher quality anti-aliasing by brute force rendering a much larger image, then rescaling it down to the target resolution. Rendering a larger image in the first place, then using a Resize tool to bring the image to the desired resolution can achieve the exact same results. Using the supersampling built into the renderer offers two distinct advantages over this method.

The rendering is not restricted by memory or image size limitations. For example, consider the steps to create a float16 1920 x 1080 image with 16x supersampling. Using the traditional Resize tool would require first rendering the image with a resolution of 30720 x 17280, then using a resize to scale this image back down to 1920 x 1080. Simply producing the image would require nearly 4 GB of memory. When supersampling is performed on the GPU, the OpenGL renderer can use tile rendering to significantly reduce memory usage.

The GL renderer can perform the rescaling of the image directly on the GPU much more quickly than the CPU can manage it. In general, the more GPU memory the graphics card has the faster the operation will be.

Interactively, Fusion will skip the supersampling stage unless the HiQ button is selected in the Time Ruler. Final quality renders will always include supersampling, if it is enabled.

Due to hardware limitations, point geometry (particles) and lines (locators) are always rendered at their original size, independent from supersampling. This means that these elements will be scaled down from their original sizes, and will likely appear much thinner than expected.

Supersampling of Aux Channels in the OpenGL Renderer

The reason we supply separate SS options for color and aux channels is that supersampling of color channels is a quite a bit slower than aux channels. You may find that 4 x 4 SS is sufficient for color, but for worldposition or Z, you may require 64 x 64 to get adequate results. The reasons color SS is slower are that the shaders for RGBA can be 10x to even 100x or 1000x more complex, and color is rendered with sorting enabled, while aux channels get rendered using the much faster Z buffer method.

Note: RGBA supersampling is no longer enabled in the Supersampling nest, but rather in the OutputChannels nest. For some things, sometimes using an SS Z buffer will improve quality, but for other things like using the merge's PerformDepthMerge option, it may make things worse.

Note: Do not mistake SS with improved quality. SSing an aux channel does not mean it's better quality. In fact, SSing an aux channel in many cases can make the results much worse. The only channels we recommend you enable SS on are WorldCoord and Z.

Note

We strongly recommend disabling SSing on MaterialID and ObjectID channels. We recommend disabling SSing on TexCoord, Normal, BackVector, and Vector channels. The issue arises when you have multiple 3D surfaces with radically different TexCoord values in one pixel. The SSing does not restrict itself to sampling the main surface, but will sample both surfaces. For example, if one surface has TexCoords that are approx (u,v)=(0, 0) within that pixel and the other surface has (0.5, 0.5) you will get a blending of these two. The blended area of the texture could have colors like (0, 0) or (0.5, 0.5), resulting in an oddly colored pixel artifact being output from the 2D Texture tool. The same problem can happen for normals.

Enable (HiQ Only)

This checkbox can be used to enable supersampling of the rendered image. The remaining controls in this reveal will only appear if this is selected.

Lock X/Y Supersampling Rates

When this checkbox is disabled separate sliders are presented to control the amount of supersampling on the X- and Y-axis.

Supersampling Rate X

The Supersampling Rate tells the OpenGL render how large to scale the image. For example, if the supersampling rate is set to 4 and the OpenGL renderer is set to output a 1920 x 1080 image, internally a 7680 x 4320 image will be rendered and then scaled back to produce the target image. Set the multiplier higher to get better edge antialiasing at the expense of render time. Typically 8x8 supersampling (64 samples per pixel) is sufficient to reduce most aliasing artifacts.

The supersampling rate doesn't exactly define the number of samples done per destination pixel; the width of the reconstruction filter used may also have an impact.

Reconstruction Filter

When downsampling the supersized image, the surrounding pixels around a given pixel are often used to give a more realistic result. There are various filters available for combining these pixels. More complex filters can give better results, but are usually slower to calculate. The best filter for the job will often depend on the amount of scaling and on the contents of the image itself.

The functions of these filters are shown in the image above. From left to right these are:

Box	This is a simple interpolation scale of the image.
Bi-Linear (triangle)	This uses a simplistic filter, which produces relatively clean and fast results.
Bi-Cubic (quadratic)	This filter produces a nominal result. It offers a good compromise between speed and quality.
Bi-Spline (cubic)	This produces better results with continuous tone images but is slower than Quadratic. If the images have fine detail in them, the results may be blurrier than desired.
Catmul-Rom	This produces good results with continuous tone images which are scaled down, producing sharp results with finely detailed images.

Gaussian	This is very similar in speed and quality to Quadratic.
Mitchell	This is similar to Catmull-Rom but produces better results with finely detailed images. It is slower than Catmull-Rom.
Lanczos	This is very similar to Mitchell and Catmull-Rom but is a little cleaner and also slower.
Sinc	This is an advanced filter that produces very sharp, detailed results, however, it may produce visible `ringing' in some situations.
Bessel	This is similar to the Sinc filter but may be slightly faster.

Window Method

The Window Method menu appears only when the reconstruction filter is set to Sinc or Bessel.

Hanning	This is a simple tapered window.
Hamming	Hamming is a slightly tweaked version of Hanning.
Blackman	A window with a more sharply tapered falloff.

Lock Tweak Filter Width/Height

When this checkbox is disabled it is possible to set different values for the X and Y-axis when setting the filter width.

Tweak Filter Width

This slider can be used to adjust the size of the filter kernel. The kernel describes how many of the pixels surrounding the current pixel are sampled to produce the scaled result. Decreasing the width of the filter causes the anti-aliasing in the resulting image to appear sharper, while increasing it makes it seem blurrier.

Each type of filter has a default width setting. For example, a Box filter by default uses a 1x1 kernel, a Triangle filter is 2x2, a Bi-cubic filter is 3x3, B-spline and Catmull-Rom use 4x4, while a Gaussian filter is 3.34x3.34. The kernel width of the filter is essentially multiplied by the value set in this control.

This can be used as a mechanism to blur the resulting image but is not recommended as it becomes increasingly inefficient for larger tweak multipliers and consumes significantly more resources. Larger values will often cause a graphics card to fail entirely. For values higher than 4, using a blur tool on the output image will almost certainly be more efficient.

Accumulation Effects

Rendering multiple subframes to produce the final image creates accumulation effects. This technique allows depth of field rendering on the graphic hardware.

Enable Accumulation Effects

This checkbox enables calculation of the accumulation effects.

Depth of Field

This checkbox enables depth of field rendering. Rendering subframes then combining them into a single frame creates depth of field. In each subframe the camera is rotated around a virtual target point. The distance to the target point is set by the plane of focus control in the Camera 3D tool. Pixels at the plane of focus will appear to be in focus.

If supersampling is enabled, then each subframe will be produced using the supersampled size.

For reasons of efficiency, the subframes created for the DoF effect are also used to produce motion blur when this option is enabled in the Common Controls tab. Effectively, both features share subframes.

Depth of Field Quality

This control sets the number of subframes used to create the DoF calculation. As with motion blur, the value of the control is doubled internally, so setting this control to 2 actually produces 5 subframes (4 + 1 original). If both motion blur and DoF are enabled, the number of sub-frames produced is determined by the higher quality value. This prevents the number of subframes produced from growing exponentially.

The following image shows the effect of DoF quality on a small circle:

The value of the controls are from left to right: 0, 1, 2, 8, 32, 128, 1024, 4096.

Amount of DoF Blur

Defines how much the camera is moved per subframe from its original position. A higher value will result in a blurrier image or stronger DoF effect.

Lighting

Enable Lighting

When the Enable Lighting checkbox is selected, any lights in the scene will light objects. If no lights are present, all objects will be black.

Enable Shadows

When the Enable Shadows checkbox is selected, the renderer will produce shadows, at the cost of some speed.

Lighting Mode

The Per-vertex lighting model calculates lighting at each vertex of the scene's geometry. This produces a fast approximation of the scene's lighting, but tends to produce blocky lighting on poorly tessellated objects. The Per-pixel method uses a different approach that does not rely on the amount of detail in the scene's geometry for lighting, so generally produces superior results.

While using Per-pixel lighting in the OpenGL renderer produces results closer to that produced by the more accurate Software renderer, it still has some disadvantages. Even with Per-pixel lighting, the OpenGL renderer is less capable of dealing correctly with semi transparency, soft shadows and colored shadows. The color depth of the rendering will be limited by the capabilities of the graphics card in the system.

Transparency

The OpenGL renderer reveals this control for selecting which ordering method to use when calculating transparency.

→ **Z Buffer (fast):** This mode is extremely fast, and is adequate for scenes containing only opaque objects. The speed of this mode comes at the cost of accurate sorting; only the objects closest to the camera are certain to be in the correct sort order. As a result, semi-transparent objects may not be shown correctly, depending on their ordering within the scene.

→ **Sorted (accurate):** This mode will sort all objects in the scene (at the expense of speed) before rendering, giving correct transparency.

→ **Quick Mode:** This experimental mode is best suited to scenes that almost exclusively contain particles.

Shading Model

Use this menu to select a Shading model to use for materials in the scene. Smooth is the shading model employed in the views and Flat produces a simpler and faster shading model.

Wireframe

Renders the whole scene as Wireframe. This will show the edges and polygons of the objects. The edges are still shaded by the material of the objects.

Wireframe Antialiasing

Enables anti-aliasing for the Wireframe render.

OpenGL UV Unwrap Renderer
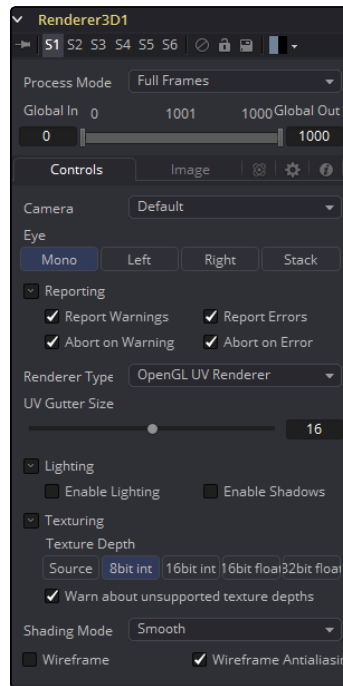
Takes a model with existing textures and renders it out via the Renderergluv3D to produce an unwound flattened 2D version of the model. Optionally lighting can be baked in. You can then paint on the texture and reapply it.

Caution

After you have baked lighting into a models texture, you need to be careful to turn lighting off on the object in the future when you render it with the burnt-in-lighting texture.

→ Issue Beware of cases where a single area of the texture map is used on multiple areas of the model. This is often done to save texture memory and decrease modeling time. An example of this is the texture for a person where the artist mirrored the left side mesh/uvs/texture to produce the right side. Trying to burn in lighting in this case won't work.

Unwrapping more than one mesh at once can cause problems. The reason is that most models are authored so they make maximal usage of (u,v) in [0,1]x[0,1], so that in general models will overlap each other in UV space.

→ Seams When the UV gutter size is left at 0 this produces seams when the model is retextured with the unwrapped texture.

→ UV Gutter Size Increase this value to hide seams between faces.
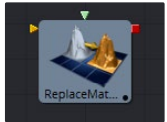
Replace Material 3D [3RPL]

The Replace Material 3D tool replaces the material applied to all of the geometry in the input scene with its own material input. Any lights or cameras in the input scene are passed through unaffected.

The scope of the replacement can be limited using Object and Material identifiers. The scope can also be limited to individual channels, making it possible to use a completely different material on the Red channel, for example.

External Inputs
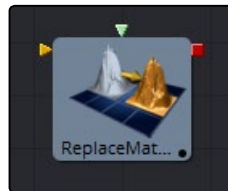
→ Replacematerial3D.SceneInput

[orange, required] This input expects a 3D scene.

→ Replacematerial3D.MaterialInput

[green, optional] This input will accept either a 2D image or a 3D material. If a 2D image is provided, it will be used as a diffuse texture map for the basic material built into the tool. If a 3D material is connected, then the basic material will be disabled.

Controls
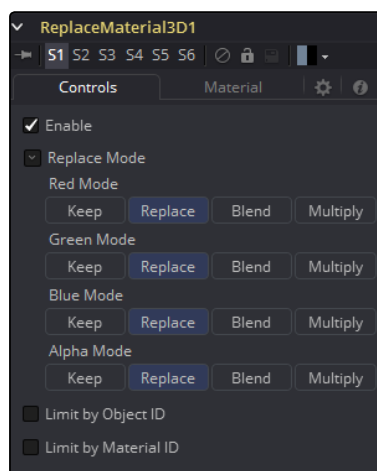
Enable

Enables the material replacement.

Replace Mode

Red, Green, Blue, and Alpha Mode
Offers several replacing modes for each RGBA channel:

→ Keep: Prevents the channel from being replaced by the input material.

→ Replace: Replaces the material for the according color channel.

→ Blend: Blends the materials together.

→ Multiply: Multiplies the according channels of both inputs.

Limit by Object ID/Material ID
When enabled, a slider appears where the desired IDs can be set. All other objects will keep their materials. If both options are enabled an object must satisfy both conditions.

Material Tab

The options that appear in this tab determine the appearance the geometry created by this tool. Since these controls are identical on all tools that generate geometry, these controls are fully described in the Common 3D Controls section of this documentation.
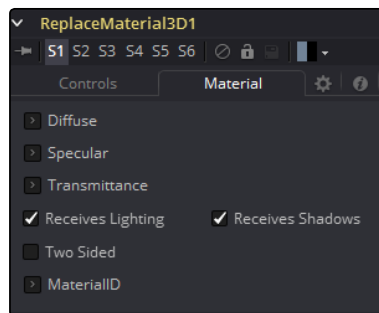
If an external 3D material is connected to the tool tile's material input, then the controls in this tab will be replaced with the "Using External Material" label.
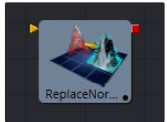
Replace Normals 3D [3R$_N$]

ReplaceNormals is used to replace the Normals/Tangents on incoming geometry. All geometry in the input scene is affected. Lights/Cameras/PointClouds/Locators/Materials and other non-mesh tools are passed through unaffected. The normals/tangents affected by this tool are Per-vertex normals/tangents, not Per-face normals/tangents. The input geometry must have texture coordinates in order for tangents to be computed. Sometimes geometry does not have texture coordinates or the texture coordinates were set to All by FBX import because they were not present on the FBX.
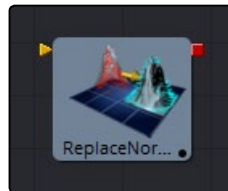
Controls
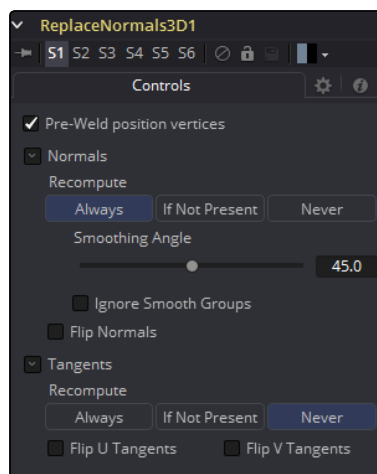
Pre-Weld Position Vertices

Pre-welds the position vertices. Sometimes position vertices are duplicated in a geometry, even though they have the same position, causing normals/tangents to be miscomputed. The results of pre-welding are thrown away; they do not affect the output geometry's position vertices.

Recompute

Controls when normals/tangents are recomputed.

> → Always: The normals on the mesh will always be recomputed.

> → If Not Present: The normals on the mesh are recomputed only if they are not present.

> → Never: The normals will never be computed. This option is useful when animating.

Smoothing Angle

Adjacent faces with angles in degrees smaller than this will have their adjoining edges smoothed across. A typical value one might choose for the Smoothing Angle is between 20 and 60 degrees. There is special case code for 0.0f and 360.0f. When set to 0.0f, faceted normals are produced; this is useful for artistic effect.

Ignore Smooth Groups

If set to False, two faces that have different Smooth Groups will not be smoothed across (e.g., the faces of a cube or the top surfaces of a cylinder have different Smooth Groups). If you check this On and set the smoothing angle large enough, the faces of a cube will be smoothed across. There is currently no way to visualize Smooth Groups within Fusion.

Flip Normals

Flipping of tangents can sometime be confusing. Flip will have an effect if the mesh has tangent vectors. Most meshes in Fusion don't have tangent vectors until they reach a Renderer3D, though. Also, when viewing tangent vectors in the Viewers, the tangent vectors will be created if they don't exist. The confusing thing is if you view a Cube3D that has no tangent vectors and press the FlipU/FlipV button, nothing happens. This is because there were no tangent vectors to create, but later the GL renderer created some (unflipped) tangent vectors.

Known issues the FBX importer will recompute the normals if they don't exist, but you can get a higher quality result from this tool.

Bumpmaps can sometimes depend on the model's normals. In particular, when you simplify a complex high poly model to a low poly model + bumpmap, the normals and bumpmap can become 'linked.' Recomputing the normals in this case can make the model look funny. The bumpmap was intended to be used with those normals.

Most primitives in Fusion are not generated with tangents; when needed they are generated on the fly by a Renderer3D and cached.

Tangents currently are only needed for bumpmapping. If a material needs bumpmapping, then tangents are created. These tangents are created with some default settings (e.g., smoothingAngle, etc), and if you don't want Fusion automatically creating tangents you should manually create them using ReplaceNormals.

All the computations are done in the local coordinates of the geometries rather than in the coordinate system of the ReplaceNormals3D tool. This can cause problems when there is a non-uniform scale applied to the geometry before ReplaceNormals3D is applied.
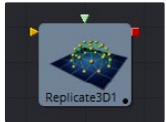
Replicate 3D [3Rep]

The Replicate 3D tool replicates input geometry at positions of destination vertices. This includes mesh vertices as well as particle positions. For each copy of the replicated input geometry, various transformations can be applied. The options in the Jitter tab allow for non-uniform transformations, such as random positioning or sizes.

External Inputs
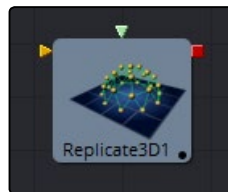
→ Replicate3d.Destination

[orange, required] This input expects a 3D scene with vertex positions, either from meshes or 3D particle animations.

→ Replicate3d.Input[#]

[any, required] This input expects a 3D scene that will be replicated. Once connected, a new input for alternating 3D scenes will be created.

At least one connected input is required.

Controls
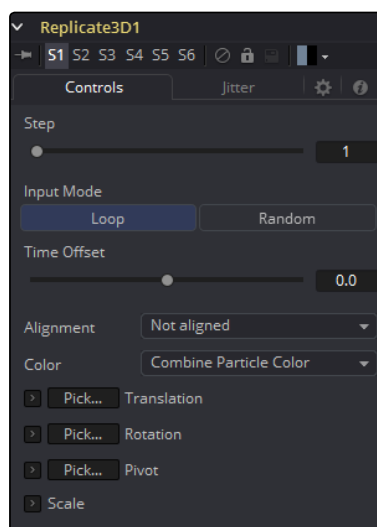
Step

Defines how many positions are skipped. For example, a step of 3 means that only every 3rd position of the destination mesh will be used, while a step of 1 means that all positions will be used.

The Step helps to keep reasonable performance for big destination meshes. On parametric geometry like a torus, it can be used to isolate certain parts of the mesh.

Pointclouds are internally represented by 6 points once the Make Renderable option has been set. In order to get a single point, use a step of 6 and set a X offset of -0.5 in the Replicate3D to get to the center of the pointcloud. Use -0.125 for Locator3Ds. Once these have been scaled the offset may differ.

Input Mode

This parameter defines in which order multiple input scenes are replicated at the destination. Both parameters won't have a visible effect if only one input scene is supplied.

With Loop, the inputs are used successively. The first input will be at the first position, the second at the second and so on. If there are more positions in the destination present than inputs, the sequence will be looped.

Random will use a definite but random input for each position based on the seed in the Jitter tab. This input mode can be used to simulate variety with few input scenes.

Death of Particles causes their IDs to change, therefore their copy order may change.
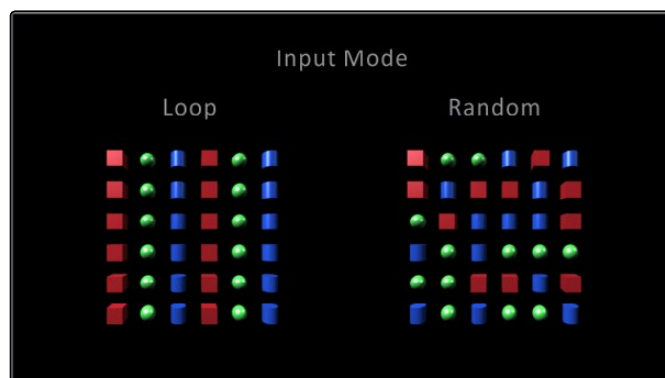
Time Offset

Use the Time Offset slider to offset any animations that are applied to the source geometry by a set amount per copy. For example, set the value to -1.0 and use a cube set to rotate on the Y-axis as the source. The first copy will show the animation from a frame earlier. The second copy will show animation from a frame before that, and so forth.

This can be used with great effect on textured planes, for example, where successive frames of a clip can be shown.

Alignment

Alignment specifies how to align the copies in respect of the destination mesh normal or particle rotation.

→ Not Aligned: Does not align the copy. It stays rotated in the same direction as its input mesh.

Not Aligned

→ Aligned: This mode uses the point's normal and tries to reconstruct an upvector. It works best with organic meshes that have unwelded vertices, like imported FBX meshes, since it has the same rotations for vertices at the same positions. On plane geometric meshes a gradual shift in rotation will be noticeable. For best results, it is recommended to use this method at the origin before any transformations.
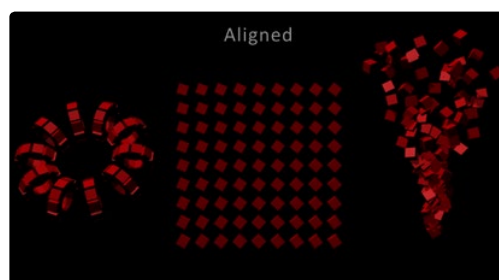
Aligned

→ Aligned TBN: Results in a more accurate and stable alignment based on the tangent, binormal and normal of the destination point. Works best for particles and geometric shapes. On unwelded meshes, two copies of multiple unwelded points at the same position may result in different alignments due to their individual normals.

TBN Aligned

Color

Affects the diffuse color or shader of each copy based on the input's particle color.

→ Use Object Color: Does not use the color of the destination particle.

→ Combine Particle Color: Uses the shader of any input mesh and modifies the diffuse color to match the color from the destination particle.

→ Use Particle Color: Replaces the complete shader of any input mesh with a default shader. Its diffuse color is taken from the destination particle.
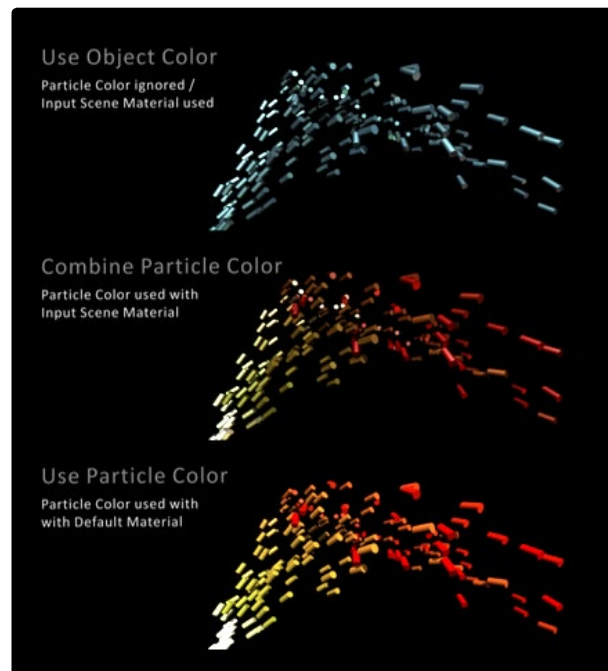
Translation

These three sliders tell the tool how much offset to apply to each copy. An X Offset of 1 would offset each copy 1 unit; 1 unit along the X-axis from the last copy.

Rotation Order

These buttons can be used to set the order in which rotations are applied to the geometry. Setting the rotation order to XYZ would apply the rotation on the X-axis first, followed by the Y-axis rotation, then the Z-axis rotation.

XYZ Rotation

These three rotation sliders tell the tool how much rotation to apply to each copy.

XYZ Pivot

The pivot controls determine the position of the pivot point used when rotating each copy.

Lock XYZ

When the Lock XYZ checkbox is selected, any adjustment to the scale will be applied to all three axes simultaneously.

If this checkbox is disabled, the scale slider will be replaced with individual sliders for the X, Y and Z scale.

Scale

The Scale control sets how much scaling to apply to each copy.
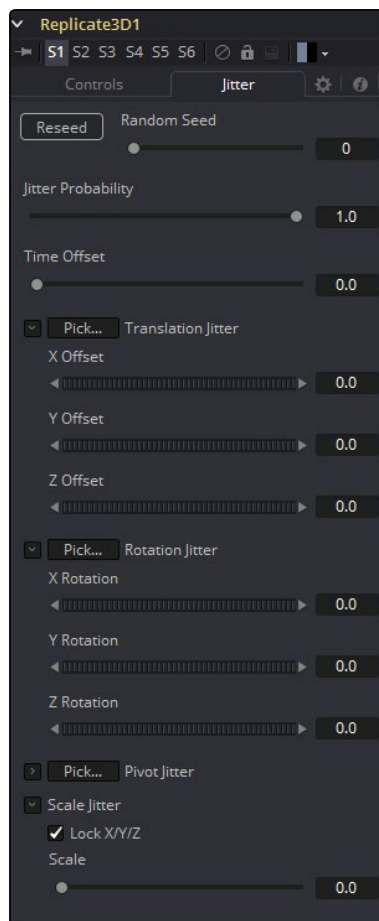
Jitter

Random Seed/Randomize

The Random Seed is used to 'seed' the amount of jitter applied to the replicated objects. Two replicate tools with identical settings but different random seeds will produce two completely different results. Click on the Randomize button to assign a Random Seed value.

Time Offset

Use the Time Offset slider to offset any animations that are applied to the source geometry by a set amount per copy. For example, set the value to -1.0 and use a cube set to rotate on the Y-axis as the source. The first copy will show the animation from a frame earlier. The second copy will show animation from a frame before that, and so forth. This can be used with great effect on textured planes, for example, where successive frames of a clip can be shown.

Translation XYZ Jitter

Use these three controls to adjust the amount of variation in the translation of the replicated objects.

Rotation XYZ Jitter

Use these three controls to adjust the amount of variation in the rotation of the replicated objects.

Pivot XYZ Jitter

Use these three controls to adjust the amount of variation in the rotational pivot center of the replicated objects. This affects only the additional jitter rotation, not the rotation produced by the rotation settings in the Controls tab.

Scale XYZ Jitter

Use this control to adjust the amount of variation in the scale of the replicated objects. Uncheck the Lock XYZ checkbox to adjust the scale variation independently on all three axes.

Ribbon 3D [3Rɪ]

Ribbon 3D generates an array of subdivided line segments or a single line between two points. It is quite useful for motion graphics, especially in connection with Replicate 3D to attach other geometry to the lines, and with Displace3D for creating lightning-bolt like structures. The array of lines is, by default, assigned with texture coordinates, so they can be used with a 2D texture. As usual, UVMap3D can be used to alter the texture coordinates. This tool heavily relies on certain OpenGL features and will not produce any visible result in the Software renderer. Furthermore, the way lines are drawn is completely up to the graphic card vendor, so any artifacts may vary from card to card.

Controls
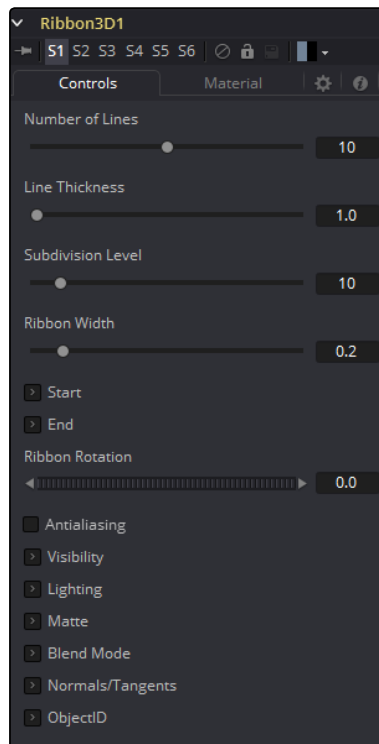
Number of Lines

The number of parallel lines drawn between the start point and endpoint.

Line Thickness

Line thickness is allowed in the user interface to take on a floating point value, but some graphics cards will only allow integer values. Some cards may only allow lines equal to or thicker than 1, or max out at a certain value.

Subdivision Level

The number of vertices on each line between start point and endpoint. The higher the number, the more precise any 3D displacement can be applied.

Ribbon Width

Determines how far the lines are apart from each other.

Start

XYZ control to set the start point of the ribbon.

End

XYZ control to set the endpoint of the ribbon.

Ribbon Rotation

Allows rotation of the ribbon around the virtual axis defined by start point and endpoint.

Antialiasing

Allows you to apply antialiasing to the rendered lines. Using antialiasing isn't necessarily advised. When activated, there will be gaps between the line segments. This is especially noticeable with high values of line thickness. Again, the way lines are drawn is completely up to the graphic card vendor which means that these artifacts can vary from card to card.

Shape 3D [3S_H]

The Shape 3D tool is used to produce several basic primitive 3D shapes, including planes, cubes, spheres and cylinders.

External Inputs

→ Shape3d.SceneInput

[orange, required] This input expects to receive a 3D scene.

→ Shape3d.MaterialInput

[green, optional] This input will accept either a 2D image or a 3D material. If a 2D image is provided it will be used as a diffuse texture map for the basic material built into the tool. If a 3D material is connected, then the basic material will be disabled.
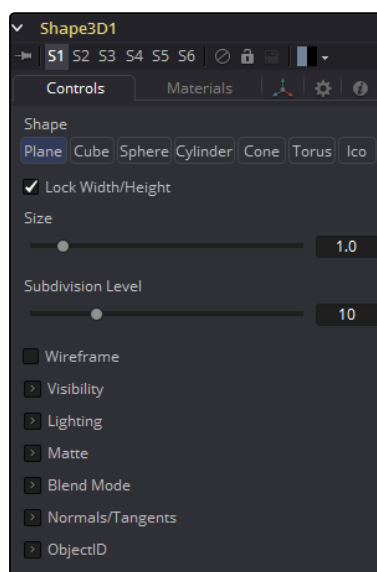
Controls

Shape

Select one of these options to determine which geometry primitive will be produced by the Shape 3D tool. The controls below will change to match the selected shape.

→ Lock Width/Height/Depth: [plane, cube] If this checkbox is selected, the width, height and depth controls are locked together as a single size slider. Otherwise, individual control over the size of the shape along each axis is provided.

→ Size Width/Height/Depth: [plane, cube] Used to control the size of the shape.

Cube Mapping

[Cube] Uses cube mapping to apply the Shape tool's texture (a 2D image connected to the Texture input).

Radius

[Sphere, Cylinder, Cone, Torus] Sets the radius of the selected shape.

Top Radius

[Cone] This control is used to define a radius for the top of a cone, making it possible to create truncated cones.

Start/End Angle

[Sphere, Cylinder, Cone, Torus] This range control determines how much of the sweep of the shape is drawn. A start angle of 180 and end angle of 360 would only draw half of the shape.

Start/End Latitude

[Sphere, Torus] This range control is used to slice the object by defining a latitudinal sub-section of the object.

Bottom/Top Cap

[Cylinder, Cone] Used for cylinder and cone shapes only, the Bottom Cap and Top Cap checkboxes are used to determine if the end caps of these shapes are created or if the shape is left open.

Section

[Torus] Used for torus only, section controls the thickness of the tube making up the torus.

Subdivision Level/Base/Height

[All shapes] Used for all shapes, the Subdivision controls are used to determine the tessellation of the mesh composing the object. The higher the subdivision, the more vertices each shape will have.

Wireframe

Enabling this checkbox will cause the mesh to render only the wireframe for the object.

Visibility

Visible

If the Visibility checkbox is not selected, the object will not be visible in the Viewers, nor will it be rendered into the output image by the Renderer 3D tool. A non-visible object does not cast shadows.

Unseen by Cameras

If the Unseen by Cameras checkbox is selected, the object will be visible in the Viewers (unless the Visible checkbox is turned off), except when viewed through a camera. The object will not be rendered into the output image by the Renderer 3D tool. Shadows cast by an unseen object will still be visible when rendered by the Software renderer, though not by the OpenGL renderer.

Cull Front Face/Back Face

Use these options to cull (eliminate) rendering and display of certain polygons in the geometry. If Cull Back Face is selected, all polygons facing away from the camera not be rendered, and will not cast shadows. If Cull Front Face is selected, all polygons facing toward the camera will likewise be dropped. Selecting both checkboxes has the same effect as deselecting the Visible checkbox.

Ignore Transparent Pixels in Aux Channels

In previous versions of Fusion, the Software/OpenGL renderers rejected transparent pixels. To be more specific, the Software renderer rejected pixels with R=G=B=A=0 and the GL renderer rejected pixels with A=0. This is now optional. The reason you might want to do this is to get aux channels (e.g., Normals, Z, UVs) for the transparent areas. For example, suppose in post you want to replace the texture on a 3D element that is transparent in certain areas with a texture that is transparent in different areas, then it would be useful to have transparent areas set aux channels (in particular UVs). As another example, suppose you are doing post DoF. You will probably not want the Z channel to be set on transparent areas, as this will give you a false depth. Also keep in mind that this rejection is based on the final pixel color including lighting, if it is on. So if you have a specular highlight on a clear glass material, this checkbox will not affect it.

Lighting

Affected by Lights

If this checkbox is not selected, lights in the scene will not affect the object, it will not receive nor cast shadows, and it will be shown at the full brightness of its color, texture or material.

Shadow Caster

If this checkbox is not enabled, the object will not cast shadows on other objects in the scene.

Shadow Receiver

If this checkbox is not enabled, the object will not receive shadows cast by other objects in the scene.

Matte

Enabling the Is Matte option will apply a special texture to this object, causing this object to not only become invisible to the camera, but also making everything that appears directly behind the camera invisible as well. This option will override all textures. See the matte objects section of the 3D chapter for more information.

Is Matte

When activated, objects whose pixels fall behind the matte objects pixels in Z do not get rendered.

Opaque Alpha

Sets the alpha value of the matte object to 1. This checkbox is only visible when the Is Matte option is enabled.

Infinite Z

Sets the value in the Z channel to infinite. This checkbox is only visible when the Is Matte option is enabled.

Blend Mode

A Blend mode specifies which method the renderer will use when combining this object with the rest of the scene. The blend modes are essentially identical to those listed in the documentation for the 2D Merge tool. For a detailed explanation of each mode, see the documentation for that tool.

The blending modes were originally designed for use with 2D images. Using them in a lit 3D environment can produce undesirable results. For best results, use the Apply modes in unlit 3D scenes rendered in software.

OpenGL Blend Mode

Use this menu to select the blending mode that will be used when the geometry is processed by the OpenGL renderer. This is also the mode used when viewing the object in the Viewers. Currently the OpenGL renderer supports three blending modes.

Software Blend Mode

Use this menu to select the blending mode that will be used when the geometry is processed by the Software renderer. Currently, the Software renderer supports all of the modes described in the Merge tool documentation, except for the Dissolve mode.

Material Tab

The options that appear in this tab determine the appearance the geometry created by this tool. Since these controls are identical on all tools that generate geometry, these controls are fully described in the Common 3D Controls section of this documentation.

If an external 3D material is connected to the tool tile's material input then the controls in this tab will be replaced with the "Using External Material" label.

Transform Tab

The options that appear in this tab determine the position of the geometry created by this tool. Since these controls are identical on all tools that generate geometry, these controls are fully described in the Common 3D Controls section of this documentation.

Sphere Map vs. Connecting the Texture to a Sphere Directly

You can connect a latlong (equirectangular) texture map directly to a sphere instead of piping it through the Sphere Map tool first. This results in a different rendering if you set the start/end angle and latitude to less than 360°/180°. In the first case, the texture will be squashed. When using the Sphere Map tool, the texture will be cropped. Compare:

Note: If you pipe the texture directly into the sphere, it will also be mirrored horizontally. You can "fix" this by using a Transform tool first.
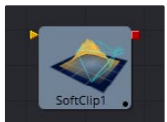
Softclip [3SC]

The Softclip tool is used to fade out geometry and particles that get close to the camera. This helps avoid the visible 'popping off' that affects many particle systems and 3D flythroughs. This tool is very similar to the Fog 3D tool, in that it is dependent on the geometry's distance from the camera.

The Softclip tool is usually placed just before the renderer to ensure that downstream adjustments to lighting and textures do not affect the result. It can be placed in any part of the 3D portion of the flow if the soft clipping effect is only required for a portion of the scene.

External Inputs
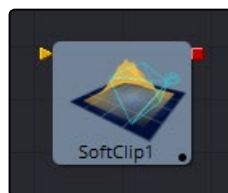
→ Softclip.SceneInput

[orange, required] This input expects a 3D scene.

Controls
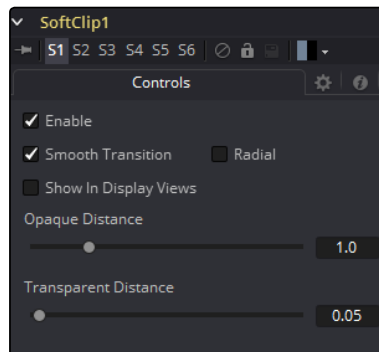
Enable
This checkbox can be used to enable or disable the tool.

Smooth Transition
Changes the linear gradient to a curve shaped one.

Radial
By default, the softclipping is done based upon the perpendicular distance to a plane (parallel with the near plane) passing through the eye point. When the radial option is checked, the Radial distance to the eye point is used instead of the Perpendicular distance. The problem with Perpendicular distance softclipping is that when you move the camera about, as objects on the left or right side of the frustum move into the center, they become less clipped, even though they remain the same distance from the eye. Radial softclip fixes this. Sometimes Radial softclipping is not desirable. For example, if you apply softclip to an object that is close to the camera, like an image plane, the center of the image plane could be unclipped while the edges could be fully clipped because they are further from the eye point.

Show In Display Views
Normally, the effect is only visible when the scene is viewed using a Camera tool. When enabled, the softclip becomes visible in the scene from all points of view.

Transparent/Opaque Distance
Defines the range of the softclip. The objects will begin to fade in from an opacity of 0 at the Transparent distance and are fully visible at the Opaque distance. All units are expressed as distance from the camera along the Z-axis.

Text 3D [3Txт]

The Text3D tool is a 3D version of the 2D Text tool. The controls for this tool are mostly identical to the controls for the 2D version in almost all respects, except that it only supports one shading element. See Text Plus for more details on the controls found in this tool.

The Text 3D tool was based on a tool that pre-dates the Fusion 3D environment. As a result, some of the controls found in the basic primitive shapes and geometry loaders, such as many of the material, lighting, and matte options, are not found in this tool's controls. The Text 3D tool has a built in material, but unlike the other 3D tools it does not have a Material input. The Shading tab contains controls to adjust the diffuse and specular components. To replace this default material with a more advanced material, follow the Text Plus tool with a Replace Material 3D tool. The Override 3D tool can be used to control the lighting, visibility and matte options for this tool.

One thing to be aware of when network-rendering a comp that contains a Text3D tool is that each machine that does not have the font installed will fail. Fusion cannot share or copy fonts to Render Slaves due to legal issues.

External Inputs

→ Text3d.SceneInput

[orange, required] This input expects a 3D scene.

→ Text3d.ColorImage

[orange, required] This input expects a 2D image. It is only visible when the Image mode is enabled in the Material section of the Shading tab.

→ Text3d.BevelTexture

[orange, required] This input expects a 2D image. It is only visible when the Image mode is enabled in the Bevel Material section of the Shading tab.

Text Extrusion
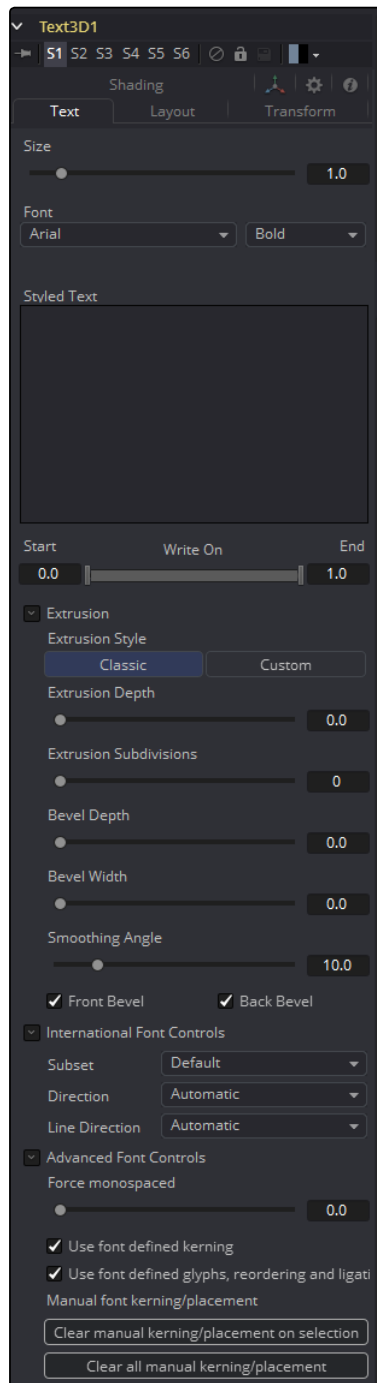
Extrusion Depth

An extrusion of 0 produces completely 2D text. Any value greater than 0 will extrude the text to generate text with depth.

Bevel Depth

Increase the value of the Bevel Depth slider to bevel the text. The text must have extrusion before this control has any effect.

Bevel Width

Use the Bevel Width control to increase the width of the bevel.

Smoothing Angle

Use this control to adjust the smoothing angle applied to the edges of the bevel.

Front/Back Bevel

Use these checkboxes to enable beveling for the front and back faces of the text separately

Custom Extrusion

In Custom mode, the Smoothing Angle controls the smoothing of normals around the edges of a text character. The spline itself controls the smoothing along the extrusion profile. If a spline segment is smoothed, for example by using the shortcut Shift-S, the Normals will be smoothed as well. If the keypoint is linear, there will be a sharp shading edge. The first and last keypoint on the spline defines the extent of the text.

→ Custom Extrusion Subdivisions: Controls the number of subdivisions within the smoothed portions of the extrusion profile.

Tip: Remember that the spline can also be edited from within the Spline Editor tab and you do not have to work with the limited abilities and size of the text3D.Extrusionprofile spline control. Do not try to go to zero size at the Front/Back face. This will result in Z-fighting due to self-intersecting faces. To avoid this problem, make sure the first and last point have their profile set to 0.

Shading

Opacity

Reducing the material's opacity will decrease the color and alpha values of the specular and diffuse colors equally, making the material transparent and allowing hidden objects to be seen through the material.

Use One Material

Deselecting this option will reveal a second set of Material controls for the beveled edge of the text.

Material
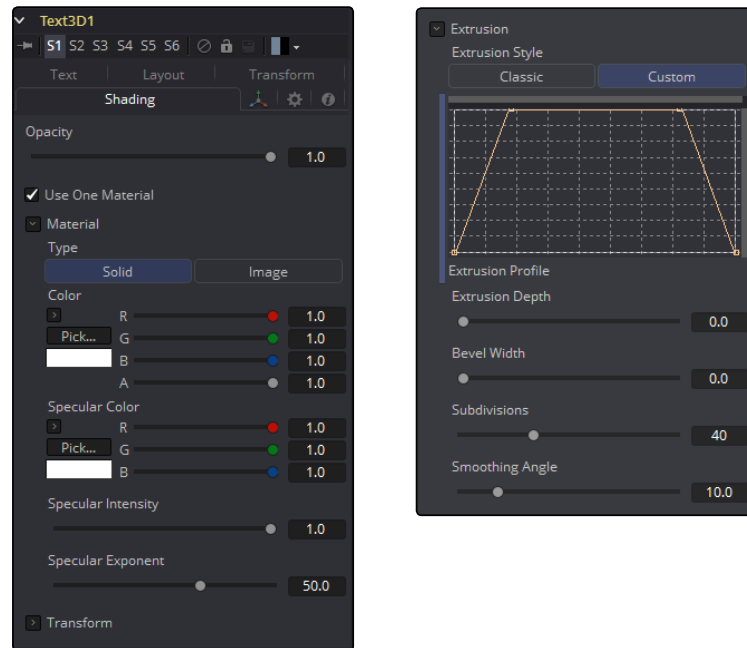
Type

To use a solid color texture, select the Solid mode. Selecting the Image mode will reveal a new external input on the tools tile that can be connected to another 2D image.

Specular Color

Specular Color determines the color of light that reflects from a shiny surface. The more specular a material is, the glossier it appears. Surfaces like plastics and glass tend to have white specular highlights, whereas metallic surfaces like gold have specular highlights that tend to inherit their color from the material color. The basic shader material does not provide an input for textures to control the specularity of the object. Use tools from the 3D Material category when more precise control is required over the specular appearance.

Specular Intensity

Specular Intensity controls the strength of the specular highlight. If the specular intensity texture port has a valid input, then this value is multiplied by the alpha value of the input.

Specular Exponent

Specular Exponent controls the falloff of the specular highlight. The greater the value, the sharper the falloff, and the smoother and glossier the material appears. The basic shader material does not provide an input for textures to control the specular exponent of the object. Use tools from the 3D Material category when more precise control is required over the specular exponent.

Image Source

This control determines the source of the texture applied to the material. If the option is set to Tool, then an input will appear on the tool tile that can be used to apply the output of a 2D tool as the texture. Selecting Clip will expose a file browser that can be used to select an image or image sequence from disk. The Brush option will provide a list of clips found in the Fusion\brushes folder.

Bevel Material

This reveal only appears when the Use One Material checkbox control is selected. The controls under this reveal are an exact copy of the Material controls above, but are applied only to the beveled edge of the text.

Transform

These controls can be used to transform the material applied to the text. See the Text Plus tool for a complete description of these tools.

Tips for Text3D

Character Level Styling
The Text 3D tool doesn't support Character Level Styling directly. You have to create a Text+ tool first and modify its text field with a Character Level Styling modifier. Then either connect the Text 3D's text field to the modifier that is now available or copy the Text+ tool and paste its settings to the Text 3D tool (right-click > Paste Settings).

Uncapped 3D Text
To hide the front face of extruded text, uncheck Use One Material on the Shading tab and reduce the first material's color to black including its alpha value.

Transform 3D [3X$_F$]

The Transform 3D tool can be used to translate, rotate or scale all the elements within a scene without requiring a Merge 3D tool. This can be useful for hierarchical transformations, or for offsetting objects that are merged into a scene multiple times. Its controls are identical to those found in other 3D tools' Transformation tabs.

3D Transform Tab
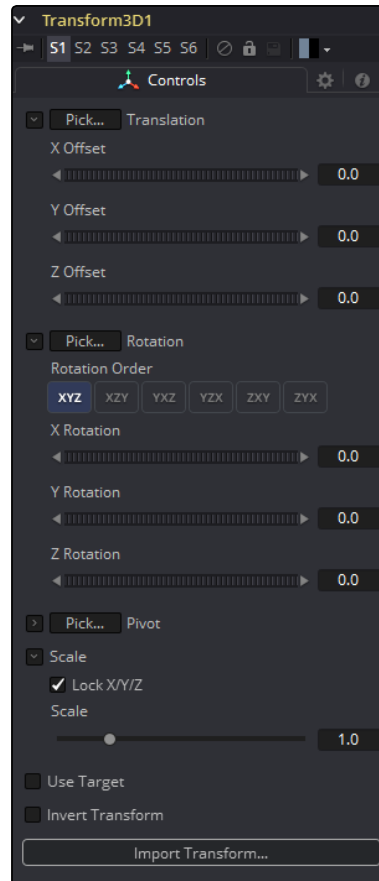
Translation

X, Y, Z Offset

These controls can be used to position the 3D element.

Rotation

Rotation Order

Use these buttons to select the order used to apply the Rotation along each axis of the object. For example, XYZ would apply the rotation to the X-axis first, followed by the Y-axis and then followed by the Z-axis.

X, Y, Z Rotation

Use these controls to rotate the object around its pivot point. If the Use Target checkbox is selected, then the rotation is relative to the position of the target, otherwise the global axis is used.

Pivot Controls

X, Y, Z Pivot

A pivot point is the point around which an object rotates. Normally, an object will rotate around its own center, which is considered to be a pivot of 0,0,0. These controls can be used to offset the pivot from the center.

Scale

X, Y, Z Scale

If the lock X/Y/Z checkbox is checked, a single scale slider will be shown. This adjusts the overall size of the object. If the Lock checkbox is unchecked, individual X, Y and Z sliders will be displayed to allow scaling in any dimension.

Note: If the Lock checkbox is checked, scaling of individual dimensions is not possible, even when dragging specific axes of the Transformation widget in Scale mode.

Use Target

Selecting the Use Target checkbox enables a set of controls for positioning an XYZ target. When Target is enabled, the object will always rotate to face the target. The rotation of the object becomes relative to the target.

Import Transform

Opens a file browser where you can select a scene file saved or exported by your 3D application. It supports the following file types:

LightWave Scene	.lws
Max Scene	.ase
Maya Ascii Scene	.ma
dotXSI	.xsi

The Import Transform button will only import transformation data. For 3D geometry, lights and cameras, consider using the File > FBX Import option from the menus.
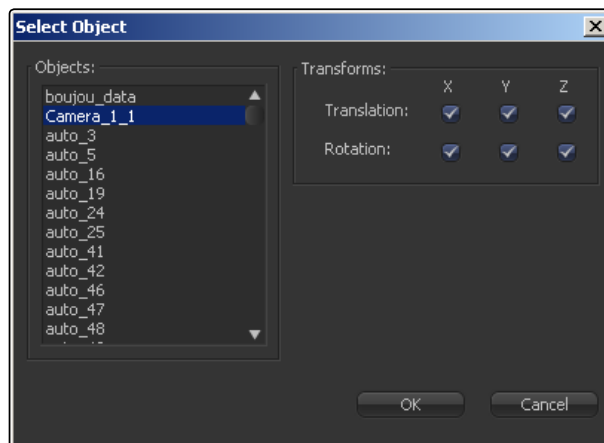
On Screen Transformation Widget

A Transformation Widget represents most of the controls in this tab in the Viewer, with modes for transformation, rotation and scaling. To change the mode of the widget, select one of the three buttons in the toolbar along the side of the Viewer. The modes can also be toggled using the keyboard shortcut q for translation, w for rotation and e for scaling. In all three modes, an individual axis of the control may be dragged to affect just that axis, or the center of the control may be dragged to affect all three axes.

The scale sliders for most 3D tools defaults to locked, which causes uniform scaling of all three axes. Unlock the Lock X/Y/Z Scale checkbox to scale an object on a single axis only.
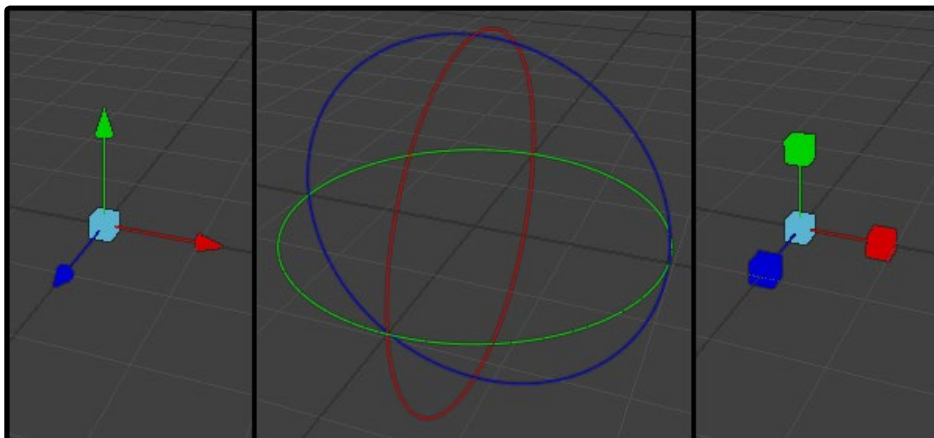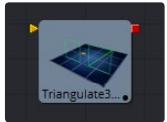
Triangulate 3D [3TRI]

This tool has no controls. It triangulates any quads or convex polygons.UV map 3D [3Uv]
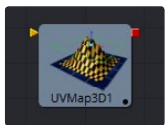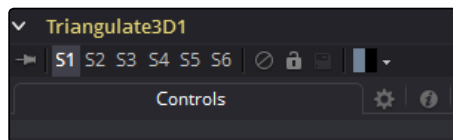
UV Map 3D [3UV]

The UV map 3D tool replaces the UV texture coordinates on the geometry in the scene. These coordinates tell Fusion how to apply a texture to an object. The tool provides Planar, Cylindrical, Spherical, XYZ and Cubic Mapping modes, which can be applied to basic Fusion primitives as well as imported geometry. The position, rotation and scale of the texture coordinates can be adjusted to allow for fine control over the texture's appearance. An option is also provided to lock the UV produced by this tool to animated geometry according to a reference frame. This can be used to ensure that textures applied to animated geometry do not slide.

While it is possible to adjust the global properties of the selected mapping mode, it is not possible to manipulate the UV coordinates of individual vertices directly from within Fusion. The onscreen controls drawn in the Viewers are for reference only and cannot be manipulated.

External Inputs
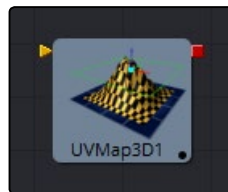
→ UVMap3d.SceneInput
  [orange, required] This input expects to receive a 3D scene.

→ UVMap3d.CameraInput
  [green, optional] This input expects the output of the Camera 3D tool. It is only visible when the Camera Map mode is used.

Camera Projections with UV Map 3D

The Camera Mapping mode makes it possible to project texture coordinates onto geometry through a camera. Enable the Camera Mapping mode on the UV Map 3D tool. Directly connect the camera that will be used to create the UV coordinates to the new 'Camera' input that appears on the UV Map 3D tool's tile in the flow.

Note that this does not directly project an image through the camera. The image to be projected should be connected to the diffuse texture input of whatever material is assigned to the objects. When the texture is applied it will use the UV coordinates created by the camera. Because this is a texture projection and not light, the alpha channel of the texture will correctly set the opacity of the geometry.

See the Camera 3D and Projector 3D tool for alternate approaches to projection.

The projection can optionally be locked to the vertices as it appears on a selected frame. This will fail if the number of vertices in the mesh changes over time, as Fusion must be able to match up the mesh at the reference time and the current time. To be more specific, vertices may not be created or destroyed or reordered. For this reason, projection locking does not work for many particle systems, for primitives with animated subdivisions, and with duplicate tools using non-zero time offsets.

Note: The UV Map 3D tool does not put a texture or material on the mesh, it only modifies the texture coordinates that the materials will use. This may be confusing because the material usually sits upstream. For example, a composition containing the tools: Loader > Blinn > Shape 3D (cube) > UV Map 3D > Renderer 3D.

Controls
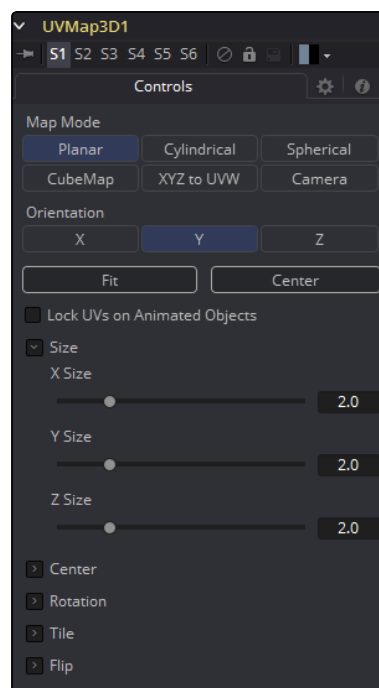
Map Mode

Defines how the texture coordinates are created. Think of it as a virtual geometry which projects the UV space on the object.

→ Planar: Creates the UV coordinates using a plane.

→ Cylindrical: Creates the UV coordinates using a cylindrical shaped object.

→ Spherical: The UVs are created using a sphere.

→ XYZ to UVW: The position coordinates of the vertices are converted to UVW coordinates directly. This is used for working with procedural textures.

→ CubeMap: The UVs are created using a cube.

→ Camera: Enables the Camera Input port of the tool. After connecting a camera to it, the texture coordinates are created based on camera projection.

Orientation X/Y/Z

Defines the reference axis for aligning the Map mode.

Fit

Clicking this button will fit the Map mode to the bounding box of the input scene.

Center

Clicking this button will move the center of the Map mode to the bounding box center of the input scene.

Lock UVs on Animated Objects

If the object is animated, the UVs can be locked to it. Enabling this option will do so and also reveal the Ref Time slider, where it is possible to choose a reference frame for the UV mapping. Using this feature, it is not required to animate the uvmap parameters. It is enough to set up the UV map at the reference time.

Size X/Y/Z

Defines the size of the projection object.

Center X/Y/Z

Defines the position of the projection object.

Rotation/Rotation Order

Use these buttons to select which order is used to apply the rotation along each axis of the object. For example, XYZ would apply the rotation to the X-axis first, followed by the Y-axis and then followed by the Z-axis.

Rotation X/Y/Z

Sets the orientation of the projection object for each axis, dependent from the rotation order.

Tile U/V/W

Defines how often a texture fits into the projected UV space on the according axis. Note that the UVW coordinates are transformed, not a texture. Works best when used in conjunction with the Create Texture tool.

Flip U/V/W

Mirrors the texture coordinates around the according axis.

Flip Faces (CubeMap mode only)

Mirrors the texture coordinates on the individual faces of the cube.

> ### Note
>
> To utilize the full capabilities of the UV Map 3D tool it helps to have a basic understanding of how 2D images are mapped onto 3D geometry. When a 2D image is applied to a 3D surface, it is converted into a texture map that uses UV coordinates to determine how the image translates to the object. Each vertex on a mesh has a (U, V) texture coordinate pair that describes the appearance the object will take when it is unwrapped and flattened. Different mapping modes use different methods for working out how the vertices transform into a flat 2D texture. When using the UV Map 3D tool to modify the texture coordinates on a mesh, it is best to do so using the default coordinate system of the mesh or primitive. So the typical workflow would look like Shape 3D > UV Map 3D > Transform 3D. The Transformation tab on the shape tool would be left to its default values, and the Transform 3D tool following the UV Map 3D does any adjustments needed to place the tool in the scene. Modifying/animating the transform of the Shape tool will cause the texture to slide across the shape, which is generally undesirable. The UV Map 3D tool modifies texture coordinates per vertex and not per pixel. If the geometry the UV map is applied to is poorly tessellated, then undesirable artifacts may appear.

Weld 3D [3W<small>E</small>]

Sometimes 3D geometry has vertices that should have been joined but haven't. This can cause artifacts, especially when the two vertices have different normals.

For example:

→ The different normals will produce a hard shading/lighting edge where none was intended;
→ If you try to Displace3D the vertices along their normals, a crack will appear;
→ Missing pixels or doubled up pixels in the rendered image;
→ Particles to pass through the tiny invisible cracks.

Rather than roundtripping back to your 3D modeling application to fix the 'duplicated' vertices, the Weld3D tool allows you to do this in Fusion. Weld3D welds together vertices with the same or nearly the same positions. This can be used to fix cracking issues when vertices are displaced by welding the geometry before the Displace. There are no user controls to pick vertices. Currently, this tool welds together just Position vertices; it does not weld normals, texcoords, or any other vertex stream. So even though the positions of two vertices have been made the same, their normals will still have their old values. This can lead to hard edges in certain situations.

Controls
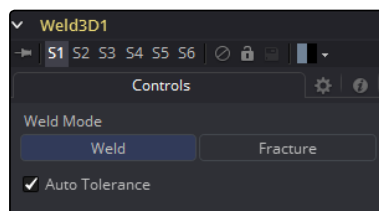
Fracture

Fracturing is the opposite of welding, so all vertices are unwelded. This means that all polygon adjacency information is lost. For example, an Imageplane3D normally consists of connected quads that share vertices. Fracturing the image plane causes it to become a bunch of unconnected quads.

Tolerance

In auto-mode the Tolerance value is automatically detected. This should work in most cases. It can also be adjusted manually if needed.

Usage

Use Weld3D when issues occur with the geometry. Don't use it everywhere just because it's there, as it will influence render time.

Weld3D is intended to be used as a mesh robustness tool and not as a mesh editing tool to merge together vertices. If you can see the gap between the vertices you want to weld in the 3D view, you are probably misusing Weld3D. Unexpected things may happen when you do this; do so at your own peril.

Current Issues

Setting the tolerance too large can cause edges/faces to collapse to points.

If your model has detail distributed over several orders of scale, picking a tolerance value can be hard or impossible.

For example, suppose you have a model of the iss and there are lots of big polygons and lots of really tiny polgyons. If you set the tolerance too large, small polygons will be merged that shouldn't; if you set the tolerance too small, some large polgyons won't be merged.

Vertices that are far from the origin can fail to be merged correctly. This is because bignumber + epsilon can exactly equal bignumber in float math. This is one reason it may be best to merge in local coords and not in world coords.

Sometimes Weld3-ing a mesh can make things worse. Take Fusion's cone as an example. The top vertex of the cone is currently duplicated for each adjoining face and they all have different normals. If you weld the cone, the top vertices will merge together and will only have one normal, making the lighting look weird.

Weld3D is not multithreaded.

Warning

Do not misuse Weld3D to simplify (reduce the polgyon count of) meshes. It is designed to efficiently weld vertices that differ by only very small values, like a 0.001 distance.

3D Light Tools

2

3D Light Tools

3D Light Tools

Ambient Light

Directional Light

Point Light

Spot Light
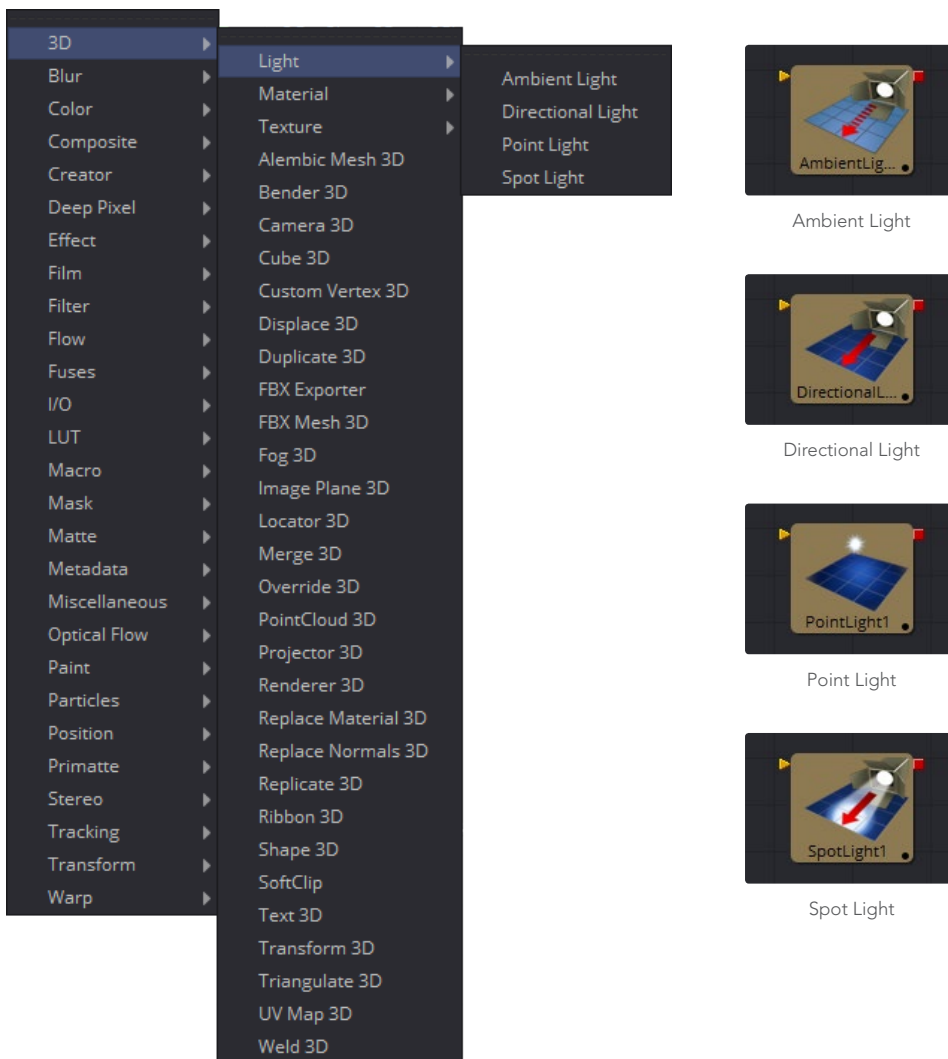
Ambient Light [3Aᴍ]

An Ambient Light is a directionless light that globally illuminates a scene. It has no real position or rotation, although an onscreen widget will appear in the views to indicate that a light is present in the scene. Position controls for the widget are provided to make it possible to move the widget out of the way of other geometry, if necessary.

External Inputs

→ AmbientLight.SceneInput

> [orange, optional] This input expects a 3D scene. If a scene is provided, the Transform controls in this tool will apply to the entire scene provided.

Controls Tab
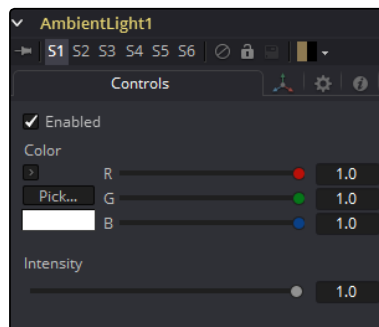
Enabled

When the Enabled checkbox is selected, the ambient light affects the scene. Clear the checkbox to turn off the light.

Color

Use this standard Color control to set the color of the light.

Intensity

Use this slider to set the Intensity of the ambient light. A value of .2 indicates 20% percent light. A perfectly white texture lit only with a .2 ambient light would render at 20% gray (.2, .2, .2).

Transform Tab

The options that appear in this tab determine the position of the geometry created by this tool. Since these controls are identical on all tools that generate geometry, these controls are fully described in the Common 3D Controls section of this documentation.
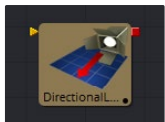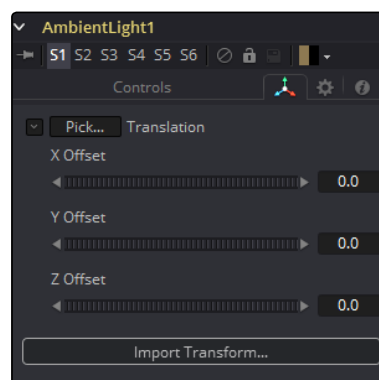
Directional Light [3DL]

A Directional Light is a light with a clear direction but without a clear source. This light shows an onscreen widget, but the position of the widget has no meaning. The rotation of the widget is used to determine from where in the scene the light appears to be coming.

External Inputs

→ DirectionalLight.SceneInput

[orange, optional] This input expects a 3D scene. If a scene is provided, the Transform controls in this tool will apply to the entire scene provided.

Control Tab

This tab contains all parameters for the tool.
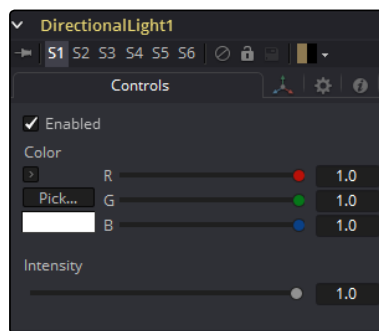
Enabled

When the Enabled checkbox is selected, the directional light affects the scene. Clear the checkbox to turn off the light.

Color

Use this standard Color control to set the color of the light.

Intensity

Use this slider to set the Intensity of the ambient light. A value of .2 indicates 20% percent light.

Transform Tab
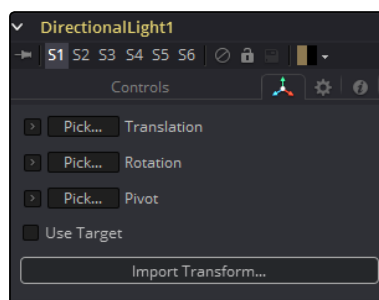
The options that appear in this tab determine the position of the geometry created by this tool. Since these controls are identical on all tools that generate geometry, these controls are fully described in the Common 3D Controls section of this documentation.

Point Light [3PL]

A Point Light is a light source with a clear position in space that emits light in all directions. A light bulb is a point light, as is the sun, although light from the sun can appear to be ambient due to scattering from the atmosphere.

This light shows an onscreen widget, although only the position of the widget affects the light. Since the light is a 360-degree source, the rotation of the widget has no meaning. Unlike both ambient and directional lights, a point light may fall off with distance.

External Inputs

→ PointLight.SceneInput

[orange, optional] This input expects a 3D scene. If a scene is provided, the Transform controls in this tool will apply to the entire scene provided.

Controls Tab

Enabled

When the Enabled checkbox is selected, the point light affects the scene. Clear the checkbox to turn off the light.

Color

Use this standard Color control to set the color of the light.

Intensity

Use this slider to set the Intensity of the ambient light. A value of .2 indicates 20% percent light.

Decay Type

A point light defaults to No Decay, meaning that its light has equal intensity at all points in the scene. To cause the intensity to fall off with distance, set the Decay Type either to Linear or Quadratic modes.

Transform Tab

The options that appear in this tab determine the position of the geometry created by this tool. Since these controls are identical on all tools that generate geometry, these controls are fully described in the Common 3D Controls section of this documentation.
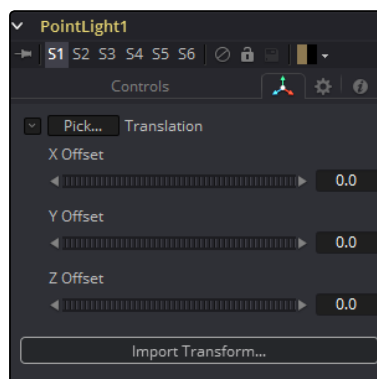
Spot Light [3SL]

A Spotlight is a light that comes from a specific point and that has a clearly defined cone, with falloff of the light to the edges. Experienced stage and theatre lighting technicians will recognize the spotlight as being very similar to standard luminaries that are used in live productions. This is the only type of light capable of casting shadows.

External Inputs

→ SpotLight.SceneInput

[orange, optional] This input expects a 3D scene. If a scene is provided, the Transform controls in this tool will apply to the entire scene provided.

Controls

This tab contains all parameters for the tool.
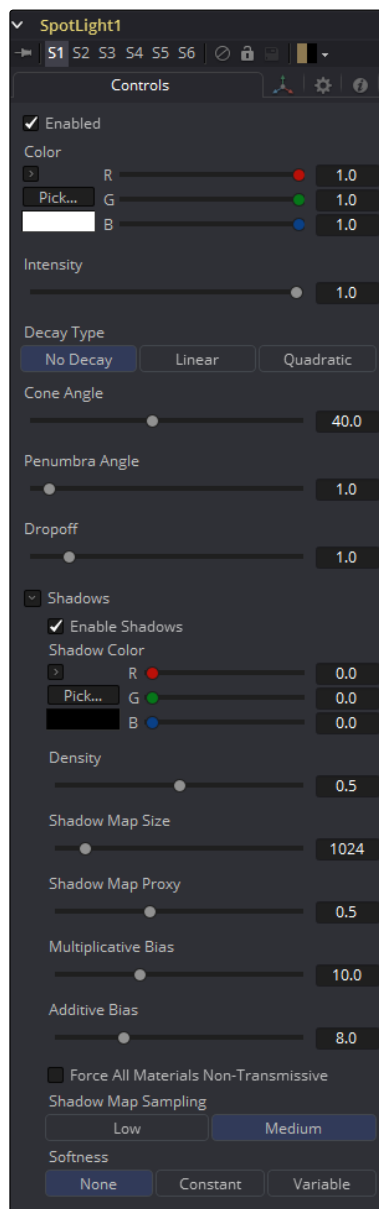
Enabled

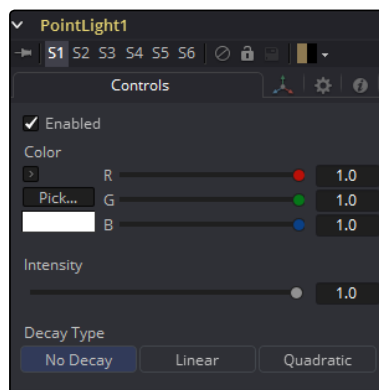When this checkbox is selected, the spotlight light affects the scene. Clear the checkbox to turn off the light.

Color

Use this standard color control to set the color of the light.

Intensity

Use this slider to set the intensity of the spotlight.

Decay Type

A spotlight defaults to No Falloff, meaning that its light has equal intensity on geometry regardless of the distance from the light to the geometry. To cause the intensity to fall off with distance, set the Decay type either to Linear or Quadratic modes.

Cone Angle

The Cone Angle of the light refers to the width of the cone where the light emits its full intensity. The larger the angle, the wider the cone angle, up to a limit of 90 degrees.

Penumbra Angle

The Penumbra Angle determines the area beyond the cone angle where the light's intensity falls off toward 0. A larger penumbra angle defines a larger falloff, while a value of 0 generates a hard-edged light.

Dropoff

The Dropoff controls how quickly the penumbra angle falls off from full intensity to 0.

Shadows

This section provides several controls used to define the shadow map used when this spotlight creates shadows. See the Lights and Shadows chapter for details.

Enable Shadows

The Enable Shadows checkbox should be selected if the light is to produce shadows. This defaults to selected.

Shadow Color

Use this standard Color control to set the color of the shadow. This defaults to black (0, 0, 0).

Density

The shadow Density determines how opaque the shadow will be. A density of 1.0 will produce a completely transparent shadow, whereas lower values make the shadow transparent.

Shadow Map Size

The Shadow Map Size control determines the size of the bitmap used to create the shadow map. Larger values will produce more detailed shadow maps at the expense of memory and performance.

Shadow Map Proxy

Shadow Map Proxy determines the size of the shadow map used when the Proxy or Auto Proxy modes are enabled. A value of 0.5 would produce a shadow map at half the resolution defined in the Shadow Map Size.

Multiplicative/Additive Bias

Shadows are essentially textures applied to objects in the scene so there will occasionally be Z-fighting, where the portions of the object that should be receiving the shadows render over top of the shadow instead. Biasing works by adding a small depth offset to move the shadow away from the surface it is shadowing, eliminating the Z-fighting. Too little bias and the objects can self-shadow themselves. Too much bias and the shadow can become separated from the surface. Make adjustments to the Multiplicative Bias first, then fine tune the result using the Additive Bias control.

See the Multiplicative and Additive Bias section of the 3D chapter for examples and more information.

Force All Materials Non-Transmissive

Normally, a RGBAZ shadow map is used when rendering shadows. By enabling this option you are forcing the renderer to use a Z-only shadow map. This can result in significantly faster shadow rendering while using a fifth as much memory. The disadvantage is that you can no longer cast 'stained-glass' like shadows.

Shadow Map Sampling

Sets the quality for sampling of the shadow map.

Softness

Soft edges in shadows are produced by filtering the shadow map when it is sampled. Fusion has three separate filtering methods available when rendering shadows which produce different effects.

→ None: Shadows will have a hard edge. No filtering of the shadow map is done at all. The advantage of this method is that you only have to sample one pixel in the shadow map, so it is fast.

→ Constant: Shadows edges will have a constant softness. A filter with a constant width is used when sampling the shadow map. Adjusting the Constant Softness slider controls the size of the filter. Note that the larger you make the filter, the longer it will take to render the shadows.

→ Variable: The softness of shadow edges will grow the further away the shadow receiver is from the shadow caster. The variable softness is achieved by changing the size of the filter based on the distance between the receiver and caster. When this option is selected, the Softness Falloff, Min Softness and Max Softness sliders appear.

Constant Softness

If the Softness is set to constant, then this slider will appear. It can be used to set the overall softness of the shadow.

Softness Falloff

The Softness Falloff slider appears when the Softness is set to variable. This slider controls how fast the softness of shadow edges grows with distance. To be more precise, it controls how fast the shadow map filter size grows based upon the distance between shadow caster and receiver. Its effect is mediated by the values of the Min and Max Softness sliders.

Min Softness

The Min Softness slider appears when the Softness is set to variable. This slider controls the Minimum Softness of the shadow. The closer the shadow is to the object casting the shadow, the sharper it will be up to the limit set by this slider.

Max Softness

The Max Softness slider appears when the Softness is set to variable. This slider controls the Maximum Softness of the shadow. The further the shadow is from the object casting the shadow, the softer it will be up to the limit set by this slider.

Transform Tab

The options that appear in this tab determine the position of the geometry created by this tool. Since these controls are identical on all tools that generate geometry, these controls are fully described in the Common 3D Controls section of this documentation.

3D Material Tools

3

3D Material Tools

3D Material Tools

Menu	Submenu	Material
3D ▸	Light ▸	Blinn
Blur ▸	Material ▸	Channel Boolean
Color ▸	Texture ▸	CookTorrance
Composite ▸	Alembic Mesh 3D	Mtl Merge
Creator ▸	Bender 3D	Phong
Deep Pixel ▸	Camera 3D	Reflect
Effect ▸	Cube 3D	Stereo Mix
Film ▸	Custom Vertex 3D	Ward
Filter ▸	Displace 3D	
Flow ▸	Duplicate 3D	
Fuses ▸	FBX Exporter	
I/O ▸	FBX Mesh 3D	
LUT ▸	Fog 3D	
Macro ▸	Image Plane 3D	
Mask ▸	Locator 3D	
Matte ▸	Merge 3D	
Metadata ▸	Override 3D	
Miscellaneous ▸	PointCloud 3D	
Optical Flow ▸	Projector 3D	
Paint ▸	Renderer 3D	
Particles ▸	Replace Material 3D	
Position ▸	Replace Normals 3D	
Primatte ▸	Replicate 3D	
Stereo ▸	Ribbon 3D	
Tracking ▸	Shape 3D	
Transform ▸	SoftClip	
Warp ▸	Text 3D	
	Transform 3D	
	Triangulate 3D	
	UV Map 3D	

Blinn

Phong

Channel Boolean
Material

Reflect

Cook Torrance

Stereo Mix

Materaial Merge 3D

Ward

Blinn [3B_L]

The Blinn tool is a basic illumination material that can be applied to geometry in the 3D scene. It describes how the object will respond to light, and provides a large number of texture map inputs to allow fine control over the diffuse, specular and bumpmap components of the material.

The standard basic material provided in the Material tab of most geometry tools is a simplified version of the Blinn tool. The primary difference is that the Blinn tool provides additional texture map inputs beyond just diffuse.

The Blinn tool outputs a 3D Material that can be connected to the material inputs on any 3D geometry tool.

The Blinn model implemented by Fusion calculates the highlight as the dot product of the surface normal and the half angle vector between lightsource and viewer (dot(N, H)). This may not always match the Blinn model illumination model used by other 3D applications.

External Inputs

→ Blinn.DiffuseTex

[orange, optional] This input will accept a 2D image or a 3D material to be used as a diffuse texture map.

→ Blinn.SpecularColorTex

[green, optional] This input will accept a 2D image or a 3D material to be used as a specular color texture map.

→ Blinn.SpecularIntensityTex

[magenta, optional] This input will accept a 2D image or a 3D material to be used as an intensity map for the materials specular highlights. When the input is a 2D image, the alpha channel is used to create the map while the color channels are discarded.

→ Blinn.SpecularExponentTex

[light blue, optional] This input will accept a 2D image or a 3D material to be used as a falloff map for the materials specular highlights. When the input is a 2D image, the alpha channel is used to create the map while the color channels are discarded.

→ Blinn.BumpmapTex

[white, optional] This input will accept a 2D image or a 3D material, then uses the RGB information as texture-space normals.

Each of these inputs multiplies the pixels in the texture map by the equivalently named parameters in the tool itself. This provides an effective method for scaling parts of the material.

When tools have as many inputs as this one does, it is often difficult to make connections with any precision. Hold the Option (Mac OS X) or Alt (Windows) key down while dragging the output from another tool over the tool tile, and keep holding Option or Alt when releasing the left mouse button. A small menu listing all of the inputs provided by the tool will appear. Click on the desired input to complete the connection.

Alternatively, you can drag the output from a tool with the right mouse button to activate the same menu.

Controls

Diffuse

Diffuse describes the base surface characteristics without any additional effects like reflections or specular highlights. In addition to defining the base color of an object, the diffuse color also defines the transparency of the object. The alpha in a diffuse texture map can be used to make portions of the surface of any object the material is applied to transparent.

Diffuse Color

A material's Diffuse Color describes the base color presented by the material when it is lit indirectly or by ambient light. If a diffuse texture map is provided, then the color value provided here is multiplied by the color values in the texture.

Alpha

This slider sets the material's Alpha channel value. This affects diffuse and specular colors equally, and affects the alpha value of the material in the rendered output. If a diffuse texture map is provided, then the alpha value set here is multiplied by the alpha values in the texture map.

Opacity

Reducing the material's Opacity will decrease the color and alpha values of the specular and diffuse colors equally, making the material transparent.

Specular

The parameters in the Specular section describe the look of the specular highlight of the surface. These values are evaluated in a different way for each illumination model.

Specular Color

Specular Color determines the color of light that reflects from a shiny surface. The more specular a material is, the glossier it appears. Surfaces like plastics and glass tend to have white specular highlights, whereas metallic surfaces like gold have specular highlights that inherit their color from the material color. If a specular texture map is provided, then the value provided here is multiplied by the color values from the texture.

Specular Intensity

Specular Intensity controls how strong the specular highlight is. If the specular intensity texture is provided, then this value is multiplied by the alpha value of the texture.

Specular Exponent

Specular Exponent controls the falloff of the specular highlight. The greater the value, the sharper the falloff, and the smoother and glossier the material appears. If the specular exponent texture is provided, then this value is multiplied by the alpha value of the texture map.

Transmittance

Transmittance controls the way light passes through a material. For example, a solid blue sphere will cast a black shadow, but one made of translucent blue plastic would cast a much lower density blue shadow.

There is a separate Opacity option. Opacity determines how transparent the actual surface is when it is rendered. Fusion allows for adjusting both opacity and transmittance separately. This might be a bit counter-intuitive to those who are unfamiliar with 3D software at first. It is possible to have a surface that is fully opaque but transmits 100% of the light arriving upon it, effectively making it a luminous/emissive surface.

Attenuation

Attenuation determines how much color is passed through the object. For an object to have transmissive shadows, set the attenuation to (1, 1, 1), which means 100% of green, blue, red light pass through the object. Setting this color to RGB (1, 0, 0) means that the material will transmit 100% of the red arriving at the surface but none of the green or blue light. This allows for 'stained glass' shadows.

Alpha Detail

When the Alpha Detail slider is set to 0, the alpha channel of the object is ignored and the entire object casts a shadow. If it is set to 1, the alpha channel determines what portions of the object cast a shadow.

Color Detail

The Color Detail slider modulates light passing through the surface by the diffuse color + texture colors. Use this to throw a shadow that contains color details of the texture applied to the object. Increasing the slider from 0 to 1 brings in more of diffuse color + texture color into the shadow. Note that the alpha and opacity of the object is ignored when transmitting color, allowing an object with a solid alpha to still transmit its color to the shadow.

Saturation

The Saturation slider controls the saturation of the color component transmitted to the shadow. Setting this to 0.0 will result in monochrome shadows.

Receives Lighting/Shadows

These checkboxes control whether the material is affected by lighting and shadows in the scene. If turned off, the object will always be fully lit and/or unshadowed.

Two Sided Lighting

This makes the surface effectively two sided by adding a second set of normals facing the opposite direction on the backside of the surface. This is normally off, to increase rendering speed, but can be turned on for 2D surfaces or for objects that are not fully enclosed, to allow the reverse or interior surfaces to be visible as well.

Normally, in a 3D application only the front face of a surface is visible and the back face is culled, so that if a camera were to revolve around a plane in a 3D application, when it reached the backside, the plane would become invisible. Making a plane two sided in a 3D application is equivalent to adding another plane on top of the first but rotated by 180 degrees so the normals are facing the opposite direction on the backside. Thus, when you revolve around the back, you see the second image plane, which has its normals facing the opposite way.

Fusion does exactly the same thing as 3D applications when you make a surface two sided. The confusion about what two sided does arises because Fusion does not cull backfacing polygons by default. If you revolve around a one-sided plane in Fusion you will still see it from the backside (but you are seeing the frontside duplicated through to the backside as if it were transparent). Making the plane two sided effectively adds a second set of normals to the backside of the plane.

Note: This can become rather confusing once you make the surface transparent, as the same rules still apply and produce a result, which is counter-intuitive. If you view from the frontside a transparent two-sided surface illuminated from the backside, it will look unlit.

Material ID
This slider sets the numeric identifier assigned to this material. This value will be rendered into the MatID auxiliary channel if the according option is enabled in the renderer.

Channel Boolean Material [3BOL]

The Channel Boolean Material can be used to remap and modify channels of 3D materials using mathematical operations. For example, if you want to use the red channel of a material to control an scalar input of an illumination model which uses the alpha channel (e.g., Blinn.SpecularExponent), you can remap the channels here. Furthermore, it allows the use of geometry-specific information like texture space coordinates and normals.

External Inputs

→ ChannelBooleanMaterial.BackgroundMaterial
[orange, optional] This input will accept a 2D image or a 3D material.

→ ChannelBooleanMaterial.ForegroundMaterial
[green, optional] This input will accept a 2D image or a 3D material.

Controls
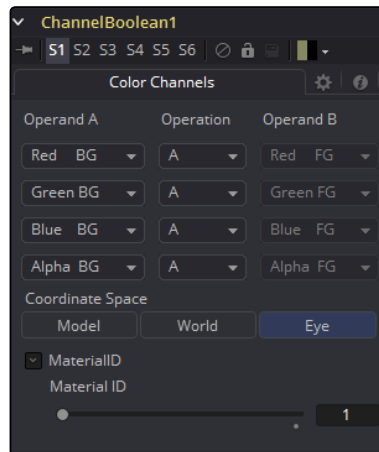
Operand A/B

The Operand menus, one for each output RGBA channel, allow the user to set the desired input information for the according channel.

→ Red/Green/Blue/Alpha FG

Reads the color information of the foreground material.

→ Red/Green/Blue/Alpha BG

Reads the color information of the background material.

→ Black/White/Mid Gray

Sets the value of the channel to 0, 1 or 0.5.

→ Hue/Lightness/Saturation FG

Reads the color information of the foreground material, converts it into the HLS color space and puts the selected information into the according channel.

→ Hue/Lightness/Saturation BG

Reads the color information of the background material, converts it into the HLS color space and puts the selected information into the according channel.

→ Luminance FG

Reads the color information of the foreground material and calculates the luminance value for the channel.

→ Luminance BG

Reads the color information of the background material and calculates the luminance value for the channel.

→ X/Y/Z Position FG

Sets the value of the channel to the position of the pixel in 3D space. The vector information is returned in eye space.

→ **U/V/W Texture FG**
Applies the texture space coordinates of the foreground material to the channels.

→ **U/V/W EnvCoords FG**
Applies the environment texture space coordinates to the channels. Use it upstream of tools modifying the environment texture coordinates like the Reflect 3D tool.

→ **X/Y/Z Normal**
Set the value of the channel to the selected axis of the normal vector. The vector is returned in eye space.

Operation

Determines the Operation of how the operands are combined.

→ **A:** Uses Operand A only for the output channel.

→ **B:** Uses Operand B only for the output channel.

→ **1-A:** Subtracts the value of Operand A from 1.

→ **1-B:** Subtracts the value of Operand B from 1.

→ **A+B:** Adds the value of Operand A and B.

→ **A-B:** Subtracts the value of Operand B from A.

→ **A*B:** Multiplies the value of both Operands.

→ **A/B:** Divides the value of Operand B from A.

→ **min(A,B):** Compares the values of Operands A and B and returns the smaller one.

→ **max(A,B):** Compares the values of Operands A and B and returns the bigger one.

→ **avg(A,B):** Returns the average value of both Operands.

Material ID

This slider sets the numeric identifier assigned to this material. This value will be rendered into the MatID auxiliary channel if the according option is enabled in the renderer.

Cook Torrance [3CT]

The Cook Torrance tool is a basic illumination material that can be applied to geometry in the 3D scene. The diffuse calculation for this tool is similar to that used in the basic material and the Blinn tool, but the specular highlights are evaluated using an optimized Fresnel/Beckmann equation. This illumination model is primarily used for shading metal or other shiny and highly reflective surfaces.

The Cook Torrance tool outputs a 3D Material that can be connected to the material inputs on any 3D geometry tool.

External Inputs

→ CookTorrance.DiffuseTex

[orange, optional] This input will accept a 2D image or a 3D material to be used as a diffuse texture map.

→ CookTorrance.SpecularColorTex

[green, optional] This input will accept a 2D image or a 3D material to be used as a specular color texture map.

→ CookTorrance.SpecularIntensityTex

[magenta, optional] This input will accept a 2D image or a 3D material to be used as an intensity map for the materials specular highlights. When the input is a 2D image, the alpha channel is used to create the map while the color channels are discarded.

→ CookTorrance.SpecularRoughnessTex

[light blue, optional] This input will accept a 2D image or a 3D material to be used as a map for modifying the roughness of the specular highlight. The alpha of the texture map is multiplied by the value of the roughness control.

→ CookTorrance.SpecularRefractiveIndexTex

[white, optional] This input will accept a 2D image or a 3D material to be used as a map for modifying the roughness of the specular refractive index. The alpha of the texture map is multiplied by the value of the refractive index.

→ CookTorrance.BumpmapTex

[white, optional] This input will accept a 2D image or a 3D material, then uses the RGB information as texture-space normals.

Each of these inputs multiplies the pixels in the texture map by the equivalently named parameters in the tool itself. This provides an effective method for scaling parts of the material.

When tools have as many inputs as this one does, it is often difficult to make connections with any precision. Hold the Option (Mac OS X) or Alt (Windows) key down while dragging the output from another tool over the tool tile, and keep holding Option or Alt when releasing the left mouse button. A small menu listing all of the inputs provided by the tool will appear. Click on the desired input to complete the connection.

Controls

Diffuse

Diffuse describes the base surface characteristics without any additional effects like reflections or specular highlights. In addition to defining the base color of an object, the diffuse color also defines the transparency of the object. The alpha in a diffuse texture map can be used to make portions of the surface of any object the material is applied to transparent.

Diffuse Color

A material's Diffuse Color describes the base color presented by the material when it is lit indirectly or by ambient light. If a diffuse texture map is provided, then the color value provided here is multiplied by the color values in the texture.

Alpha

This slider sets the material's Alpha channel value. This affects diffuse and specular colors equally, and affects the alpha value of the material in the rendered output. If a diffuse texture map is provided, then the alpha value set here is multiplied by the alpha values in the texture map.

Opacity

Reducing the material's Opacity will decrease the color and alpha values of the specular and diffuse colors equally, making the material transparent.

Specular

The parameters in the Specular section describe the look of the specular highlight of the surface. These values are evaluated in a different way for each illumination model.

Specular Color

Specular Color determines the color of light that reflects from a shiny surface. The more specular a material is, the glossier it appears. Surfaces like plastics and glass tend to have white specular highlights, whereas metallic surfaces like gold have specular highlights that inherit their color from the material color. If a specular texture map is provided, then the value provided here is multiplied by the color values from the texture.

Specular Intensity

Specular Intensity controls how strong the specular highlight is. If the specular intensity texture is provided, then this value is multiplied by the alpha value of the texture.

Roughness

The Roughness of the specular highlight describes diffusion of the specular highlight over the surface. The greater the value, the wider the falloff, and the more brushed and metallic the surface appears. If the roughness texture map is provided, then this value is multiplied by the alpha value from the texture.

Do Fresnel

Selecting this checkbox will add Fresnel calculations to the materials illumination model. This will provide more realistic looking metal surfaces by taking into account the refractiveness of the material.

Refractive Index

This slider appears when the Do Fresnel checkbox is selected. The Refractive Index applies only to the calculations for the highlight; it does not perform actual refraction of light through transparent surfaces. If the refractive index texture map is provided, then this value is multiplied by the alpha value of the input.

Transmittance

Transmittance controls the way light passes through a material. For example, a solid blue sphere will cast a black shadow, but one made of translucent blue plastic would cast a much lower density blue shadow.

There is a separate Opacity option. Opacity determines how transparent the actual surface is when it is rendered. Fusion allows for adjusting both opacity and transmittance separately. This might be a bit counter-intuitive to those who are unfamiliar with 3D software at first. It is possible to have a surface that is fully opaque but transmits 100% of the light arriving upon it, effectively making it a luminous/emissive surface.

Attenuation

Attenuation determines how much color is passed through the object. For an object to have transmissive shadows, set the attenuation to (1, 1, 1), which means 100% of green, blue, red light pass through the object. Setting this color to RGB (1, 0, 0) means that the material will transmit 100% of the red arriving at the surface but none of the green or blue light. This allows for 'stained glass' shadows.

Alpha Detail

When the Alpha Detail slider is set to 0, the alpha channel of the object is ignored and the entire object casts a shadow. If it is set to 1, the alpha channel determines what portions of the object cast a shadow.

Color Detail

The Color Detail slider modulates light passing through the surface by the diffuse color + texture colors. Use this to throw a shadow that contains color details of the texture applied to the object. Increasing the slider from 0 to 1 brings in more of diffuse color + texture color into the shadow. Note that the alpha and opacity of the object is ignored when transmitting color, allowing an object with a solid alpha to still transmit its color to the shadow.

Saturation

The Saturation slider controls the saturation of the color component transmitted to the shadow. Setting this to 0.0 will result in monochrome shadows.

Receives Lighting/Shadows

These checkboxes control whether the material is affected by lighting and shadows in the scene. If turned off, the object will always be fully lit and/or unshadowed.

Two Sided Lighting

This makes the surface effectively two sided by adding a second set of normals facing the opposite direction on the backside of the surface. This is normally off, to increase rendering speed, but can be turned on for 2D surfaces or for objects that are not fully enclosed, to allow the reverse or interior surfaces to be visible as well.

Normally, in a 3D application only the front face of a surface is visible and the back face is culled, so that if a camera were to revolve around a plane in a 3D application, when it reached the backside, the plane would become invisible. Making a plane two sided in a 3D application is equivalent to adding another plane on top of the first but rotated by 180 degrees so the normals are facing the opposite direction on the backside. Thus, when you revolve around the back, you see the second image plane, which has its normals facing the opposite way.

> Fusion does exactly the same thing as 3D applications when you make a surface two sided. The confusion about what two sided does arises because Fusion does not cull backfacing polygons by default. If you revolve around a one-sided plane in Fusion you will still see it from the backside (but you are seeing the frontside duplicated through to the backside as if it were transparent). Making the plane two sided effectively adds a second set of normals to the backside of the plane.

Note: This can become rather confusing once you make the surface transparent, as the same rules still apply and produce a result that is counter-intuitive. If you view from the frontside a transparent two-sided surface illuminated from the backside, it will look unlit.

Material ID

This slider sets the numeric identifier assigned to this material. This value will be rendered into the MatID auxiliary channel if the according option is enabled in the renderer.

Material Merge 3D [3MM]

The Material Merge tool can be used to combine two separate materials together. This tool can be used to composite Material tools, combining multiple Illumination materials (Blinn, Cook Torrance) with Texture tools (Bumpmap, Reflection) to create complex shader networks.

The tool also provides a mechanism for assigning a new material identifier to the combined material.

External Inputs

→ MtlMerge3D.BackgroundMaterial

[orange, required] This input will accept a 2D image or a 3D material to be used as the background material. A 2D image will be treated as a diffuse texture map in the basic shading model.

→ MtlMerge3D.ForegroundMaterial

[green, optional] This input will accept a 2D image or a 3D material to be used as the foreground material.

A 2D image will be treated as a diffuse texture map in the basic shading model.

Controls
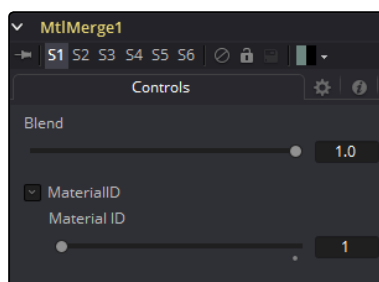
Blend

The Blend behavior of the Material Merge is similar to the Dissolve (DX) tool for images. The two materials/textures are mixed together using the value of the slider to determine the percentage each input contributes. While the background and foreground inputs can be a 2D image rather than a material, the output of this tool will always be a material.

Unlike the 2D Dissolve tool, both foreground and background inputs are required.

MaterialID

This slider sets the numeric identifier assigned to the resulting material. This value will be rendered into the MatID auxiliary channel if the according option is enabled in the renderer.

Phong [3PH]

The Phong tool is a basic illumination material that can be applied to geometry in the 3D scene. It describes how the object will respond to light, and provides a large number of texture map inputs to allow fine control over the diffuse, specular and bumpmap components of the material.

While producing a highlight similar to that produced by the Blinn model, it is more commonly used for shiny/polished plastic surfaces.

External Inputs

→ Phong.DiffuseTex

[orange, optional] This input will accept a 2D image or a 3D material to be used as a diffuse texture map.

→ Phong.SpecularColorTex

[green, optional] This input will accept a 2D image or a 3D material to be used as a specular color texture map.

→ Phong.SpecularIntensityTex

[magenta, optional] This input will accept a 2D image or a 3D material to be used as an intensity map for the material's specular highlights. When the input is a 2D image, the alpha channel is used to create the map while the color channels are discarded.

→ Phong.SpecularExponentTex

[light blue, optional] This input will accept a 2D image or a 3D material to be used as a falloff map for the material's specular highlights. When the input is a 2D image, the alpha channel is used to create the map while the color channels are discarded.
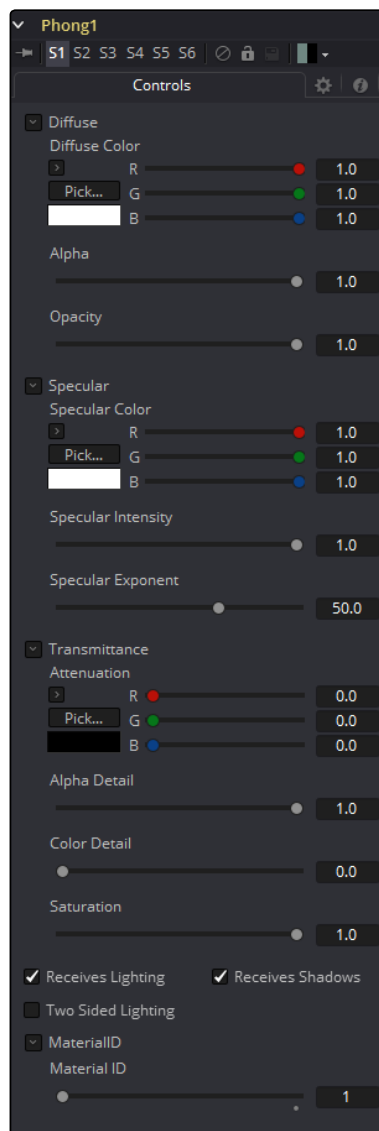
→ Phong.BumpmapTex

[white, optional] This input will accept a 2D image or a 3D material, then uses the RGB information as texture-space normals.

Each of these inputs multiplies the pixels in the texture map by the equivalently named parameters in the tool itself. This provides an effective method for scaling parts of the material.

When tools have as many inputs as this one does it is often difficult to make connections with any precision. Hold the Option or Alt key down while dragging the output from another tool over the tool tile, and keep holding Option or Alt when releasing the left mouse button. A small menu listing all of the inputs provided by the tool will appear. Click on the desired input to complete the connection.

Controls

Diffuse

Diffuse describes the base surface characteristics without any additional effects like reflections or specular highlights. In addition to defining the base color of an object, the diffuse color also defines the transparency of the object.

The alpha in a diffuse texture map can be used to make portions of the surface of any object the material is applied to transparent.

Diffuse Color

A material's Diffuse Color describes the base color presented by the material when it is lit indirectly or by ambient light. If a diffuse texture map is provided, then the color value provided here is multiplied by the color values in the texture.

Alpha

This slider sets the material's Alpha channel value. This affects diffuse and specular colors equally, and affects the alpha value of the material in the rendered output. If a diffuse texture map is provided, then the alpha value set here is multiplied by the alpha values in the texture map.

Opacity

Reducing the material's Opacity will decrease the color and alpha values of the specular and diffuse colors equally, making the material transparent.

Specular

The parameters in the Specular section describe the look of the specular highlight of the surface. These values are evaluated in a different way for each illumination model.

Specular Color

Specular Color determines the color of light that reflects from a shiny surface. The more specular a material is, the glossier it appears. Surfaces like plastics and glass tend to have white specular highlights, whereas metallic surfaces like gold have specular highlights that inherit their color from the material color. If a specular texture map is provided, then the value provided here is multiplied by the color values from the texture.

Specular Intensity

Specular Intensity controls how strong the specular highlight is. If the specular intensity texture is provided, then this value is multiplied by the alpha value of the texture.

Specular Exponent

Specular Exponent controls the falloff of the specular highlight. The greater the value, the sharper the falloff, and the smoother and glossier the material appears. If the specular exponent texture is provided, then this value is multiplied by the alpha value of the texture map.

Transmittance

Transmittance controls the way light passes through a material. For example, a solid blue sphere will cast a black shadow, but one made of translucent blue plastic would cast a much lower density blue shadow.

There is a separate Opacity option. Opacity determines how transparent the actual surface is when it is rendered. Fusion allows for adjusting both opacity and transmittance separately. This might be a bit counter-intuitive to those who are unfamiliar with 3D software at first. It is possible to have a surface that is fully opaque but transmits 100% of the light arriving upon it, effectively making it a luminous/emissive surface.

Attenuation

Attenuation determines how much color is passed through the object. For an object to have transmissive shadows, set the attenuation to (1, 1, 1), which means 100% of green, blue, red light pass through the object. Setting this color to RGB (1, 0, 0) means that the material will transmit 100% of the red arriving at the surface but none of the green or blue light. This allows for 'stained glass' shadows.

Alpha Detail

When the Alpha Detail slider is set to 0, the alpha channel of the object is ignored and the entire object casts a shadow. If it is set to 1, the alpha channel determines what portions of the object cast a shadow.

Color Detail

The Color Detail slider modulates light passing through the surface by the diffuse color + texture colors. Use this to throw a shadow that contains color details of the texture applied to the object. Increasing the slider from 0 to 1 brings in more of diffuse color + texture color into the shadow. Note that the alpha and opacity of the object is ignored when transmitting color, allowing an object with a solid alpha to still transmit its color to the shadow.

Saturation

The Saturation slider controls the saturation of the color component transmitted to the shadow. Setting this to 0.0 will result in monochrome shadows.

Receives Lighting/Shadows

These checkboxes control whether the material is affected by lighting and shadows in the scene. If turned off, the object will always be fully lit and/or unshadowed.

Two Sided Lighting

This makes the surface effectively two sided by adding a second set of normals facing the opposite direction on the backside of the surface. This is normally off, to increase rendering speed, but can be turned on for 2D surfaces or for objects that are not fully enclosed, to allow the reverse or interior surfaces to be visible as well.

Normally, in a 3D application only the front face of a surface is visible and the back face is culled, so that if a camera were to revolve around a plane in a 3D application, when it reached the backside, the plane would become invisible. Making a plane two sided in a 3D application is equivalent to adding another plane on top of the first but rotated by 180 degrees so the normals are facing the opposite direction on the backside. Thus, when you revolve around the back, you see the second image plane, which has its normals facing the opposite way.

Fusion does exactly the same thing as 3D applications when you make a surface two sided. The confusion about what two sided does arises because Fusion does not cull backfacing polygons by default. If you revolve around a one-sided plane in Fusion, you will still see it from the backside (but you are seeing the frontside duplicated through to the backside as if it were transparent). Making the plane two sided effectively adds a second set of normals to the backside of the plane.

Note: This can become rather confusing once you make the surface transparent, as the same rules still apply and produce a result, which is counter-intuitive. If you view from the frontside a transparent two-sided surface illuminated from the backside, it will look unlit.

Material ID

This slider sets the numeric identifier assigned to this material. This value will be rendered into the MatID auxiliary channel if the according option is enabled in the renderer.

Reflect [3RR]

The Reflection tool is used to add environment map reflections and refractions to materials. Control is offered over the face on and glancing strength, falloff, per channel refraction indexes and tinting. Several texture map inputs can modify the behavior of each parameter.

The Reflection tool is usually combined with a standard lighting material such as Blinn, Cook Torrance, Phong or Ward by connecting the output of that tool to the Reflection tool's background material input. Then a reflection texture is connected to the reflection texture input. This can be a 2D image, but is more frequently an environmental map created by the Sphere Map or Cube Map tools.

Environment mapping is an approximation that assumes an object's environment is infinitely distant from the object. It's best to picture this as a cube or sphere with the object at the center. In particular, this infinite distance assumption means that objects cannot interact with themselves (e.g., the reflections on the handle of a teapot will not show the body of the teapot but rather the infinite environment map). It also means that if you use the same cubemap on multiple objects in the scene, those objects will not inter-reflect each other (e.g., two neighboring object would not reflect each other). If you want objects to reflect each other you need to render a cubemap for each.

For more information see Reflections and Refractions in this manual.

External Inputs

→ Reflect.BackgroundMaterial

[orange, optional] This input expects a 2D image or a 3D material. If a 2D image is provided, the tool will treat it as a diffuse texture map applied to a basic material.

→ Reflect.Reflection.ReflectionTex

[green, optional] This input expects a 2D image or a 3D material. The RGB channels are used as the reflection texture, and the alpha is ignored.

→ Reflect.Reflection.ReflectionIntensityTex

[magenta, optional] This input expects a 2D image or a 3D material. The alpha channel of the texture is multiplied by the intensity of the reflection.
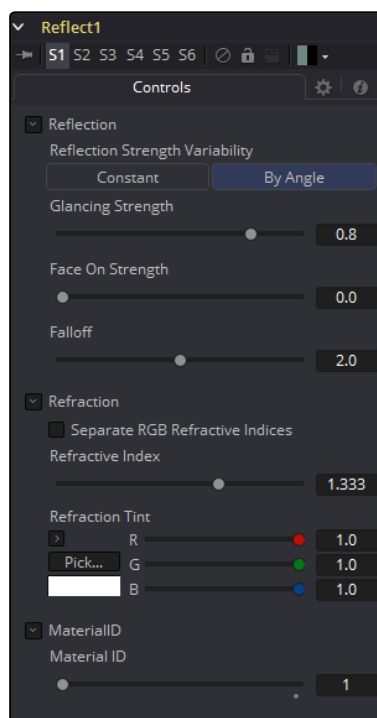
→ Reflect.Refraction.RefractionTex

[light blue, optional] This input expects a 2D image or a 3D material. The RGB channels are used as the refraction texture.

→ Reflect.BumpmapTex

[white, optional] This input will accept a 2D image or a 3D material, then uses the RGB information as texture-space normals.

Controls

Reflection

Reflection Strength Variability

This multi-button control can be set to Constant or By Angle for varying the reflection intensity, according to the relative surface orientation to the viewer. The following three controls are only visible when this control is set to By Angle.

Glancing Strength

[By Angle] Glancing Strength controls the intensity of the reflection for those areas of the geometry where the reflection faces away from the camera.

Face On Strength

[By Angle] Face On Strength controls the intensity of the reflection for those parts of the geometry that reflect directly back to the camera.

Falloff

[By Angle] Falloff controls the sharpness of the transition between the Glancing and Face On Strength regions. It can be considered to be analogous to applying gamma correction to a gradient between the Face On and Glancing values.

Constant Strength

[Constant Angle] This control is only visible when the reflection strength variability is set to Constant. In this case, the intensity of the reflection is constant regardless of the incidence angle of the reflection.

Refraction

If the incoming background material has a lower opacity than 1, then it is possible to use an environment map as refraction texture, and it is possible to simulate refraction effects in transparent objects.

Separate RGB Refraction Indices

When this checkbox is enabled, the Refraction Index slider will be hidden and three sliders for adjusting the refraction index of the Red, Green and Blue channels will appear in its place. This allows for simulation of the spectral refraction effects commonly seen in thick imperfect glass, for example.

Refraction Index

This slider controls how strongly the environment map will be deformed when viewed through a surface. The overall deformation is based on the incidence angle. Since this is an approximation and not a simulation, the results are not intended to model real refractions accurately.

Refraction Tint

The refraction texture is multiplied by the tint color for simulating color-filtered refractions. It can be used to simulate the type of coloring found in tinted glass, as seen in many brands of beer bottles, for example.

Stereo Mix [3SMM]

External Inputs


→ StereoMix.LeftMaterial

[orange, required] This input will accept a 2D image or a 3D material to be used as the material for the left eye rendering. If a 2D image is used, it will be converted to a diffuse texture map using the basic material type.

→ StereoMix.RightMaterial

[green, required] This input will accept a 2D image or a 3D material to be used as the material for the right eye rendering. If a 2D image is used, it will be converted to a diffuse texture map using the basic material type.

While the inputs can be either 2D images or 3D materials, the output will always be a material.

Controls
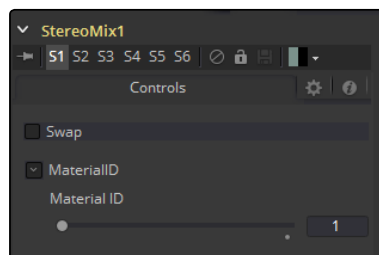
Swap
This option will swap both inputs of the tool.

Material ID
This slider sets the numeric identifier assigned to this material. This value will be rendered into the MatID auxiliary channel if the according option is enabled in the renderer.

Ward [3WD]

The Ward tool is a basic illumination material that can be applied to geometry in the 3D scene. It describes how the object will respond to light, and provides a large number of texture map inputs to allow fine control over the diffuse, specular and bumpmap components of the material.

In particular, the Ward tool is ideal for simulating brushed metal surfaces, as the highlight can be elongated in along the U or V directions of the mapping co-ordinates. This is known as an Anisotrophic highlight.

The Ward tool outputs a 3D Material that can be connected to the material inputs on any 3D geometry tool.
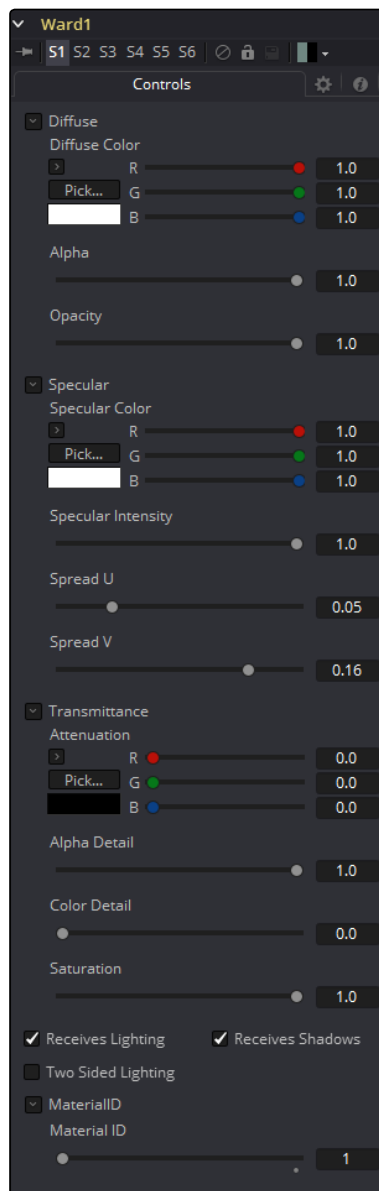
External Inputs

→ Ward.DiffuseTexture

[orange, optional] This input will accept a 2D image or a 3D material to be used as a specular color texture map.

→ Ward.SpecularColorTexture

[green, optional] This input will accept a 2D image or a 3D material to be used as a specular color texture map.

→ Ward.SpecularIntensityTexture

[magenta, optional] This input will accept a 2D image or a 3D material to be used as an intensity map for the material's specular highlights. When the input is a 2D image, the alpha channel is used to create the map while the color channels are discarded.

→ Ward.SpreadUTexture

[light blue, optional] This input will accept a 2D image or a 3D material. The value of the Spread U option in the tool's controls will be multiplied against the pixel values in the material's alpha channel.

→ Ward.SpreadVTexture

[white, optional] This input will accept a 2D image or a 3D material. The value of the Spread V option in the tool's controls will be multiplied against the pixel values in the material's alpha channel.

→ Ward.BumpmapTexture

[white, optional]This input will accept a 2D image or a 3D material, then uses the RGB information as texture-space normals.

Each of these inputs multiplies the pixels in the texture map by the equivalently named parameters in the tool itself. This provides an effective method for scaling parts of the material.

When tools have as many inputs as this one does it is often difficult to make connections with any precision. Hold the Option or Alt key down while dragging the output from another tool over the tool tile, and keep holding Option or Alt when releasing the left mouse button. A small menu listing all of the inputs provided by the tool will appear. Click on the desired input to complete the connection.

Controls

Diffuse

Diffuse describes the base surface characteristics without any additional effects like reflections or specular highlights. In addition to defining the base color of an object, the diffuse color also defines the transparency of the object. The alpha in a diffuse texture map can be used to make portions of the surface of any object the material is applied to transparent.

Diffuse Color

A material's Diffuse Color describes the base color presented by the material when it is lit indirectly or by ambient light. If a diffuse texture map is provided, then the color value provided here is multiplied by the color values in the texture.

Alpha

This slider sets the material's Alpha channel value. This affects diffuse and specular colors equally, and affects the alpha value of the material in the rendered output. If a diffuse texture map is provided, then the alpha value set here is multiplied by the alpha values in the texture map.

Opacity

Reducing the material's Opacity will decrease the color and alpha values of the specular and diffuse colors equally, making the material transparent.

Specular

The parameters in the Specular section describe the look of the specular highlight of the surface. These values are evaluated in a different way for each illumination model.

Specular Color

Specular Color determines the color of light that reflects from a shiny surface. The more specular a material is, the glossier it appears. Surfaces like plastics and glass tend to have white specular highlights, whereas metallic surfaces like gold have specular highlights that inherit their color from the material color. If a specular texture map is provided, then the value provided here is multiplied by the color values from the texture.

Specular Intensity

Specular Intensity controls how strong the specular highlight is. If the specular intensity texture is provided, then this value is multiplied by the alpha value of the texture.

Spread U

Spread U controls the falloff of the specular highlight along the U-axis in the UV-Map of the object. The smaller the value, the sharper the falloff, and the smoother and glossier the material appears in this direction. If the Spread U texture is provided, then this value is multiplied by the alpha value of the texture.

Spread V

Spread V controls the falloff of the specular highlight along the V-axis in the UV-Map of the object. The smaller the value, the sharper the falloff, and the smoother and glossier the material appears in this direction. If the Spread V texture is provided, then this value is multiplied by the alpha value of the texture.

Transmittance

Transmittance controls the way light passes through a material. For example, a solid blue sphere will cast a black shadow, but one made of translucent blue plastic would cast a much lower density blue shadow.

There is a separate Opacity option. Opacity determines how transparent the actual surface is when it is rendered. Fusion allows for adjusting both opacity and transmittance separately. This might be a bit counter-intuitive to those who are unfamiliar with 3D software at first. It is possible to have a surface that is fully opaque but transmits 100% of the light arriving upon it, effectively making it a luminous/emissive surface.

Attenuation

Attenuation determines how much color is passed through the object. For an object to have transmissive shadows, set the attenuation to (1, 1, 1), which means 100% of green, blue, red light pass through the object. Setting this color to RGB (1, 0, 0) means that the material will transmit 100% of the red arriving at the surface but none of the green or blue light. This allows for 'stained glass' shadows.

Alpha Detail

When the Alpha Detail slider is set to 0, the alpha channel of the object is ignored and the entire object casts a shadow. If it is set to 1, the alpha channel determines what portions of the object cast a shadow.

Color Detail

The Color Detail slider modulates light passing through the surface by the diffuse color + texture colors. Use this to throw a shadow that contains color details of the texture applied to the object. Increasing the slider from 0 to 1 brings in more of diffuse color + texture color into the shadow. Note that the alpha and opacity of the object is ignored when transmitting color, allowing an object with a solid alpha to still transmit its color to the shadow.

Saturation

The Saturation slider controls the saturation of the color component transmitted to the shadow. Setting this to 0.0 will result in monochrome shadows.

Receives Lighting/Shadows

These checkboxes control whether the material is affected by lighting and shadows in the scene. If turned off, the object will always be fully lit and/or unshadowed.

Two Sided Lighting

This makes the surface effectively two sided by adding a second set of normals facing the opposite direction on the backside of the surface. This is normally off, to increase rendering speed, but can be turned on for 2D surfaces or for objects that are not fully enclosed, to allow the reverse or interior surfaces to be visible as well.

Normally, in a 3D application only the front face of a surface is visible and the back face is culled, so that if a camera were to revolve around a plane in a 3D application, when it reached the backside, the plane would become invisible. Making a plane two sided in a 3D application is equivalent to adding another plane on top of the first but rotated by 180 degrees so the normals are facing the opposite direction on the backside. Thus, when you revolve around the back, you see the second image plane, which has its normals facing the opposite way.

Fusion does exactly the same thing as 3D applications when you make a surface two sided. The confusion about what two sided does arises because Fusion does not cull backfacing polygons by default. If you revolve around a one-sided plane in Fusion you will still see it from the backside (but you are seeing the frontside duplicated through to the backside as if it were transparent). Making the plane two sided effectively adds a second set of normals to the backside of the plane.

Note: This can become rather confusing once you make the surface transparent, as the same rules still apply and produce a result that is counter-intuitive. If you view from the frontside a transparent two-sided surface illuminated from the backside, it will look unlit.

Material ID

This slider sets the numeric identifier assigned to this material. This value will be rendered into the MatID auxiliary channel if the according option is enabled in the renderer.
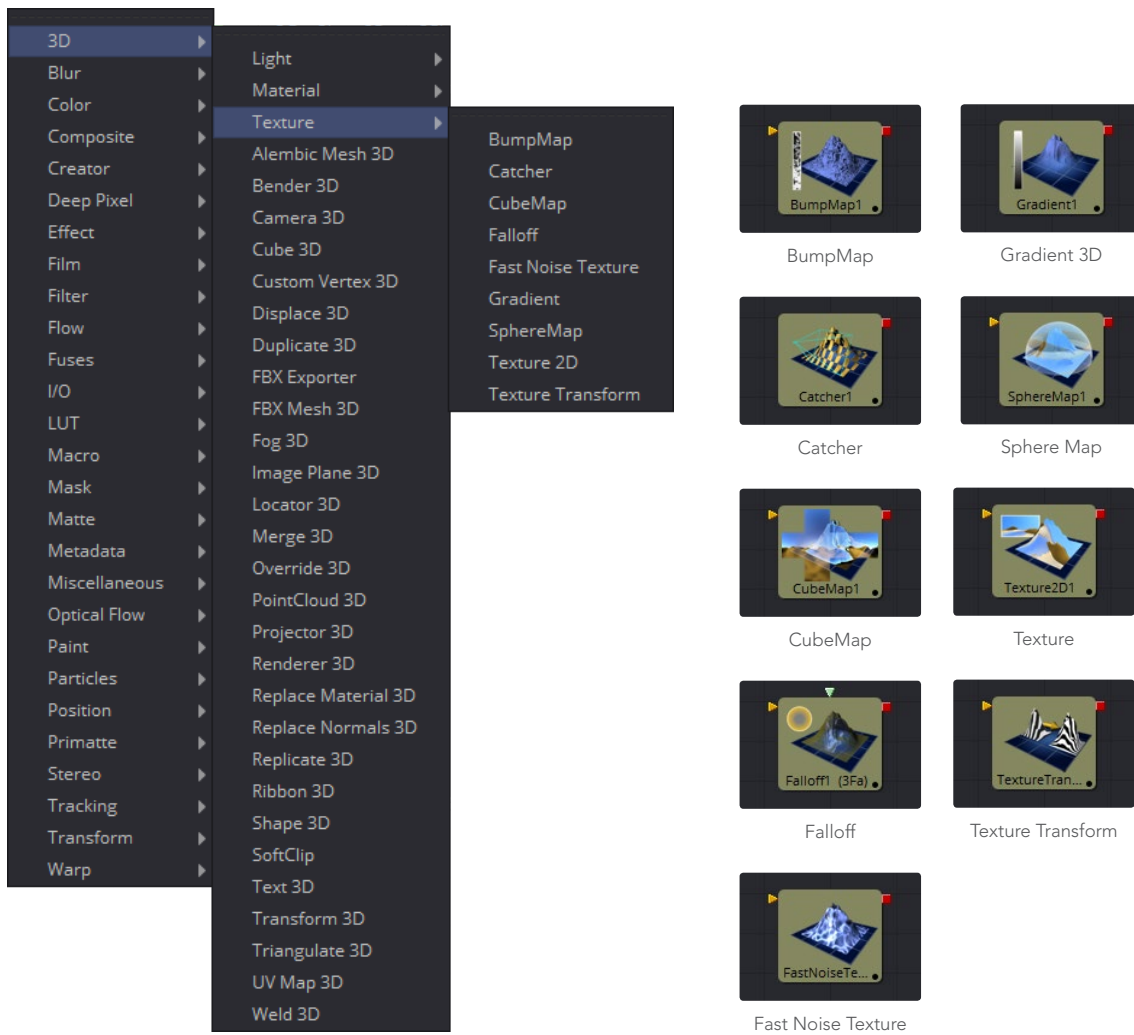
3D Texture Tools

4

3D Texture Tools

3D Texture Tools

3D ▶	Light ▶	BumpMap
Blur ▶	Material ▶	Catcher
Color ▶	Texture ▶	CubeMap
Composite ▶	Alembic Mesh 3D	Falloff
Creator ▶	Bender 3D	Fast Noise Texture
Deep Pixel ▶	Camera 3D	Gradient
Effect ▶	Cube 3D	SphereMap
Film ▶	Custom Vertex 3D	Texture 2D
Filter ▶	Displace 3D	Texture Transform
Flow ▶	Duplicate 3D	
Fuses ▶	FBX Exporter	
I/O ▶	FBX Mesh 3D	
LUT ▶	Fog 3D	
Macro ▶	Image Plane 3D	
Mask ▶	Locator 3D	
Matte ▶	Merge 3D	
Metadata ▶	Override 3D	
Miscellaneous ▶	PointCloud 3D	
Optical Flow ▶	Projector 3D	
Paint ▶	Renderer 3D	
Particles ▶	Replace Material 3D	
Position ▶	Replace Normals 3D	
Primatte ▶	Replicate 3D	
Stereo ▶	Ribbon 3D	
Tracking ▶	Shape 3D	
Transform ▶	SoftClip	
Warp ▶	Text 3D	
	Transform 3D	
	Triangulate 3D	
	UV Map 3D	
	Weld 3D	

BumpMap

Gradient 3D

Catcher

Sphere Map

CubeMap

Texture

Falloff

Texture Transform

Fast Noise Texture

BumpMap [3Bᵤ]

The Bumpmap tool either converts a grayscale (heightmap) image into a bump map or takes a bumpmap created by the Create Bumpmap tool directly. The tool outputs a material.

External Inputs
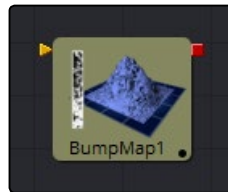
→ Bumpmap.ImageInput (white)

Receives the RGBA channels from an image for the bump calculation or an existing Bumpmap.

Controls

This tab contains all parameters for the tool.
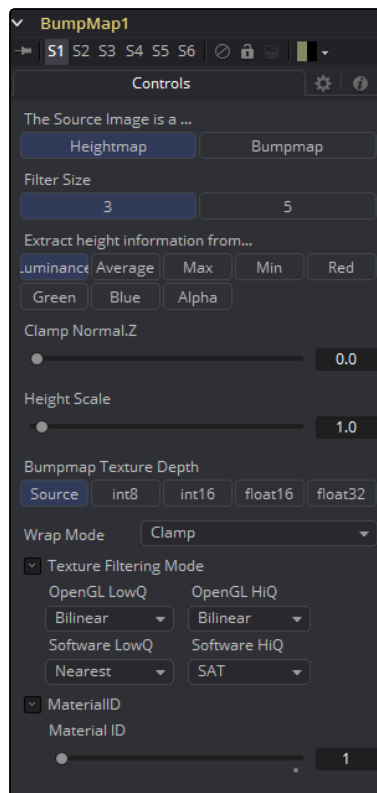
The Source Image is a...

Toggle between Heightmap, which will create a bumpmap similar to the CreateBumpmap tool, and BumpMap, which expects a bumpmap created by the CreateBumpmap tool.

Filter Size

The process of generating the bump information is basically a Custom Filter. This multi-button control sets the filter size.

Extract height information from...

Set the channel from where to extract the grayscale information.

Clamp Normal.Z

Clips the lower values of the Blue channel in the resulting bump texture.

Filter Wrap Mode

Basically "wraps" the image at the borders, so the filter produces correct result when using seamless tileable textures.

Height Scale

Changes the contrast of the resulting values in the bump map. Increasing this value yields in a more visible bump map.

Bumpmap Texture Depth

Optionally converts the resulting bump texture into the desired bit depth.

Notes on Bumpmaps

There is some confusion of terminology with bumpmapping, depending on which papers/books/people you are reading/talking to. Here are Fusion conventions:

Heightmap
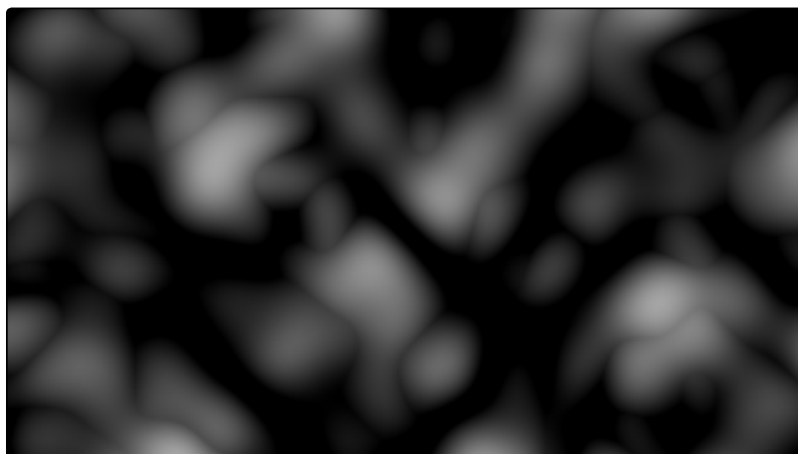
A grayscale image containing a height value per pixel
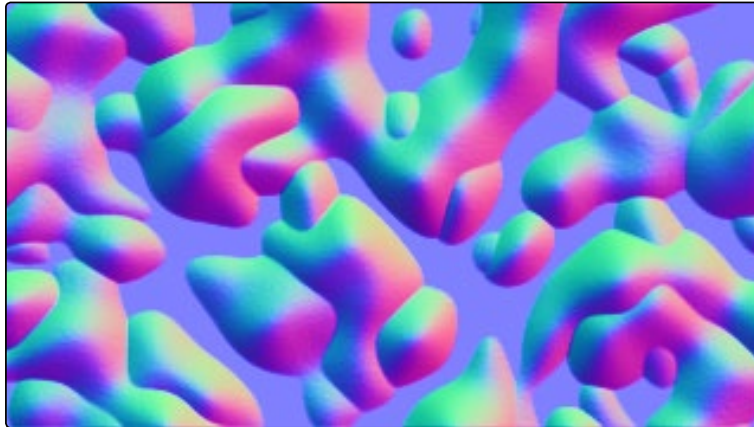
Bumpmap

An image containing normals stored in the RGB channels used for
modifying the existing normals (usually given in tangent space)

Normalmap

An image containing normals stored in the RGB channels used for
replacing the existing normals (usually given in tangent or object space)
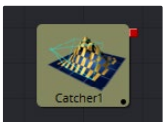
Catcher [3C$_A$]

The Catcher material is used to "catch" texture-mode projections cast from Projector 3D and Camera 3D tools. The intercepted projections are converted into a texture map and applied by the Catcher material to the geometry to which it is connected.

To understand the purpose of the Catcher tool it helps to understand the difference between light-based projections and texture-based projections. A light-based projection simply adds the values of the RGB channels in the projected image to the diffuse texture of any geometry that lies within the projection cone. This makes it impossible to clip away geometry based on the alpha channel of an image when using light mode projections.

Imagine a scenario where you want to project an image of a building onto an image plane as part of a set extension shot. You first rotoscope the image to matte out the windows. This will make it possible to see the geometry of the rooms behind the wall in the final composite. When this image is projected as light, the alpha channel is ignored, so the matted windows remain opaque.

By connecting the Catcher to the diffuse texture map of the material applied to the image plane, and then switching the projection from Light or Ambient Light mode to Texture mode, Fusion knows to apply the projected image as a texture map. When using this technique, the windows would become transparent, and it would be possible to see the geometry behind the window.

The main advantages of this approach over light projection are that the Catcher can be used to project alpha onto an object, and it doesn't require lighting to be enabled. Another advantage is that the Catcher is not restricted to the diffuse input of a material, making it possible to project specular intensity maps, or even reflection and refraction maps.

Note: The Catcher material requires a Projector 3D or Camera 3D tool in the scene, set to project an image in Texture mode on the object to which the Catcher is connected. Without a projection, or if the projection is not set to Texture mode, the Catcher will simply make the object transparent and invisible.

External Inputs
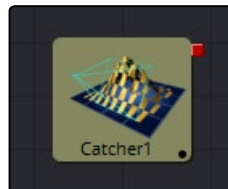
This material tool does not have any external inputs.

Controls
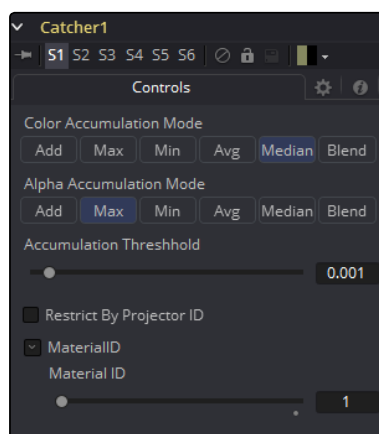
Enable

Use this checkbox to enable or disable the tool.

Color Accumulation Mode

The Color Accumulation mode is used to control how the Catcher will combine the light from multiple projectors. It will have no affect on the results when only one projector is in the scene. This control is designed to work with the Software renderer, and will have no affect when using the OpenGL renderer.

Alpha Accumulation Mode

The Alpha Accumulation mode is used to control how the Catcher will combine the Alpha channels from multiple projectors. It will have no affect on the results when only one projector is in the scene. This control is designed to work with the Software renderer, and will have no affect when using the OpenGL renderer.

Accumulation Threshold

The Accumulation Threshold can be used to exclude certain low values from the accumulation calculation. For example, when using the Median Accumulation mode, a threshold of 0.01 would exclude any pixel with a value of less than 0.01 from the median calculation.

Restrict by Projector ID

When active, the Catcher will only receive light from Projectors with a matching ID. Projectors with a different ID will be ignored.

Material ID

This slider sets the numeric identifier assigned to this material. This value will be rendered into the MatID auxiliary channel if the according option is enabled in the renderer.
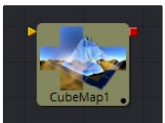
CubeMap [3Cᴜ]

The CubeMap tool creates texture maps using separate images for each face of the cube. It can also extract the individual faces of the cube from a single image containing an unfolded cube in the Vertical or Horizontal Cross layouts.

A cube map is produced by mounting 6 cameras at 90 degrees angle of views to point up, down, left, right, front, and back.

The tool provides options to set the reference coordinate system and rotation for the resulting texture map. The CubeMap tool is typically used to produce environment maps for distant areas (such as skies or horizons) or reflection and refraction maps.
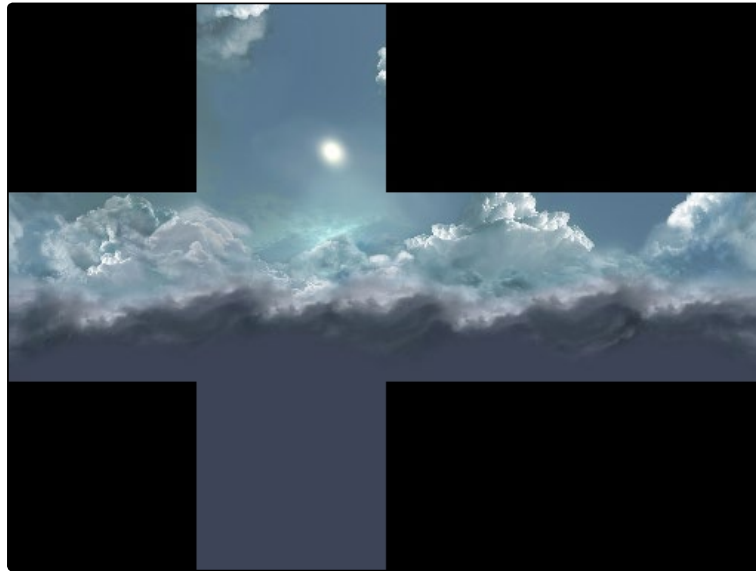
External Inputs

→ CubeMap.CrossImage

[white, required] This input is only visible when the tool is set to the Vertical Cross or Horizontal Cross orientation. It expects a 2D image.

→ CubeMap.[DIRECTION]

[white, required] These six inputs are only visible when the tool is set to the Separate Images orientation mode. Each input expects an image aligned to match the left, right, up, down, front and back faces.

Controls
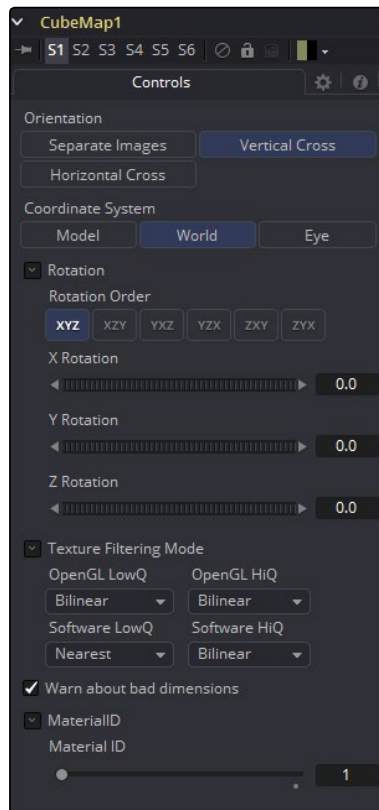
Orientation

This multi-button control tells the tool which type of input to expect for the cubemap texture. Valid options are:

→ Separate Images: This option exposes six inputs on the tool tile, one for each face of the cube. If the separate images are not square or not of the same size, they will be rescaled into the largest 1:1 image that can contain all of them.

→ Vertical Cross: This option exposes a single input on the tool tile. The image should be an unwrapped texture of a cube containing all the faces organized into a Vertical Cross formation, where the height is larger than the width. If the image aspect of the cross image is not 3:4, the Cubemap tool will crop it down so that matches the appropriate aspect ratio.

→ Horizontal Cross: This option exposes a single input on the tool tile. The image should be an unwrapped texture of a cube containing all the faces organized into a Horizontal Cross formation, where the width is larger than the height. If the image aspect of the cross image is not 4:3, the Cubemap tool will crop it down so that matches the appropriate aspect ratio.

Coordinate System

This multi-button control sets the coordinate system used when converting the image into a texture.

→ Model: This option orients the texture along the object local coordinate system.

→ World: This option orients the resulting texture using the global or world coordinate system.

→ Eye: This option aligns the texture map to the coordinate system of the camera or viewer.

Warn about bad dimensions

Selecting this checkbox will print a warning message into the console if the dimensions of the image provided do not meet the requirements of the selected orientation mode.

Material ID

This slider sets the numeric identifier assigned to this material. This value will be rendered into the MatID auxiliary channel if the according option is enabled in the renderer.

Falloff [3FA]

The Falloff tool blends two materials together based on the incidence angle between the object the material is applied to and the camera. This is useful when you wish to use one material for portions of the geometry that would reflect light directly back to the camera and a different material for parts that reflect light back into the scene.
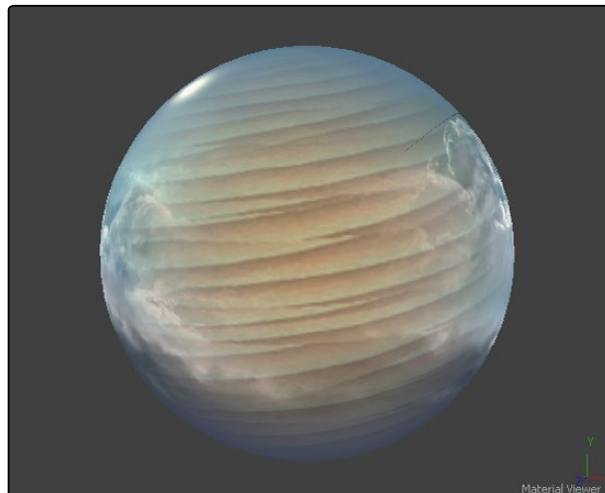
External Inputs

→ Falloff.FaceOnMaterial

[orange, optional] This input expects a 2D image or a 3D material. If a 2D image is provided, it will be turned into a diffuse texture map using the basic material shader.

→ Falloff.GlancingMaterial

[green, optional] This input expects a 2D image or a 3D material. If a 2D image is provided, it will be turned into a diffuse texture map using the basic material shader.

While the inputs for this tool can be images, the output will always be a material.
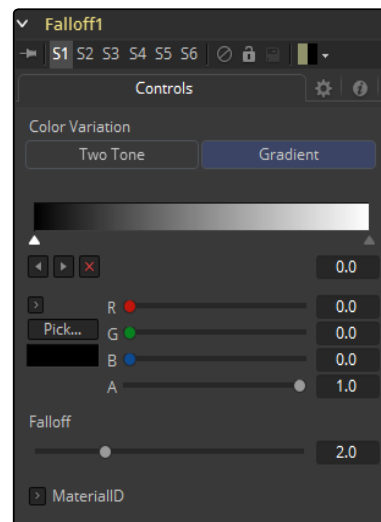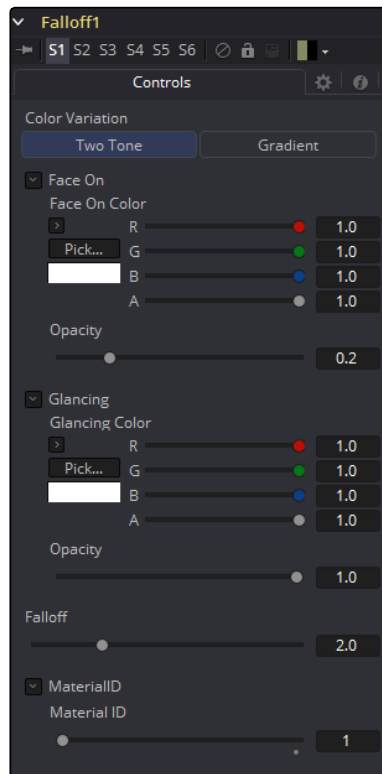
Controls

Color Variation

Two Tone
Two regular Color controls define the colors for Glancing and Face On.

Gradient
A Gradient control defines the colors for Glancing and Face On. This can be used for a multitude of effects, like creating Toon Shaders, for example.

Face On Color

Face On Color
The Face On Color defines the color of surface parts facing the camera. If the Face On texture map is provided, then the color value provided here is multiplied by the color values in the texture.

Face On Opacity
Reducing the material's Opacity will decrease the color and alpha values of the Face On material, making the material transparent.

Glancing Color

Glancing Color
The Glancing Color defines the color of surface parts more perpendicular to the camera. If the Glancing material port has a valid input, then this input is multiplied by this color.

Glancing Opacity
Reducing the material's Opacity will decrease the color and alpha values of the Glancing material, making the material transparent.

Falloff
This value controls the transition between Glancing and Face On strength. It is very similar to a gamma operation applied to a gradient blending one value into another.
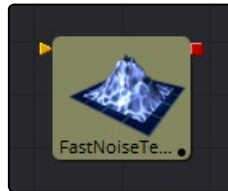
Material ID
This slider sets the numeric identifier assigned to this material. This value will be rendered into the MatID auxiliary channel if the according option is enabled in the renderer.
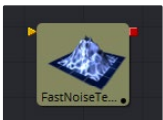
Fast Noise Texture [3FN]

The Fast Noise Texture tool is the procedural resolution-independent version of the 2D Fast Noise tool. It creates a noise texture directly as a material for usage with 3D tools. It offers a 3D volumetric mode for creating seamless textures in conjunction with tools providing UVW texture coordinates (like the UV Map tool set to XYZtoUVW or Camera).
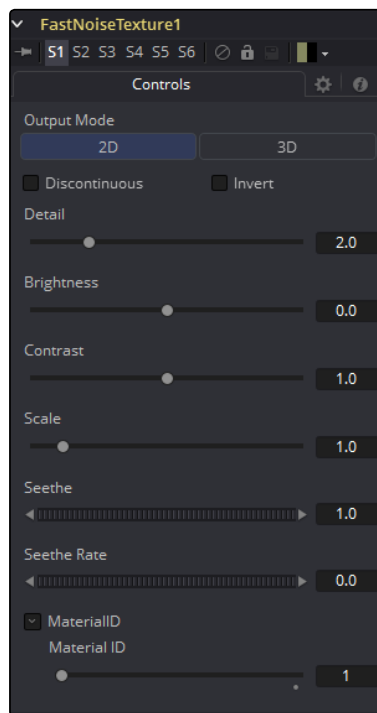
External Inputs

→ **FastNoiseTexture.SourceMaterial**
[orange, required] This input will accept a 2D image or a 3D material. This is modulated by the noise pattern.

Controls

Output Mode
→ **2D:** Calculates the noise texture based on 2D texture coordinates (UV). This mode allows smoothly varying the noise pattern.

→ **3D:** Calculates the noise texture based on 3D texture coordinates (UVW). Tools like Shape 3D automatically provide a third texture coordinate, otherwise a 3D texture space can be created using the UV Map tool. Does not support animation of the noise pattern.

Discontinuous
Normally, the noise function interpolates between values to create a smooth continuous gradient of results. Enable this checkbox to create hard discontinuity lines along some of the noise contours. The result will be a dramatically different effect.

Invert

Select this checkbox to Invert the noise, creating a negative image of the original pattern. This is most effective when Discontinuous is also enabled.

Detail

Increase the value of this slider to produce a greater level of detail in the noise result. Larger values add more layers of increasingly detailed noise without affecting the overall pattern. High values take longer to render but can produce a more natural result (not all graphics cards support higher detail levels in hardware).

Brightness

This control adjusts the overall Brightness of the noise map.

Contrast

This control increases or decreases the overall Contrast of the noise map. It can exaggerate the effect of the noise.

Scale

The feature scale of the noise map can be adjusted using the Scale slider, changing it from gentle variations over the whole image to a tighter overall texture effect. This value represents the scale along the UV axis.

Scale Z

(3D only) The Scale Z value scales the noise texture along the W-axis in texture space.

Seethe

(2D only) The Seethe control smoothly varies the 2D noise pattern.

Seethe Rate

(2D only) As with the Seethe control above, the Seethe Rate also causes the noise map to evolve and change. The Seethe Rate defines the rate at which the noise changes each frame, causing an animated drift in the noise automatically, without the need for spline animation.

Material ID

This slider sets the numeric identifier assigned to this material. This value will be rendered into the MatID auxiliary channel if the according option is enabled in the renderer.
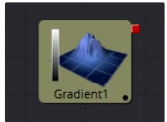
Gradient 3D [3Gᴅ]

With the Gradient 3D tool it is possible to texture objects with a variety of gradient types. It offers many of the controls of the Background tool. While it is not possible to transform the gradient directly in 3D space, it is orientable using the following tools:
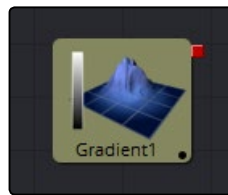
Texture Transform tool

The Texture Transform tool can be used to adjust the mapping per pixel.

UVMap tool

The UV Map tool can be used to adjust the mapping per vertex (use the XYZtoUVW mode). This has onscreen controls, so you can see what the gradient is doing. Using this tool is recommended because it is faster to evaluate.

Working with the Gradient tool may be a bit confusing at first. The gradient defaults to a linear gradient that goes from -1 to +1 along the Z-axis. All primitives in Fusion (Shape 3D) can output a third texture coordinate for UVW mapping.

Controls

Gradient Type

Determines the type of or pattern used for the gradient.

> → Linear: A simple linear gradient.

> → Reflect: Based on the Linear mode, this gradient will be mirrored at the middle of the textured range.

> → Square: The gradient is applied using a square pattern.

> → Cross: Similar to the Reflect mode, but it will use two axes to apply the gradient.

> → Radial: The Radial mode uses a circular pattern to apply the gradient.
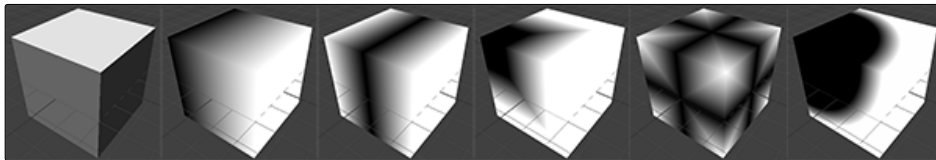
Gradient

The Gradient control consists of a bar where it is possible to add, modify and remove points of the gradient. Each point has its own color. It is possible to animate the color as well as the position of the point. Furthermore, a From Image modifier can be applied to the gradient to evaluate it from an image.

Gradient Interpolation Method

The gradient is linear interpolated from point to point in RGB color space by default. This can result in unwanted colors sometimes. Choosing another color space may provide a better result.

Offset

Allows panning through the gradient.

Repeat

Defines how the left and right border of the gradient is treated.

Gradients set to Once, Repeat and Ping Pong from top to
bottom respectively and shifting the gradient to the left.

> → Once: When using the Gradient Offset control to shift the gradient, the border colors will keep their values. Shifting the default gradient to the left will result in a white border on the left, shifting it to the right will result in a black border on the right.

→ Repeat: When using the Gradient Offset control to shift the gradient, the border colors will be wrapped around. Shifting the default gradient to the left will result in a sharp jump from white to black, shifting it to the right will result in a sharp jump from black to white.

→ Ping Pong: When using the Gradient Offset control to shift the gradient, the border colors ping pong back and forth. Shifting the default gradient to the left will result in the edge fading from white back to black, shifting it to the right will result in the edge fading from black back to white.

Sub Pixel

Determines the accuracy with which the gradient is created.

Material ID

This slider sets the numeric identifier assigned to this material. This value will be rendered into the MatID auxiliary channel if the according option is enabled in the renderer.
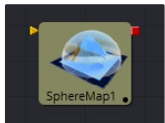
Sphere Map [3SPM]

The Sphere Map tool allows the creation of a spherical texture map from an image. The input image should represent the texture information in a longitude/latitude format, where the X-axis represents 0-360 degrees longitude and the Y-axis represents -90 to +90 degrees latitude.

External Inputs

→ SphereMap.ImageImage
  [white, required] Receives the RGBA channels from an image output

Controls
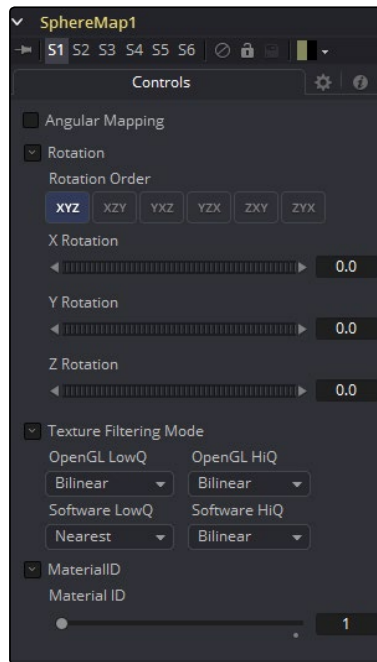
Angular Mapping

Adjusts the texture coordinate mapping so the poles are less squashed and areas in the texture get mapped to equal areas on the sphere. In other words, it turns the mapping of the latitude lines from a hemispherical fisheye to an angular fisheye. This mapping attempts to preserve area and makes it easier to paint on or modify a sphere map since the image is not as compressed at the poles.

Rotation

Offers controls to rotate the texture map.

Material ID

This slider sets the numeric identifier assigned to this material. This value will be rendered into the MatID auxiliary channel if the according option is enabled in the renderer.

The tool expects an image with an aspect ratio of 2:1. Otherwise, the image is clamped according to the following rules:
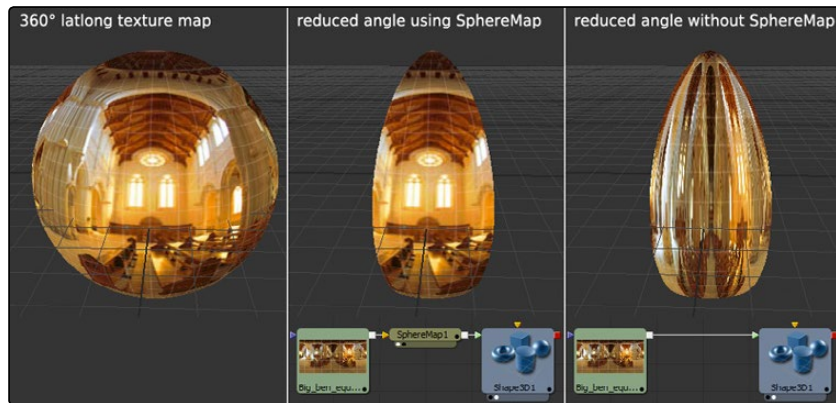
→ 2 * width > height

The width is fit onto the sphere and the poles will display clamped edges.

→ 2 * width < height

The height is fit onto the sphere and there will be clamping about the 0 degree longitude line.

Sphere Map vs. Connecting the Texture to a Sphere Directly

You can connect a latlong (equirectangular) texture map directly to a sphere instead of piping it through the Sphere Map tool first. This results in a different rendering if you set the start/end angle and latitude to less than 360°/180°. In the first case, the texture will be squashed. When using the Sphere Map tool, the texture will be cropped. Compare:

Note: If you pipe the texture directly into the sphere, it will also be mirrored horizontally. You can "fix" this by using a Transform tool first.
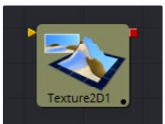

Texture [TXR]

The Texture tool can control the texture mapping of elements in a rendered image. The Texture-map image (connected to the green input) can be wrapped around objects to replace the current texture. The Texture tool relies on the presence of U and V Map channels in 3D rendered images. If these channels are not present, this tool has no effect.

Note: Background pixels may have U and V values of 0.0, which will set those pixels to the color of the texture's corner pixel. To restrict texturing to specific objects, use an effect mask based on the alpha of the object, or its Object or Material ID channel.
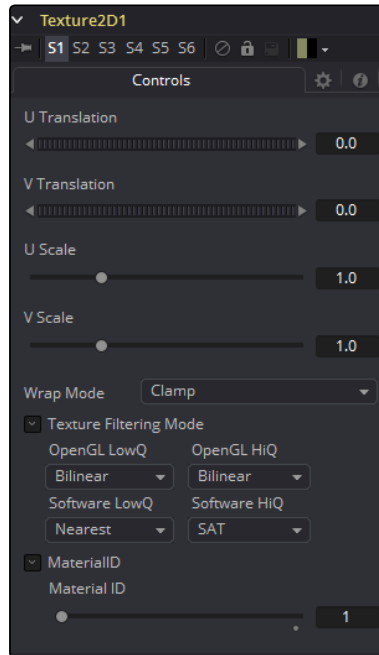
For more information, see the Auxiliary Channels chapter.

External Inputs
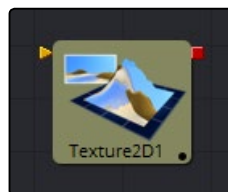
→ CreateTexture.ImageInput
[orange, required] This input expects a 2D image.

Controls

Wrap Mode

If a texture is transformed in the texture space (using the controls below or the UV Map tool), then it's possible that areas beyond the image borders are mapped on the object. The Wrap Mode determines how the image is applied in these areas.

→ Wrap: This wraps the edges of the image around the borders of the image.

→ Clamp: The color at the edges of the images is used for texturing. This mode is similar to the Duplicate mode in the Transform tool.

→ Black: The image is clipped along its edges. A black color with alpha=0 is used instead.

→ Mirror: The image is mirrored in both X and Y.

U/V Offset

These sliders can be used to offset the texture along the U and V coordinates.

U/V Scale

These sliders can be used to scale the texture along the U and V coordinates.

Texture Transform [3TX]

The TextureTransform tool can be used to translate, rotate and scale image textures on the input material. While the input can also be an image, the output will always be a material.

External Inputs
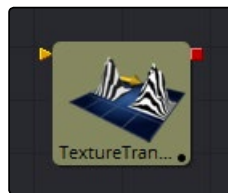
→ TextureTransform.MaterialInput

   [orange, optional] This input expects a 2D image or 3D material.

Controls

Note: Not all Wrap modes will be supported by all graphics cards.

Translation

U, V, W Translation
These sliders will shift the texture along U, V, and W axes.

Rotation

Rotation Order
Use these buttons to set the order in which the rotation is applied.

U, V, W Rotation
In conjunction with the Rotation Order, these settings define the rotation around the UVW axis.

Scale

U, V, W Scale
Scales the texture along the according UVW axis.

Pivot

U, V, W Pivot
Sets the reference point for rotation and scaling.

Material ID
This slider sets the numeric identifier assigned to this material. This value will be rendered into the MatID auxiliary channel if the according option is enabled in the renderer.
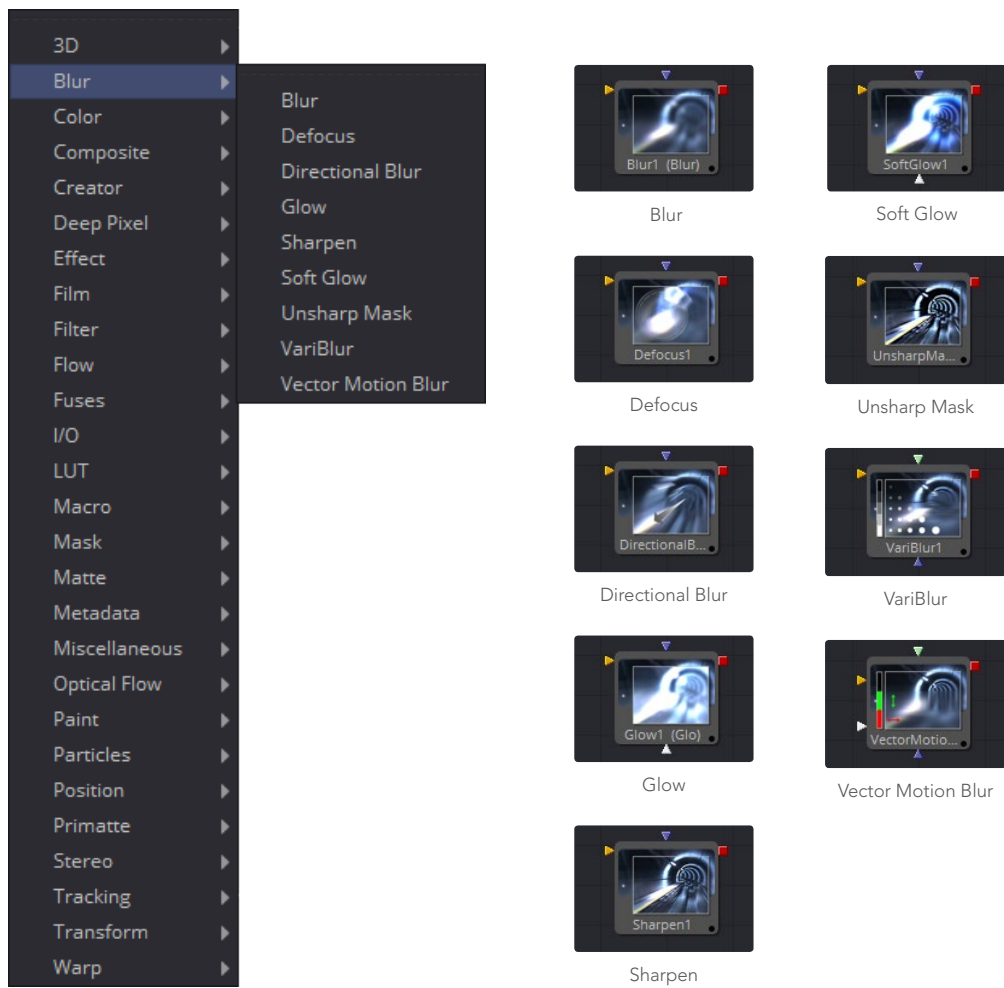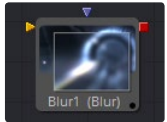
Blur Tools

5

Blur Tools

Blur Tools

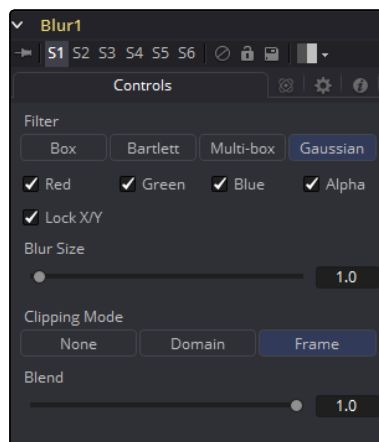|	
Blur	Soft Glow
Defocus	Unsharp Mask
Directional Blur	VariBlur
Glow	Vector Motion Blur
Sharpen	

Blur [BLUR]

The Blur tool does exactly what its name implies - it blurs the input image. This is one of the most commonly used image processing operations.

Controls

Note: Since a perfect Gaussian filter would require examining an infinite number of pixels, all practical Gaussians are, of necessity, approximations. The algorithm Fusion uses is a highly-optimized approach that has many strengths, but can give rise to visible ringing around the edges in certain extreme cases. This ringing only appears when blurring float-depth images and is normally far below the limits of visibility, especially in final renders or HiQ mode, but may appear in subsequent processing. If you experience this, selecting the Multi-Box filter may be a viable alternative.

Filter Type

The Filter Type button array allows for the selection of the filter to be applied to the image.

→ Box Blur: This option applies a Box Blur effect to the whole image. This method is faster than the Gaussian blur but produces a lower quality result.

→ Soften: Soften applies a general softening filter effect. This filter method is slower than the Gaussian filter and produces a lower quality result. It is included for compatibility with older flows only.

→ Bartlett: Bartlett applies a more subtle, anti-aliased blur filter.

→ Multi-Box: Multi-Box uses a box filter layered in multiple passes to approximate a Gaussian shape. With a moderate number of passes (e.g., 4), a high quality blur can be obtained, often faster than the Gaussian filter and without any ringing.

→ Gaussian: Gaussian applies a smooth, symmetrical blur filter, using a sophisticated constant-time Gaussian approximation algorithm. This mode is the default filter method.

Color Channels (RGBA)

The filter defaults to operating on R, G, B and A channels. Selective channel filtering is possible by clicking the checkboxes beside each channel to make them active or inactive

Note: This is not the same as the RGBA checkboxes found under the common controls. The Blur tool takes these selections into account before it processes the image, so deselecting a channel will cause the tool to skip that channel when processing, speeding up the rendering of the effect.

In contrast, the channel controls under the Common Controls tab are applied after the tool has processed.

Lock X/Y

Locks the X and Y Blur sliders together for symmetrical blurring. This is checked by default.

Blur Size

Sets the amount of blur applied to the image. When the Lock X and Y control is deselected, independent control over each axis is provided.

Clipping Mode

This option sets the mode used to handle the edges of the image when performing domain of definition rendering. This is profoundly important for tools like Blur, which may require samples from portions of the image outside the current domain.

Frame

The default option is Frame, which automatically sets the tool's domain of definition to use the full frame of the image, effectively ignoring the current domain of definition. If the upstream DoD is smaller than the frame, the remaining area in the frame will be treated as black/transparent.

Domain

Setting this option to Domain will respect the upstream domain of definition when applying the tool's effect. This can have adverse clipping effects in situations where the tool employs a large filter.

None

Setting this option to None will not perform any source image clipping at all. This means that any data required to process the tool's effect that would normally be outside the upstream DoD will be treated as black/transparent.

Blend

This is a cloned instance of the Blend slider in the Common Controls tab. Changes made to this control are simultaneously made to the one in the common controls.

The Blend slider mixes the result of the tool with its input, blending back the effect at any value less than 1.0.

Examples

This is a comparison of Blur filters visualized as "cross-sections" of a filtered edge. As you can see, Box will create a linear ramp, while Bartlett creates a somewhat smoother ramp. Multibox and Gaussian result in even smoother ramps that are virtually indistinguishable unless you zoom in really close on the slopes. As mentioned above, Gaussian will overshoot slightly and may result in negative values if used on floating-point images.
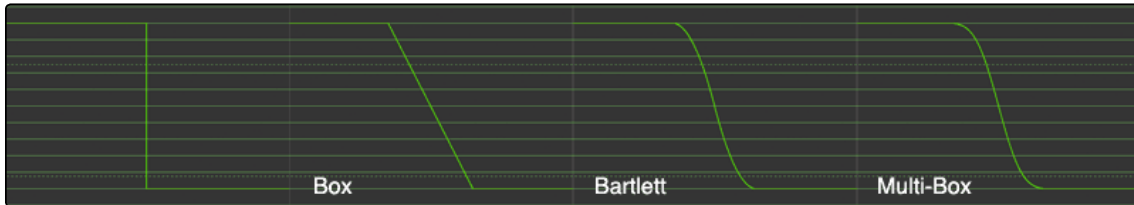
Defocus [DFO]

The Defocus Tool simulates the effects of an out-of focus camera lens, including blooming and image flaring. It provides a fast but relatively inaccurate Gaussian mode, as well as a more realistic but much slower Lens mode.

Controls
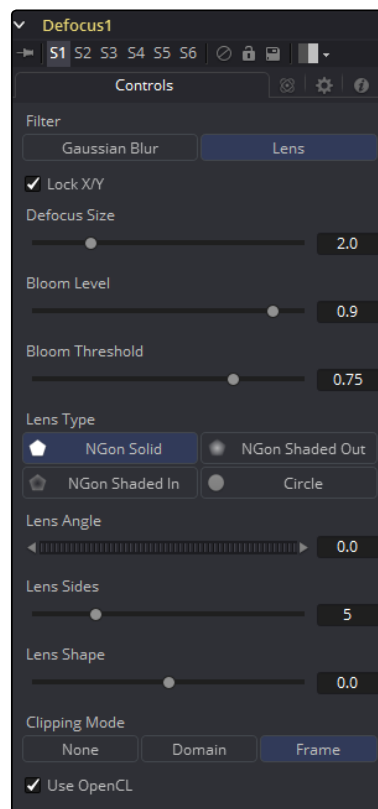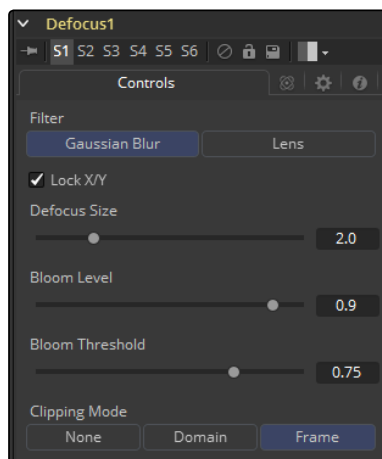
Filter

Use this menu to select the exact method applied to create the defocus. Gaussian applies a fairly simplistic effect, while Lens mode will create a much more realistic defocus. Lens mode will take significantly longer than Gaussian.

Lock X/Y

When Lock X/Y is selected, this performs the same amount of defocusing to both the X- and Y-axis of the image. Deselect to obtain individual control.

Defocus Size

The Defocus Size control sets the size of the defocus effect. Higher values blur the image by greater amounts and produce larger blooms.

Bloom Level

The Bloom Level control determines the intensity and size of the blooming applied to pixels that are above the bloom threshold.

Bloom Threshold

Pixels with values above the set Bloom Threshold are defocused and have a glow applied (blooming). Pixels below that value are only defocused.

Lens Type

The basic shape that is used to create the "bad bokeh" effect. This can be refined further with the Angle, Sides and Shape sliders.

Lens Angle

Defines the rotation of the shape. Best visible with NGon Lens Types. Due to the round nature of a circle, this slider will have no visible effect when the Lens Type is set to Circle.

Lens Sides

Defines how many sides the NGon shapes will have. Best visible with NGon Lens Types. Due to the round nature of a circle, this slider will have no visible effect when the Lens Type is set to Circle.

Lens Shape

Defines how pointed the NGons are. Higher values will create a more pointed, starry look. Lower values create smoother NGons. Best visible with NGon Lens Types and Lens Sides between 5 and 10. Due to the round nature of a circle, this slider will have no visible effect when the Lens Type is set to Circle.

Use OpenCL

Introduced with Fusion's OpenCL Supercomputing, this option renders the effect on the GPU rather than on the CPU. Depending on the graphics card used in the computer, this can boost the speed of the tool by a factor of 30 and more.

Clipping Mode

This option sets the mode used to handle the edges of the image when performing domain of definition rendering. This is profoundly important for tools like Blur, which may require samples from portions of the image outside the current domain.

Frame

The default option is Frame, which automatically sets the tool's domain of definition to use the full frame of the image, effectively ignoring the current domain of definition. If the upstream DoD is smaller than the frame, the remaining area in the frame will be treated as black/transparent.

Domain

Setting this option to Domain will respect the upstream domain of definition when applying the tool's effect. This can have adverse clipping effects in situations where the tool employs a large filter.

None

Setting this option to None will not perform any source image clipping at all. This means that any data required to process the tool's effect that would normally be outside the upstream DoD will be treated as black/transparent.

Directional Blur [DRBL]

This tool is used to create Directional and Radial blurs. It is useful for creating simulated motion blur and light ray type effects. Directional Blur affects all channels (RGBA).

Controls
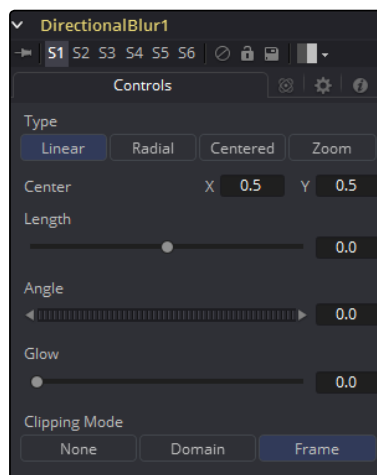
Type

This button array is used to select the Type of directional blur to be supplied to the image.

Linear

Linear distorts the image in a straight line, resembling the scenery that appears in the window of a speeding train.

Radial

Radial will create a distortion that originates at some arbitrary center, radiating outward the way that a view would appear if one were at the head of the train looking forward.

Centered

The Centered button produces a similar result to linear, but the blur effect is equally distributed on both sides of the original.

Zoom

Zoom creates a distortion in the scale of the image smear to simulate the zoom streaking of a camera filming with a slow shutter speed.

Center X and Y

This coordinate control and crosshair affects the Radial and Zoom Motion blur types only. It is used to calculate the position from where the blurring effect starts.

Length

Length adjusts the strength and heading of the effect. Values lower than zero cause blurs to oppose the angle control. Values greater than the slider maximum may be typed into the slider's edit box.

Angle

In both Linear modes, this control will modify the direction of the directional blur. In the Radial and Zoom modes, the effect will be similar to that of the camera spinning while looking at the same spot. If the setting of the length slider is other than 0, the effect will create a whirlpool effect.

Glow

This will add a Glow to the directional blur, which can be used to duplicate the effect of increased camera exposure to light caused by longer shutter speeds.

Clipping Mode

This option sets the mode used to handle the edges of the image when performing domain of definition rendering. This is profoundly important for tools like Blur, which may require samples from portions of the image outside the current domain.

Frame

The default option is Frame, which automatically sets the tool's domain of definition to use the full frame of the image, effectively ignoring the current domain of definition. If the upstream DoD is smaller than the frame, the remaining area in the frame will be treated as black/transparent.

Domain

Setting this option to Domain will respect the upstream domain of definition when applying the tool's effect. This can have adverse clipping effects in situations where the tool employs a large filter.

None

Setting this option to None will not perform any source image clipping at all. This means that any data required to process the tool's effect that would normally be outside the upstream DoD will be treated as black/transparent.

Glow [GLO]

A Glow is basically created by blurring an image, then brightening the blurred result and mixing it back with the original.

The Glow tool provides a more convenient way to accomplish this effect, as well as a variety of variations on the theme. For example, a Bartlett glow is a high quality glow with smoother drop off, however, it is more processor-intensive at larger sizes.

Controls
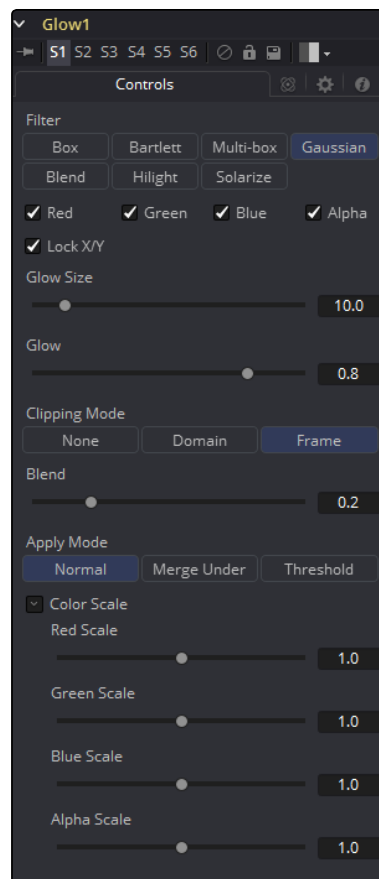
Filter

Use these buttons to select the method of Blur used in the filter. The selections are described below.

Box

A simple but very fast Box filter.

Bartlett

Bartlett adds a softer, subtler glow with a smoother drop off, but may take longer to render than Box.

Multi-box

Multi-box uses a Box filter layered in multiple passes to approximate a Gaussian shape. With a moderate number of passes (e.g., 4), a high quality blur can be obtained, often faster than the Gaussian filter, and without any ringing.

Gaussian

Gaussian adds a soft glow, blurred by the Gaussian algorithm. This is the default method.

Blend

Blend adds a non-linear glow that is evenly visible in the whites and blacks.

Hilight

Hilight adds a glow without creating a halo in the surrounding pixels.

Solarize

Solarize adds a glow and solarizes the image.

Color Channels (RGBA)

The filter defaults to operating on R, G, B and A channels. Selective channel filtering is possible by clicking the checkboxes beside each channel to make them active or inactive.

This is not the same as the RGBA checkboxes found under the common controls. The tool takes these controls into account before it processes. Deselecting a channel will cause the tool to skip that channel when processing, speeding up the rendering of the effect.

In contrast, the channel controls under the Common Controls tab are applied after the tool has processed.

Lock X/Y

When Lock X/Y is checked, both the horizontal and vertical glow amounts will be locked. Otherwise, separate amounts of blur may be applied to each axis.

Glow Size

Glow Size determines the size of the glow effect. Larger values expand the size of the glowing highlights of the image.

Num Passes

Only available in Multi-box mode. Larger values result in a smoother distribution of the effect but also increase render times. It's good to find that thin line between desired quality and acceptable render times.

Glow

The Glow slider determines the intensity of the glow effect. Larger values tend to completely blow the image out to white.

Clipping Mode

This option sets the mode used to handle the edges of the image when performing domain of definition rendering. This is profoundly important for tools like Blur, which may require samples from portions of the image outside the current domain.

Frame

The default option is Frame, which automatically sets the tool's domain of definition to use the full frame of the image, effectively ignoring the current domain of definition. If the upstream DoD is smaller than the frame, the remaining area in the frame will be treated as black/transparent.

Domain

Setting this option to Domain will respect the upstream domain of definition when applying the tool's effect. This can have adverse clipping effects in situations where the tool employs a large filter.

None

Setting this option to None will not perform any source image clipping at all. This means that any data required to process the tool's effect that would normally be outside the upstream DoD will be treated as black/transparent.

Blend

This is a cloned instance of the Blend slider in the Common Controls tab. Changes made to this control are simultaneously made to the one in the common controls.

The Blend slider mixes the result of the tool with its input, blending back the effect at any value less than 1.0.

Apply Mode

Three Apply Modes are available when it comes to applying the glow to the image.

- → **Normal:** Default. This mode simply adds the glow directly over top of the original image.

- → **Merge Under:** Merge Under places the glow beneath the image, based on the alpha channel. Threshold mode permits clipping of the threshold values.

- → **Threshold:** This control clips the effect of the glow. A new range slider will appear. Pixels in the glowed areas with values below the low value will be pushed to black. Pixels with values greater than high will be pushed to white.

- → **High-Low Range Control:** Only available in Threshold mode. Pixels in the glowed areas with values below the low value will be pushed to black. Pixels with values greater than high will be pushed to white.

Color Scale (RGBA)

These Scale sliders are normally a reveal control labeled Color Scale. They can be used to adjust the amount of glow applied to each color channel individually, thereby tinting the glow.

Glow Pre Mask

The Glow tool supports pre-masking using the glow mask. A Glow Pre Mask filters the image before applying the glow. The glow is then merged back over the original image. This is different from a regular effect mask that clips the rendered result.

The glow mask allows the glow to extend beyond the borders of the mask, while restricting the source of the glow to only those pixels within the mask.

To apply a glow mask, select Glow Mask instead of Effect Mask from the contextual menu when a glow tool is active. Glow masks are identical to effects masks in every other respect.
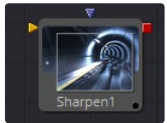
Sharpen [SHRP]

The Sharpen tool uses a convolution filter to enhance detail in an image.

Controls
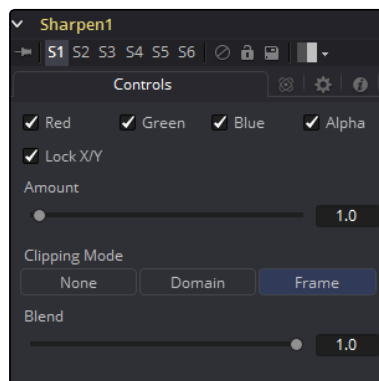
Color Channels (RGBA)

The filter defaults to operating on R, G, B and A channels. Selective channel filtering is possible by clicking the checkboxes beside each channel to make them active or inactive.

This is not the same as the RGBA checkboxes found under the common controls. The tool takes these controls into account before it processes, so deselecting a channel will cause the tool to skip that channel when processing, speeding up the rendering of the effect.

In contrast, the channel controls under the Common Controls tab are applied after the tool has processed.

Lock X/Y

This Locks the X and Y Sharpen sliders together for symmetrical sharpening. This is checked by default.

Amount

This slider sets the Amount of sharpening applied to the image. When the Lock X/Y control is deselected, independent control over each axis is provided.

Clipping Mode

This option sets the mode used to handle the edges of the image when performing domain of definition rendering. This is profoundly important for tools like Blur, which may require samples from portions of the image outside the current domain.

Frame

The default option is Frame, which automatically sets the tool's domain of definition to use the full frame of the image, effectively ignoring the current domain of definition. If the upstream DoD is smaller than the frame, the remaining area in the frame will be treated as black/transparent.

Domain

Setting this option to Domain will respect the upstream domain of definition when applying the tool's effect. This can have adverse clipping effects in situations where the tool employs a large filter.
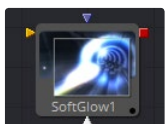
None

Setting this option to None will not perform any source image clipping at all. This means that any data required to process the tool's effect that would normally be outside the upstream DoD will be treated as black/transparent.

Blend

This is a cloned instance of the Blend slider in the Common Controls tab. Changes made to this control are simultaneously made to the one in the common controls.

The Blend slider mixes the result of the tool with its input, blending back the effect at any value less than 1.0.
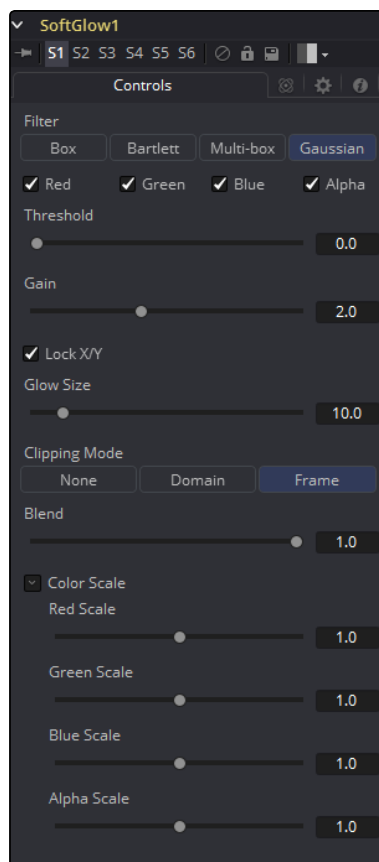
Soft Glow [SG L]

The Soft Glow tool is similar to the Glow tool but performs additional processing of the image to create a much softer, more natural glow.

This tool is perfect for atmospheric haze around planets, skin tones, and simulating dream-like environments.

Controls

Note: The Glow tool supports pre-masking using the Glow Pre Mask input on the tool tile. A pre-mask limits the image before applying the glow. The glow is then is combined with the original image. This is different from a regular effect mask that limits the rendered result.

The glow mask allows the glow to extend beyond the borders of the mask, while restricting the source of the glow to only those pixels within the mask.

Filter

Use these buttons to select the method of Blur used in the filter. The selections are described below.

→ Box: A simple but very fast Box filter.

→ Bartlett: Bartlett adds a softer, subtler glow with a smoother drop off, but may take longer to render than Box.

→ Multi-Box: Multi-Box uses a box filter layered in multiple passes to approximate a Gaussian shape. With a moderate number of passes (e.g., 4), a high quality blur can be obtained, often faster than the Gaussian filter and without any ringing.

→ Gaussian: Gaussian adds a soft glow, blurred by the Gaussian algorithm. This is the default method.

Color Channels (RGBA)

The filter defaults to operating on R, G, B and A channels. Selective channel filtering is possible by clicking the checkboxes beside each channel to make them active or inactive.

This is not the same as the RGBA checkboxes found under the common controls. The tool takes these controls into account before it processes, so deselecting a channel will cause the tool to skip that channel when processing, speeding up the rendering of the effect.

In contrast, the channel controls under the Common Controls tab are applied after the tool has processed.

Threshold

This control is used to limit the affect of the soft glow. The higher the threshold, the brighter the pixel must be before it is affected by the glow.

Gain

The Gain control defines the brightness of the glow.

Lock X/Y

When Lock X/Y is checked, both the horizontal and vertical glow amounts will be locked. Otherwise, separate amounts of glow may be applied to each axis of the image.

Glow Size

Amount determines the size of the glow effect. Larger values expand the size of the glowing highlights of the image.

Num Passes

Only available in Multi-box mode. Larger values result in a smoother distribution of the effect but also increase render times. It's good to find that thin line between desired quality and acceptable render times.

Clipping Mode

This option sets the mode used to handle the edges of the image when performing domain of definition rendering. This is profoundly important for tools like Blur, which may require samples from portions of the image outside the current domain.

Frame

The default option is Frame, which automatically sets the tool's domain of definition to use the full frame of the image, effectively ignoring the current domain of definition. If the upstream DoD is smaller than the frame, the remaining area in the frame will be treated as black/transparent.

Domain

Setting this option to Domain will respect the upstream domain of definition when applying the tool's effect. This can have adverse clipping effects in situations where the tool employs a large filter.

None

Setting this option to None will not perform any source image clipping at all. This means that any data required to process the tool's effect that would normally be outside the upstream DoD will be treated as black/transparent.

Blend

This is a cloned instance of the Blend slider in the Common Controls tab. Changes made to this control are simultaneously made to the one in the common controls. The Blend slider mixes the result of the tool with its input, blending back the effect at any value less than 1.0.

Color Scale (RGBA)

These Scale sliders are normally a reveal control labeled Color Scale. They can be used to adjust the amount of glow applied to each color channel individually, thereby tinting the glow.

Unsharp Mask [US]

Unsharp masking is a technique used to sharpen only the edges within an image. This tool is most often used to correct for blurring and loss of detail in low contrast images, for example, to extract useful detail from long exposure shots of far-away galaxies.

This filter extracts a range of frequencies from the image and blurs them to reduce detail. The blurred result is then compared to the original images. Pixels with a significant difference between the original and the blurred image are likely to be an edge detail. The pixel is then brightened to enhance it.

Controls
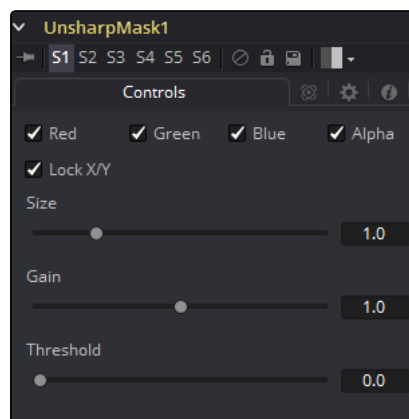
Color Channels (RGBA)

The filter defaults to operating on R, G, B and A channels. Selective channel filtering is possible by clicking the checkboxes beside each channel to make them active or inactive.

This is not the same as the RGBA checkboxes found under the common controls. The tool takes these controls into account before it processes, so deselecting a channel will cause the tool to skip that channel when processing, speeding up the rendering of the effect.

In contrast, the channel controls under the Common Controls tab are applied after the tool has processed.

Lock X/Y

When Lock X/Y is checked, both the horizontal and vertical sharpen amounts will be locked. Otherwise, separate amounts of glow may be applied to each axis of the image.

Size

This control adjusts the size of blur filter applied to the extracted image. The higher this value, the more likely it is that pixels will be identified as detail.

Gain

The Gain control adjusts how much gain is applied to pixels identified as detail by the mask. Higher values will create a sharper image.

Threshold Low and High

This range control determines the frequencies from the source image to be extracted. Raising low values will eliminate dark pixels from the comparison. Pixels above the high value will have the full effect of the gain applied.
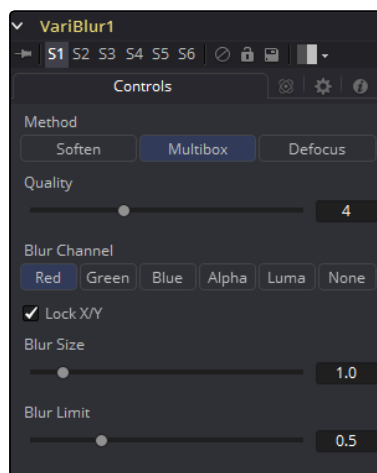
VariBlur [VBL]

The VariBlur tool gives a true Per-pixel Variable blur, using a second image to control the amount of blur for each pixel. It is somewhat similar in effect to the Depth Blur tool but uses a different approach for cleaner results in many cases.

Controls

Note: The Blur Image input must be connected, or no blurring will be performed.

Method

Soften

This method varies from a simple Box shape to a Bartlett triangle to a decent-looking Smooth blur as Quality is increased. It is a little better at preserving detail in less-blurred areas than Multibox.

Multibox

Similar to Soften, this gives a better Gaussian approximation at higher Quality settings.

Defocus

Not really a true defocus, this gives a flat, circular shape to blurred pixels that can approximate the look of a defocus.

Quality

Increasing Quality gives smoother blurs, at the expense of speed. Quality set to 1 uses a very fast but simple Box blur for all Method settings. A Quality of 2 is usually sufficient for low Blur Size values. 4 is generally good enough for most jobs unless Blur Size is particularly high.

Blur Channel

This selects which channel of the Blur Image controls the amount of blurring applied to each pixel.

Lock X/Y

When selected, only a Blur Size control is shown and changes to the amount of blur are applied to both axes equally. If the checkbox is cleared, individual controls appear for both X and Y Blur Size.

Blur Size

Increasing this control will increase the overall amount of blur applied to each pixel. Those pixels where the Blur Image is black or non-existent will never be blurred, regardless of Blur Size.

Vector Motion Blur [VB∟]

This tool is used to create Directional blurs based on a Vector Channel.

This tool will perform a 2D blur on the image, using a vector map produced by a 3D application. The vector map is typically two floating-point images, one channel specifies how far the pixel is moving in X, and the other specifies how far the pixel is moving in Y. These channels may be embedded in the image in the case of OpenEXR or RLA/RPF images, or may be provided as separate images using the tool's Vectors input.

The vector channels should use a float16 or float32 color depth, to provide + and - values. A value of 1 in the X channel would indicate that pixel has moved one pixel to the right, while a value of -10 indicates ten pixels of movement to the left.

Controls
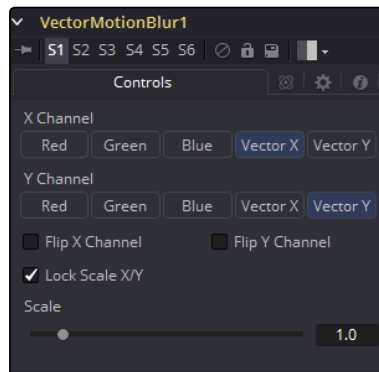
X Channel

Use this multi-button array to choose which channel of the image will provide the vectors for the movement of the pixels along the X-axis.

Y Channel

Use this multi-button array to choose which channel of the image will provide the vectors for the movement of the pixels along the Y-axis.

Flip X Channel

This checkbox can be used to flip, or invert, the X-vectors. A value of 5 for a pixel in the X-vector channel would become -5 when this checkbox is selected.

Flip Y Channel

This checkbox can be used to flip, or invert, the Y vectors. A value of 5 for a pixel in the Y-vector channel would become -5 when this checkbox is selected.

Lock Scale X/Y

Selecting this checkbox will provide access to separate sliders for X and Y Scale. By default only a single Scale slider is provided.

Scale/Scale X

This slider will be labeled Scale if the Lock Scale X/Y checkbox is not selected, otherwise it will be labeled Scale X. The vector channel value for a pixel is multiplied by the value of this slider. For example, given a scale of 2 and a vector value of 10, the result would be 20.

Scale Y

This slider will only appear if the Lock Scale X/Y checkbox is selected. Otherwise, it will be hidden, and use the same value set in the Scale slider above.
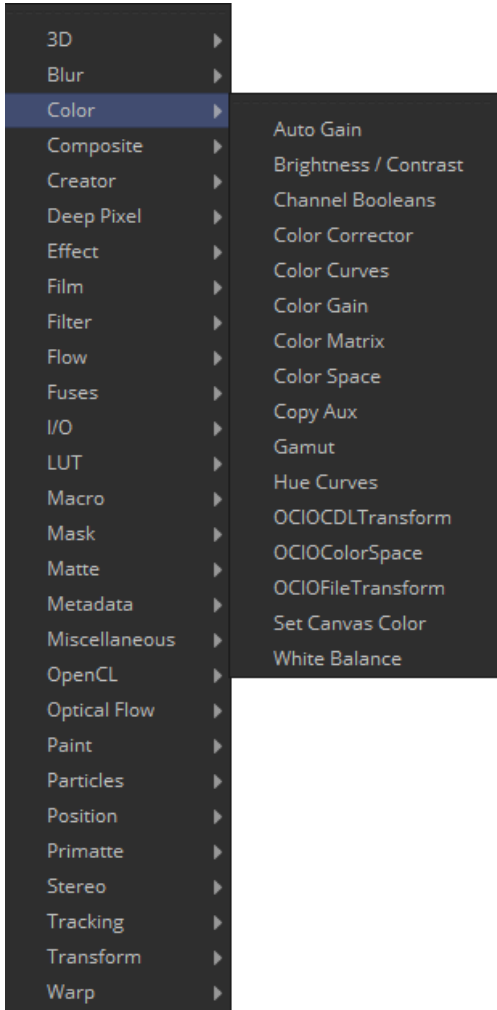
Color Tools

6

Color Tools

Color Tools

3D	▶
Blur	▶
Color	▶
Composite	▶
Creator	▶
Deep Pixel	▶
Effect	▶
Film	▶
Filter	▶
Flow	▶
Fuses	▶
I/O	▶
LUT	▶
Macro	▶
Mask	▶
Matte	▶
Metadata	▶
Miscellaneous	▶
OpenCL	▶
Optical Flow	▶
Paint	▶
Particles	▶
Position	▶
Primatte	▶
Stereo	▶
Tracking	▶
Transform	▶
Warp	▶

Color submenu:
- Auto Gain
- Brightness / Contrast
- Channel Booleans
- Color Corrector
- Color Curves
- Color Gain
- Color Matrix
- Color Space
- Copy Aux
- Gamut
- Hue Curves
- OCIOCDLTransform
- OCIOColorSpace
- OCIOFileTransform
- Set Canvas Color
- White Balance

Auto Gain

Copy Aux

Brightness/Contrast

Gamut

Channel Boolean
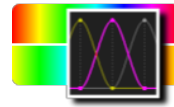
Hue Curves

Color Corrector

OCIO CDL Transform
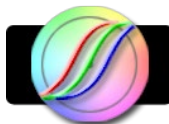
Color Curves

OCIO ColorSpace

Color Gain

OCIO FileTransform

Color Matrix
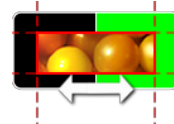
Set Canvas Color
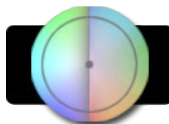

Color Space

White Balance

Auto Gain [AG]

The Auto Gain tool is used to automatically adjust the color range of an image so that the darkest and brightest pixels are set to user-selected values. By default, the darkest pixels in the image are pushed down to black, the brightest pixels are pushed to white and all of the pixels in between are stretched to cover the color range evenly.

This can be useful when compensating for variations in lighting, dealing with low contrast images, or visualizing the full color range of float images (though the Viewer's View Normalized Image button is generally more suitable for this).

Controls
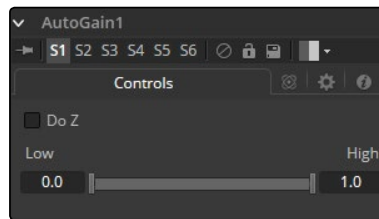
Note: Variations over time in the input image can cause corresponding variations in the levels of the result. For example, if a bright object moves out of an otherwise dark shot, the remaining scene will get suddenly brighter, as the remaining darker values are stretched to white. This also applies to sudden depth changes when Do Z is applied; existing objects may be pushed forward or backward when a near or far object enters or leaves the scene.

Do Z
Select the Do Z checkbox to apply the Auto Gain effect to the Z-channels. This can be useful for matching the ranges of one Z-channel to another, or to view a float Z-channel in the RGB values.

Range
This Range control is used to set the lowest and highest possible pixel value in the image. All color values in the image are rescaled to fit within this range.

Example

→ Create a horizontal gradient with the Background tool. Set one color to dark gray (RGB Values 0.2). Set the other color to light gray (RGB Values 0.8).

→ Add an Auto Gain tool and set the Low value to 0.0 and the High to 0.5. This will cause the brightest pixels to be pushed down to 0.5 and the darkest pixels will get pushed to black. The remainder of the pixel values will be scaled between those limits.

Brightness Contrast [BC]

The Brightness Contrast tool is used to adjust the gain, brightness, contrast, gamma and saturation of an image. The order of the controls represents the order in which each operation is applied (for example, gamma is applied before contrast but after gain). The Brightness Contrast is also reversible using the Forward and Reverse buttons. So color corrections, once applied, can be reversed further downstream.

For this to work best, make sure that your image is processed in 32bit floating point.

Controls
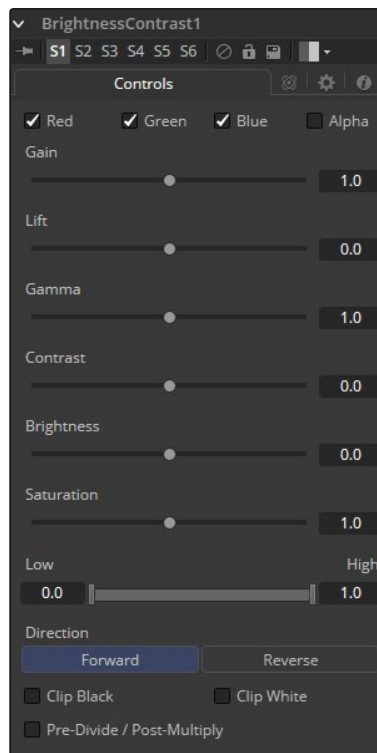
Color Channels (RGBA)

The filter defaults to operating on R, G, B and A channels. Selective channel filtering is possible by clicking the checkboxes beside each channel to make them active or inactive.

This is not the same as the RGBA checkboxes found under the common controls. The tool takes these controls into account before it processes, so deselecting a channel will cause the tool to skip that channel when processing, speeding up the rendering of the effect.

In contrast, the channel controls under the Common Controls tab are applied after the tool has processed.

Gain

The pixel values are multiplied by the value of this control. A Gain of 1.2 will make a pixel that is R0.5 G0.5 B0.4 into R0.6 G0.6, B0.48 (i.e., 0.4 * 1.2 = 0.48). Gain affects higher values more than it affects lower values, so the effect will be strongest in the midrange and top range of the image.

Lift

While Gain basically scales the color values around Black, Lift scales the color values around White. The pixel values are multiplied by the value of this control. A Lift of 0.5 will make a pixel that is R0.0 G0.0 B0.0 into R0.5 G0.5, B0.5, while leaving white pixels totally unaffected. Lift affects lower values more than it affects higher values, so the effect will be strongest in the midrange and low range of the image.

Gamma

Values higher than 1.0 will raise the Gamma (mid gray), whereas lower values will decrease it. The effect of this tool is not linear and existing black or white levels will not be affected at all. Pure gray colors will be affected the most.

Contrast

Contrast is the range of difference between the light to dark areas. Increasing the value of this slider will increase the contrast, pushing color from the midrange toward black and white. Reducing the contrast will cause the colors in the image to move toward midrange, reducing the difference between the darkest and brightest pixels in the image.

Brightness

The value of the Brightness slider is added to the value of each pixel in the image. This control's affect on an image is linear so the effect will be applied identically to all pixels regardless of value.

Saturation

This control is used to increase or decrease the amount of Saturation in the image. A saturation of 0 has no color. All colors are grayscale.

Low and High

This range control is similar to the Gain control in some respects. If Low is anchored at 0.0 and the High value is reduced from 1.0, the effect is identical to increasing the gain. High values are multiplied by the inverse of the high value. (i.e., if high is 0.75, each pixel will be multiplied by 1/0.75 or 1.3333).

Leaving the high anchored at 1.0 and increasing the low is exactly the same as inverting the image colors and increasing the gain and inverting it back again. This pushes more of the image toward black without affecting the whites at all.

Direction

Forward applies all values normally. Reverse effectively inverts all values.

Clip Black/White

The Clip Black and Clip White checkboxes are used to clip out of range color values that can appear in an image when processing in floating-point color depth. Out of range colors are below black (0.0) or above white (1.0). These checkboxes will have no affect on images processed at 8-bit or 16-bit per channel, as such images cannot have out of range values.

Pre-Divide/Post-Multiply

Selecting the Pre-Divide/Post-Multiply checkbox will cause the image pixel values to be divided by the alpha values prior to the color correction, and then re-multiplied by the alpha value after the correction.

This helps to prevent the creation of illegally additive images, particularly around the edges of a blue/green key or when working with 3D rendered objects.

Channel Boolean [Bᴏʟ]

The Channel Booleans tool can be used to apply a variety of mathematical and logical operations on the channels in an image. This tool works by using one image's channels to modify another image's channels. If a foreground input is not available, selecting options that use color channels from the foreground will end up using the background input's color channels instead.

On the Color Channels Tab the Tool Controls are Divided as Follows:

On the left side are target channels for the image piped into the Channel Booleans (background input). The drop down to the right lets you choose whether you want to modify the BG image with its own channels (suffix BG after list name) or with the channels from another image, which must be piped into the foreground input on the Channel Booleans node (suffix FG in the drop-down list).

Controls
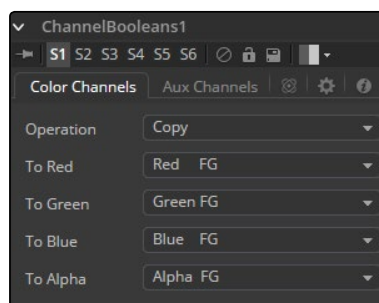
Operation Type

This drop-down box is used to select the mathematical method applied to the selected channels. Its settings are as follows:

Copy

Copy the value from one color channel to another. For example, copy the foreground red channel into the alpha channel to create a matte.

Add

Add the color values from color channel to channel.

Subtract

Subtract the color values of one color channel from another color channel.

And

Perform a logical AND on the color values from color channel to color channel. The foreground image will generally remove bits from the color channel of the background image.

Or

Perform a logical OR on the color values from color channel to color channel. The foreground image will generally add bits from the color channel of the background image.

Exclusive Or

Perform a logical XOR on the color values from color channel to color channel. The foreground image will generally flip bits from the color channel of the background image.

Multiply

Multiply the values of a color channel. This will give the appearance of darkening the image as the values are scaled from 0 to 1. White has a value of 1 so the result would be the same. Gray has a value of 0.5 so the result would be a darker image or, in other words, an image half as bright.

Divide

Divide the values of a color channel. This will give the appearance of lightening the image as the values are scaled from 0 to 1.

Maximum

Compare the two images and take the Maximum, or brightest, values from each image.

Minimum

Compare the two images and take the Minimum, or darkest, values from each image.

Negative

Invert the FG input to make a Negative version of the image.

Solid

Solid sets a channel to a full value of 255. This is useful for setting the alpha to full value.

Clear

Clear sets a channel to a value of zero. This is useful for clearing the alpha.

Difference

Difference subtracts the greater color values of one color channel from the lesser values of another color channel.

Signed Add

Signed Add subtracts areas that are lower than mid-gray and add areas that are higher than mid-gray, which is useful for creating effects with embossed gray images.

To Red, Green, Blue, Alpha

These menus represent the four color channels of the output image. Use the drop-down menu to select which channel from the source images will be used to produce the output channel.

The default setting simply copies the channels from the foreground channel. Select any one of the four color channels, as well as several auxiliary channels like Z-buffer, saturation, luminance and hue.

Auxiliary Channels
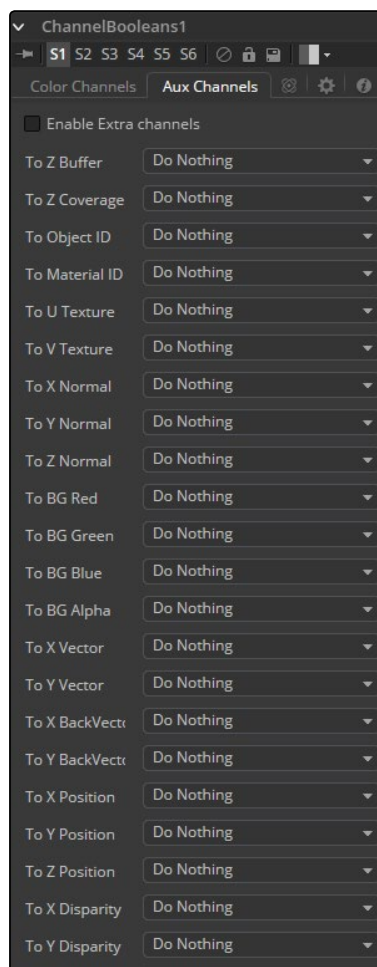
There are several Auxiliary Channels. Use these menus to select a source for the auxiliary channels of the output image. See the chapter on 3D Tools for further details on auxiliary channels.

Enable Extra Channels

When the Enable Extra Channels checkbox is selected, the Channel Boolean tool will be able to output images with channels beyond the usual RGBA. The remaining controls in this tab will become active and can be used to copy data into the auxiliary channels.

Examples: To copy the Alpha channel of one image to its own color channels, set the Red, Green and Blue channels to Alpha BG. Set the Operation to Copy. To copy the Alpha channel from another image, set operation type to Alpha FG.

To replace the existing Alpha channel of an image with the Alpha of another image choose 'Do Nothing' for To Red, To Green, and To Blue and 'Alpha FG' for To Alpha. Pipe the image containing the Alpha into the Foreground input on the Channel Booleans node. Set Operation: 'Copy.' The same operation can also be performed using the Matte Control tool.

To combine any type of mask into an Alpha for an image choose 'Do Nothing' for To Red, To Green, and To Blue and 'Matte' for To Alpha. Pipe the mask into the Foreground input on the Channel Booleans node. Set Operation: 'Copy.'

To subtract the Red channel's pixels of another image from the Blue channel choose 'Do Nothing' for To Red and To Green and 'Red FG' for To Blue. Pipe the image containing the Red channel to subtract into the Foreground input on the Channel Booleans node. Set Operation: 'Subtract.'

Color Corrector [CC]

The Color Corrector tool is a comprehensive color tool with histograms, matching and equalization, hue shifting, tinting and color suppression. The Color Corrector has two image inputs. Connect the image to be corrected to the primary input. The secondary input can be used as a reference for histogram matching.

Overview

Controls in the Color Correction tool are separated into four separate categories: colors, levels, histogram and suppress. Selecting one of the category buttons from the array at the top of the Correction tab will cause that category's controls to appear. Each category is described in detail below.

Colors Mode
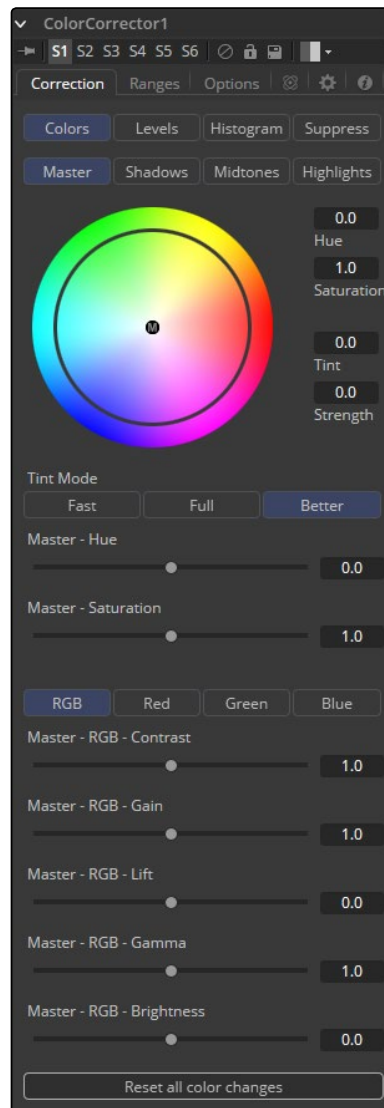
Master/Shadows/Midtones/Highlights

This array of buttons determines the range of colors affected by the controls in this tab. For example, when the Shadows range is selected, any color adjustments made will affect only the darker pixels of the image.

The selected state of this button is maintained throughout the Colors, Levels and Suppress sections of the Color Corrector tool.

Note: The controls are independent for each color range. For example, adjusting the Gamma control while in Shadows mode will not change or affect the value of the Gamma control for the Highlights mode. Each control is independent and applied separately.

Adjustments made to the image in the Master channel are applied to the image after any changes made to the Highlight, Midtone and Shadow ranges.

Color Wheel

The Color Wheel display provides a visual representation of adjustments made to Hue and Saturation, as well as any tinting applied to the image. Adjustments can be made directly on the display, or by entering values in the text boxes to the right of the Color Wheel.

Hue

The Hue control provides a method of shifting the Hue of the image (or selected color range) through the color spectrum. The control value has an effective range between 0.0 and 1.0, which represents the angle of rotation in a clockwise direction. A value of 0.25 would be 90 degrees (90/360) and would have the effect of shifting red toward blue, green to red and so on.

The degree of hue shifting can be entered directly into the text control, or by placing the mouse above the outer ring of the color control and dragging the mouse up or down. The outer ring will always show the shifted colors compared to the original colors shown in the center of the control.

Saturation

The Saturation control is used to adjust the intensity of the color values. A Saturation of 0 produces gray pixels without any chroma or color component, whereas a value of 1.0 produces no change in the chroma component of the input image. Higher values will generate over-saturated values with a high color component.

Saturation values can be entered directly into the text control, or by dragging the mouse to the left and right on the outer ring of the color wheel control.

Tint/Strength

The Tint control is used to tint an image or selected color range. The values in this control go from 0 to 1.0, which indicate the angle of the tint color on the color wheel. A value of.25 would indicate 90 degrees, which would be midway between green and yellow on the color wheel.

The Strength control determines how much tint is applied to the selected range of colors.

The tinting is represented in the Color Wheel control by small circles that show the color and strength of the tint. The Highlight Ranges marker is a black outline of a circle. The Midtones and Shadows are represented by gray circles. The Master Tint Marker is also black, but it has a white M in the center to distinguish it from the others.

The mouse can position the marker for each range only when the appropriate range is selected. For example, the Highlight Marker cannot be moved when the Master range is selected.

Holding down the Command or Ctrl key while dragging this control will allow you to make finer adjustments by reducing the control's sensitivity to mouse movements. Holding the Shift key down will limit the movement of the marker to a single axis, allowing you to restrict the effect to either tint or strength.

Tint Mode
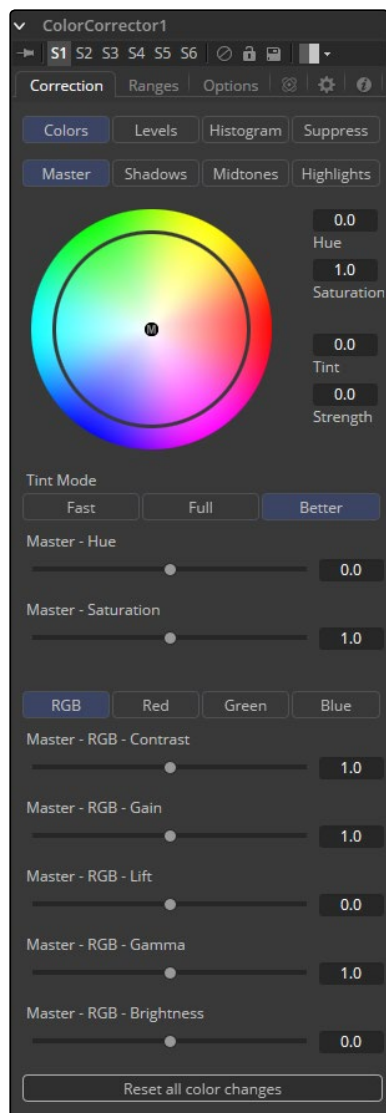
Fast/Full/Better

These three buttons are used to select the speed and quality of the algorithm used to apply the tint, hue and saturation adjustments. The default is Better, but for working with larger images, it may be desirable to use a faster method.

Hue

This slider is a clone of the Hue control shown in the Color Wheel above. The slider makes it easier to make small adjustments to the value with the mouse

Saturation

This slider is a clone of the Saturation control shown in the Color Wheel above. The slider makes it easier to make small adjustments to the value with the mouse.

RGB/Red/Green/Blue

These buttons are the same buttons seen in the Histogram, Color and Levels sections of the Color Corrector tool. When the Red channel is selected, the controls in this tab will affect the Red channel only, and so on.

The controls are independent, so switching to Blue will not remove or eliminate any changes made to Red, Green or Master. The animation and adjustments made to each channel are separate. These buttons simply determine what controls to display.

Master RGB Contrast

Contrast is the range of difference between the light to dark areas. Increasing the value of this slider will increase the contrast, pushing color from the midrange toward black and white. Reducing the contrast will cause the colors in the image to move toward midrange, reducing the difference between the darkest and brightest pixels in the image.

Master RGB Gain

The pixel values are multiplied by the value of this control. A Gain of 1.2 will make a pixel that is R0.5 G0.5 B0.4 into R0.6 G0.6, B0.48 (i.e., 0.4 * 1.2 = 0.48). Gain affects higher values more than it affects lower values, so the effect will be strongest in the midrange and top range of your image.

Master RGB Lift

While Gain basically scales the color values around Black, Lift scales the color values around White. The pixel values are multiplied by the value of this control. A Lift of 0.5 will make a pixel that is R0.0 G0.0 B0.0 into R0.5 G0.5, B0.5, while leaving white pixels totally unaffected. Lift affects lower values more than it affects higher values, so the effect will be strongest in the midrange and lowrange of the image.

Master RGB Gamma

Values higher than 1.0 will raise the Gamma (mid gray) while lower values will decrease it. The effect of this tool is not linear, and existing black or white levels will not be affected at all. Pure grays will be affected the most.

Master RGB Brightness

The value of the Brightness slider is added to the value of each pixel in your image. This control's affect on an image is linear, so the effect will be applied identically to all pixels regardless of value.

Reset All Color Changes

Selecting this button will return all color controls in this section to their default values.

Levels Mode

Master/Shadows/Midtones/Highlights

This array is described in the Colors mode above.

Histogram Control

A Histogram is a chart that represents the distribution of color values in the scene. The chart reads from left to right, with the leftmost values representing the darkest colors in the scene and the rightmost values representing the brightest. The more pixels in an image with the same or similar value, the higher that portion of the chart will be.

Luminance is calculated per channel, therefore, the Red, Green and Blue channels all have their own histogram and the combined result of these comprise the Master Histogram.

To scale the histogram vertically, place the mouse pointer inside the control and drag the pointer up to zoom in or down to zoom out.

RGB/Red/Green/Blue

These buttons are used to select and display the histogram for each color channel or for the master channel.

Display Selector Toolbar

The Display Selector Toolbar provides a method of enabling and disabling components of the histogram display. Hold the mouse pointer over the button to display a tooltip that describes the button's function.

Input Histogram

This enables or disables the display of the Input image's histogram.

Reference Histogram

This enables or disables the display of the Reference image's histogram.

Output Histogram

This enables or disables the display of the histogram from the post color corrected image.

Corrective Curve

This toggles the display of a spline used to visualize exactly how auto color corrections applied using a reference image are affecting the image. This can be useful when equalizing luminance between the input and reference images.

Low/Mid/High

These controls are used to adjust the input image's histogram, compressing or shifting the ranges of the selected color channel.

The controls can be adjusted by dragging the triangles beneath the histogram display to the left and right.

Shifting the high value toward the left (decreasing the value) will cause the histogram to slant toward white, shifting the image distribution toward white. The low value will have a similar effect in the opposite direction, pushing the image distribution toward black.

Threshold Output Low/High

The Threshold control can apply clipping to the image, compressing the histogram. Decreasing the level of the High control will reduce the value of pixels in the image, sliding white pixels down toward gray and gray pixels toward black.

Adjusting the Low control toward High will do the opposite, sliding the darkest pixels toward white.

If the low value was set to 0.1, pixels with a value of 0.0 would be set to 0.1 instead, and all other values would increase to accommodate the change. The best way to visualize the effect is to observe the change to the output histogram displayed above.

Reset All Levels

Clicking on this button will reset all of the controls in the Levels section to their defaults.

Histogram Mode

This Color Corrector mode produces a Histogram display of the input image. If a reference image is also provided, the histogram for the reference image is also displayed. The controls in this tab are primarily used to match one image to another, using either the Equalize or Match modes of the Color Corrector.
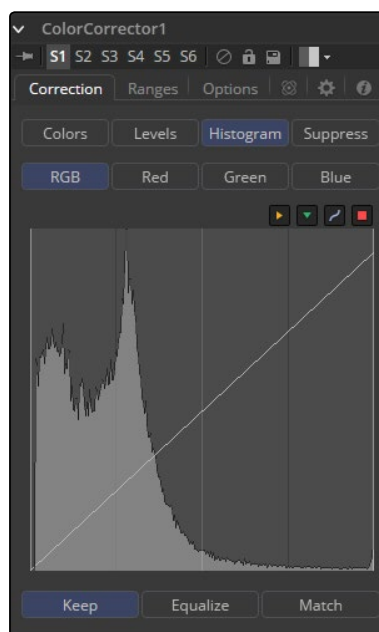
Float Images and Histogram Equalization or Matching

Use the histogram Matching or Equalization methods on a float image and the color depth of the output image will be converted to 16-bit integer. Two-dimensional histograms are not well suited to working with the extreme dynamic range of float images, so these operations will always revert to 16-bit integer processing.

Histogram Control

The Histogram Control is described in detail earlier in this tool documentation, under the heading of the Levels Mode.

Keep/Equalize/Match Buttons

Each of these buttons enables a different type of color correction operation.

Keep

Keep produces no change to the image and the reference histogram is ignored.

Equalize

Selecting Equalize adjusts the source image so that all of the color values in the image are equally represented, in essence, flattening the histogram so that the distribution of colors in the image becomes more even.

Match

The Match mode modifies the source image based on the histogram from the reference image. It is used to match two shots with different lighting conditions and exposures so that they will appear similar.

When selected, the Equalize and Match modes reveal the following controls.

Match/Equalize Luminance

This slider affects the degree to which the Color Corrector tool will attempt to affect the image based on its luminance distribution. When this control is zero (the default), matching and equalization are applied to each color channel independently and the Luminance, or combined value of the three color channels, is not affected.

If this control has a positive value when Equalizing the image, the input image's luminance distribution will be flattened before any color equalization is applied.

If this control has a positive value when the correction mode is set to Match, the luminance values of the input are matched to the reference before any correction is applied to the R, G and B channels.

The L uminance and RGB controls can have a cumulative effect, and generally they are not both set to full (1.0) at the same time.

Lock Red/Green/Blue

When this checkbox is selected, color matching will be applied to all color channels equally. When the checkbox is not selected, individual controls for each channel will appear.

Equalize/Match Red, Green, Blue

The name of this control changes depending on whether the Equalize or Match modes have been selected. The slider can be used to reduce the amount of correction applied to the image to equalize or match it. A value of 1.0 causes the full effect of the equalize or match to be applied, whereas lower values moderate the result.

8-Bit, 10-Bit, 16-Bit Buttons

This array of buttons determines the level of color fidelity used when sampling the image to produce the histogram. 10-bit produces higher fidelity than 8-bit, and 16-bit produces higher fidelity than 10-bit.

Smooth Out Correction Curves

Often, color equalization and matching operations will introduce Posterization in an image, which occurs because gradients in the image have been expanded or compressed so that the dynamic range between colors is not sufficient to display a smooth transition. This control can be used to smooth the correction curve, blending some of the original histogram back into the result for a more even transition.

Snapshot Match

Click this button to take a freeze the current reference histogram, storing its current state as a Snapshot in memory. If the reference histogram is not snapshot, the reference histogram is updated from frame to frame. This can cause flickering and phasing of the correction as the tool tries to match a changing source to a changing reference.

Release Match

Click on this button to Release the current snapshot of the histogram and return to using the live reference input.

Reset All Histogram Changes

Selecting this button will remove all changes made to the histogram, returning the controls to default and setting the mode back to keep.

Suppress Mode

Color Suppression provides a mechanism for removing an unwanted color component from the image. The Color Wheel control is similar to that shown in the Colors section of the tool, but this one is surrounded by six controls, each representing a specific color along the wheel.

To suppress a color in the selected range, drag the control that represents that color toward the center of the Color Wheel. The closer the control is to the center, the more that color will be suppressed from the image.
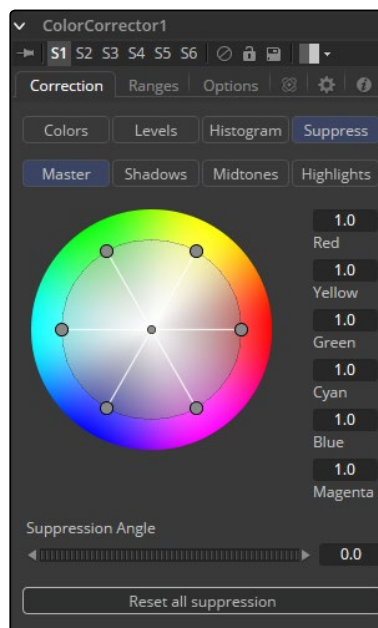
Suppression Angle

Use the Suppression Angle control to rotate the controls on the suppression wheel and zero in on a specific color.

Reset All Suppression

Clicking on this control resets the suppression colors to 1.0, the default value.

Ranges Tab

The Ranges tab contains the controls used to specify which pixels in an image are considered to be shadows and which are considered to be highlights. The midrange is always calculated as any pixels not already included in either the shadows or the highlights.
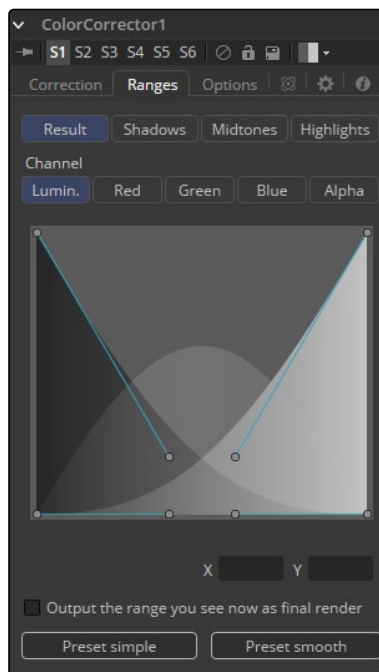
Result/Shadows/Midtones/Highlights

These buttons are used to select the color range displayed in the Viewers. They help to visualize the actual pixels that will be included in the range. When the Result button is selected, the image displayed by the color corrector in the views will be that of the color corrected image. This is the default.

Selecting one of the other buttons will switch the display to a grayscale image showing which pixels are part of the selected range. White pixels represent pixels that are considered to be part of the range and black pixels are not included in the range. For example, choosing Shadows would show pixels considered to be shadows as white and pixels that are not shadows as black. Mid gray pixels are only partly in the range and will not receive the full effect of any color adjustments to that range.

Spline Display

The extent of the ranges is selected by manipulating the spline handles. There are four spline points, each with one Bezier handle. The two handles at the top represent the start of the shadow and highlight ranges, whereas the two at the bottom represent the end of the range. The Bezier handles are used to control the falloff.

The midtones range has no specific controls since its range is understood to be the space between the shadow and the highlight ranges.

The X and Y text controls below the Spline Display can be used to enter precise positions for the selected Bezier point or handle.

Channel

The Channel selection buttons shown in this tab can be used to examine the range of a specific color channel. By default, Fusion displays the luminance channel when the color ranges are examined.

Output the Range You See Now as Final Render

Selecting this checkbox will cause the monochrome display of the range shown in the Viewers to be output as the final render. Normally, the color tool will output the full RGBA image, even if the tool was left to display one of the color ranges in the view instead. This control makes it possible to use the Color Corrector tool to generate a range's matte for use as an effect mask in other tools.

Preset Simple/Smooth Ranges

These two buttons can be used to return the spline ranges to either Smooth (default) or Simple (linear) settings.

Options Mode
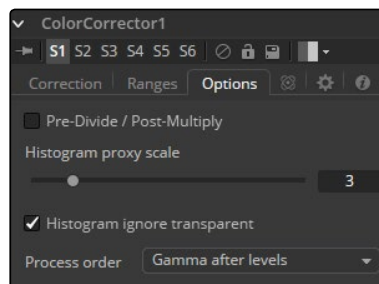
Pre-Divide/Post-Multiply

Selecting this option will divide the color channels by the value of the alpha before applying the color correction. After the color correction, the color values are re-multiplied by the alpha to produce a properly additive image. This is crucial when performing an additive merge or when working with CG images generated against black.

Histogram Proxy Scale

The Histogram Proxy Scale determines the level of precision used when creating and calculating histograms. Lower values represent higher precision and higher values produce a rougher, generalized histogram.

Process Order

This menu is used to select whether adjustments to the image's gamma are applied before or after any changes made to the images levels.

Color Curves [CCv]

The Color Curves tool is a spline-based tool for performing Look Up Table (LUT) color manipulations. A separate spline is provided for each color channel. The effect can be animated or dissolved and can be applied to the image using RGB, YUV, YIQ, CMY or HLS color spaces.

The LUT view in the color corrector can be scaled using the + and - keys on the numeric keypad. The color curves LUT has full support for out of range values, pixels with color values above 1.0 or below 0.0.

The splines shown in this LUT view are also available from the Spline Editor, should a greater precision be required when adjusting the controls.

Controls

Mode

The Mode options change between Animated and Dissolve modes. The default mode is static, where adjustments to the curves are static. Setting the mode provides a change spline for each channel, allowing the color curve to be animated over time.

Dissolve mode is essentially obsolete and is included for compatibility reasons only.

Color Space

The splines in the LUT view can represent color channels from a variety of Color Spaces. The default is Red, Green and Blue. The options in this menu allow an alternate color space to be selected. A detailed description of the color spaces available here can be found in the online reference documentation for the Color Space tool.

Color Channels (RGBA)

Use the Color Channel controls to select which channel's spline is currently active for editing. The labels of these controls will change to reflect the names of the channels for the current color space. Normally, they will read as Red, Green and Blue. If the Color Curves tool is operating in YUV color space, they will read as Y, U and V instead.

These controls do not restrict the effect of the tool to a specific channel. They only select whether the spline for that channel is editable. These controls are most often used to ensure that adding or moving points on one channel's spline does not unintentionally affect a different channel's spline.

Spline Window

The Spline Window displays splines for each RGBA channel. These can be edited individually or as a group depending on the color channels selected above.

The Spline default to a linear range, from 0 in, 0 out at the bottom left to the 1 in, 1 out Top right. In the default a color will process to the same value to the output. If a point is added in the middle at 0.5 in 0.5 out, and the point is moved up, this will raise the mid color of the image brighter.

The Spline curves allow for precise control over color ranges, so specific adjustments can be made without affecting other color values.

In and Out

Use the In and Out controls to manipulate the precise values of a selected point. To change a value, select a point and enter the in/out values desired.

Pick

Click on the Pick button and select a color from an image in the display to automatically set keypoints on the spline for the selected color. The new points will be drawn with a triangular shape and can only be moved vertically (if point is locked, only the Out value can change).

Points are only added to enabled splines. To add points only on a specific channel, disable the other channels before making the selection.

One use for this technique is white balancing an image. Use the Pick control to select a pixel from the image that should be pure gray. Adjust the points that appear so that the Out value is 0.5 to change the pixel colors to gray.

Use the contextual menu's Locked Pick Points option to unlock points created using the Pick option, converting them into normal points.

Match Reference

Clicking on the Match Reference button will automatically set points on the curve to match an image provided in the second (reference) input of the Color Curves tool.

Sample Reference

Clicking the Sample Reference button will sample the center scanline of the background image and create a LUT of its color values

Number of Samples on Match Curve

This slider determines how many points are used to match the curve to the range in the reference image.

Pre-Divide/Post-Multiply

Selecting this checkbox will cause the image's pixel values to be divided by the alpha values prior to the color correction, and then re-multiplied by the alpha value after the correction. This helps to avoid the creation of illegally additive images, particularly around the edges of a blue/green key or when working with 3D rendered objects.
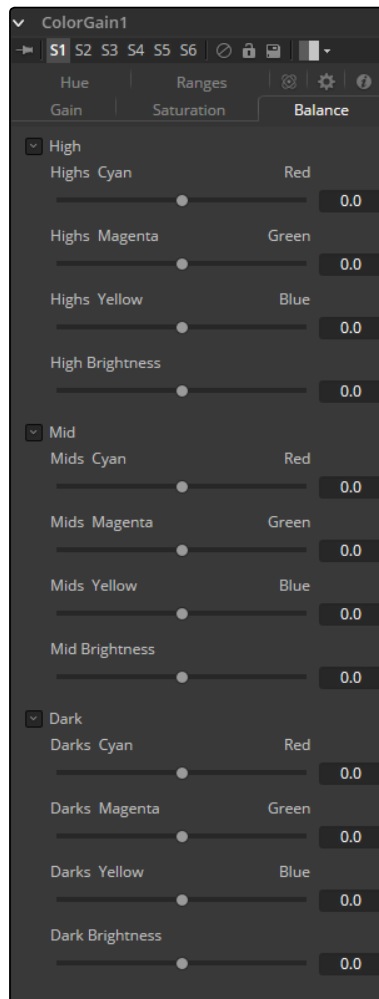
Color Gain [CLR]

The Color Gain tool contains options for adjusting the gain, gamma, saturation and hue of the image. Many of the controls provided by the Color Gain tool are also found in the Color Corrector tool, but this simpler tool may render more quickly. One feature that distinguishes the Color Gain tool from the color corrector is its balance controls. These can be used to adjust the tinting of the colors in the high, mids and lows.

Gain Tab
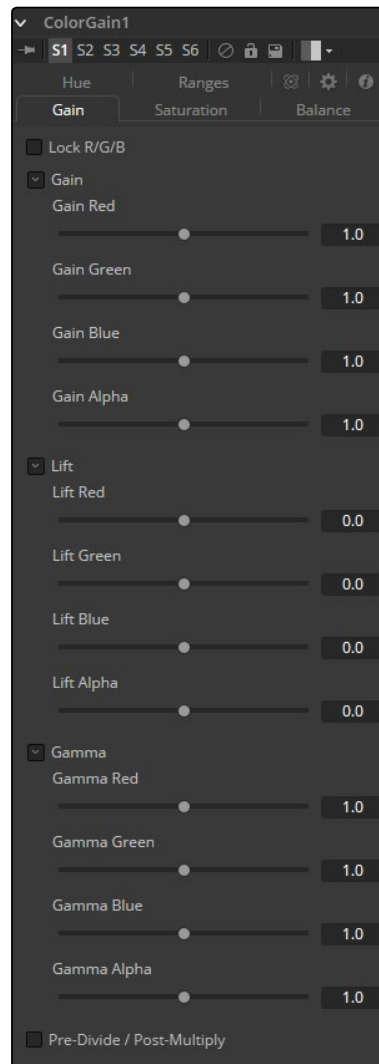
Lock R/G/B

When selected, the Red, Green and Blue channel controls for each effect are combined into one slider. Alpha channel effects remain separate.

Gain RGBA

The Gain RGBA controls multiply the values of the image channel in a linear fashion. All pixels are multiplied by the same factor, but the effect will be larger on bright pixels and smaller on dark. Black pixels will not be changed (x * 0=0).

Lift RGBA

While Gain basically scales the color values around Black, Lift scales the color values around White. The pixel values are multiplied by the value of this control. A Lift of 0.5 will make a pixel that is R0.0 G0.0 B0.0 into R0.5 G0.5, B0.5, while leaving white pixels totally unaffected. Lift affects lower values more than it affects higher values, so the effect will be strongest in the midrange and lowrange of the image.

Gamma RGBA

The Gamma RGBA controls affect the brightness of the mid-range in the image. The effect of this tool is non-linear. White and black pixels in the image are not affected when gamma is modified, whereas pure grays are affected most by changes to this parameter. Large value changes to this control will tend to push mid-range pixels into black or white, depending on the value used.

Pre-Divide/Post-Multiply

Selecting this checkbox will cause the image pixel values to be divided by the alpha values prior to the color correction, and then re-multiplied by the alpha value after the correction. This helps to avoid the creation of illegally additive images, particularly around the edges of a blue/green key or when working with 3D rendered objects.

Saturation Tab
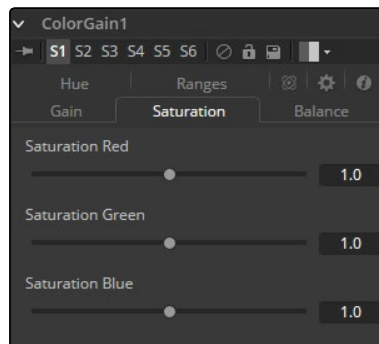
RGB Saturation

This setting controls the intensity of the colors in the image channels. A value of 0.0 will strip all of the color out of an image channel. Values greater than one will intensify the colors in the scene, pushing them toward primary colors.

Balance Tab

CMY Brightness Highs/Mids/Darks

This section of the Color Gain tool offers controls for adjusting the overall balance of a color channel. Independent color and brightness controls are offered for the High, Mid and Dark ranges of the image.

Colors are grouped into opposing pairs from the two dominant color spaces. Red values can be pushed toward Cyan, Green values to Magenta and Blue to Yellow. Brightness can be raised or lowered for each of the channels.

By default, the Balance sliders can be adjusted by -1 to +1, but values outside of this range can be entered manually to increase the effect. A value of 0.0 for any slider indicates no change to the image channel. Positive and negative values indicate that the balance of the image channel has been pushed toward one color or the other in the pair.

Hue Tab
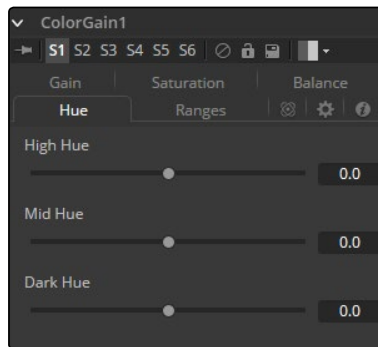
High/Mid/Dark Hue

Use the Hue section of the Color Gain tool to shift the overall hue of the image, without affecting the brightness or saturation. Independent control of the High, Mid and Dark ranges is offered by three sliders.

The following is the order of the hues in the RGB color space Red, Yellow, Green, Cyan, Blue, Magenta and Red. Values above 0 push the hue of the image toward the right (red turns to yellow). Values below 0 push the hue toward the left (red turns to magenta). At -1.0 or 1.0, the hue completes the cycle and returns to its original value. The default range of the hue sliders is -1.0 to +1.0. Values outside of this range can be entered manually.

Ranges Tab

The Ranges tab contains the controls used to specify which pixels in an image are considered to be shadows and which are considered to be highlights. The midrange is always calculated as any pixels not already included in either the shadows or the highlights.

Spline Display

The extent of the ranges is selected by manipulating the spline handles. There are four spline points, each with one Bezier handle. The two handles at the top represent the start of the shadow and highlight ranges, whereas the two at the bottom represent the end of the range. The Bezier handles are used to control the falloff.

The midtones range has no specific controls since its range is understood to be the space between the shadow and the highlight ranges. The X and Y text controls below the Spline Display can be used to enter precise positions for the selected Bezier point or handle.

Preset Simple/Smooth Ranges

These two buttons can be used to return the spline ranges to either Smooth (default) or Simple (linear) settings.

Color Matrix [CMx]

The ColorMatrix allows for a vast number of operations to modify values individually in the different color channels.

Controls
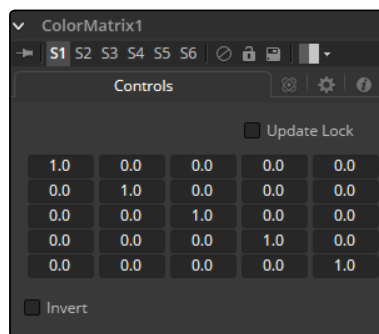
Update Lock

When this control is selected, Fusion will not render the tool. This is useful for setting up each value of the tool, then turning Update Lock off in order to render it.

Matrix

This defines what type of operation actually takes place. The horizontal rows define the output values of the tool, the vertical columns the input values. The "add" column allows for simple adding of values to the individual color channels. By default the output values are identical to the input values.

- → 100% of the Red channel input is copied to the Red channel output.
- → 100% of the Green channel input is copied to the Green channel output.
- → 100% of the Blue channel input is copied to the Blue channel output.
- → 100% of the Alpha channel input is copied to the Alpha channel output.

We can also write the default settings as mathematical equations

```
[R out] = 1 * [R in] + 0 * [G in] + 0 * [B in] + 0 * [A in] + 0

[G out] = 0 * [R in] + 1 * [G in] + 0 * [B in] + 0 * [A in] + 0

[B out] = 0 * [R in] + 0 * [G in] + 1 * [B in] + 0 * [A in] + 0

[A out] = 0 * [R in] + 0 * [G in] + 0 * [B in] + 1 * [A in] + 0
```

Invert

Enabling this option will invert the Matrix. Think of swapping channels around, doing other operations with different tools, and then copying and pasting the original ColorMatrix and setting it to Invert to get your channels back to the original.

Example 1 – Invert

If we want to do a simple invert or negative of the color values, but keep our Alpha channel as it is, the matrix would look like this.
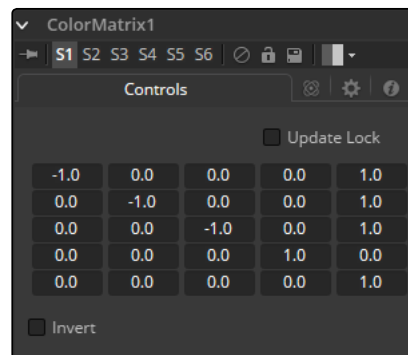
Observe the fact that we have to Add 1 to each channel to push the inverted values back into the positive numbers.

Let's follow this example step by step by viewing the waveform of a 32-bit grayscale gradient.

→ 01: The original grayscale
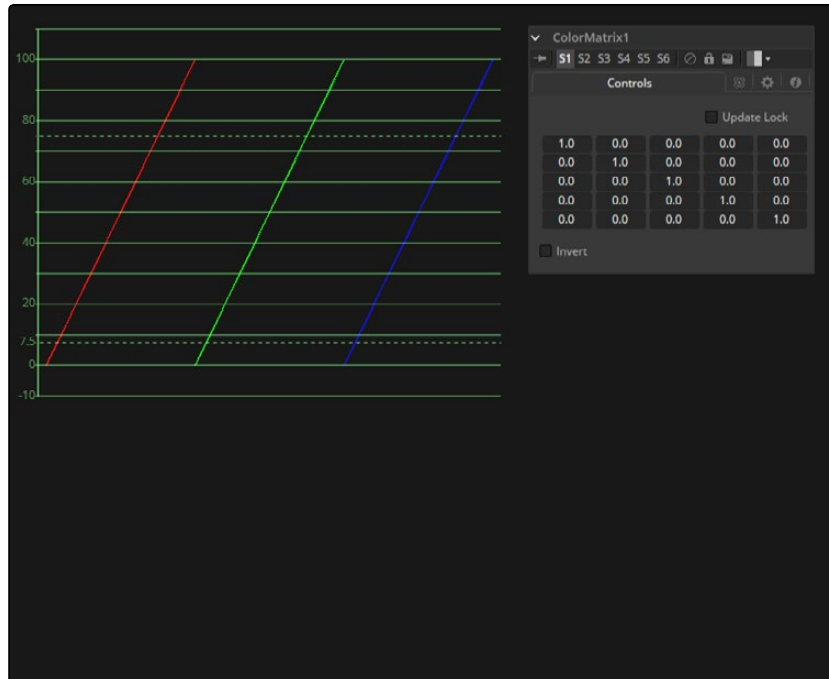
→ 02: RGB set to -1. The values get inverted but fall below 0.
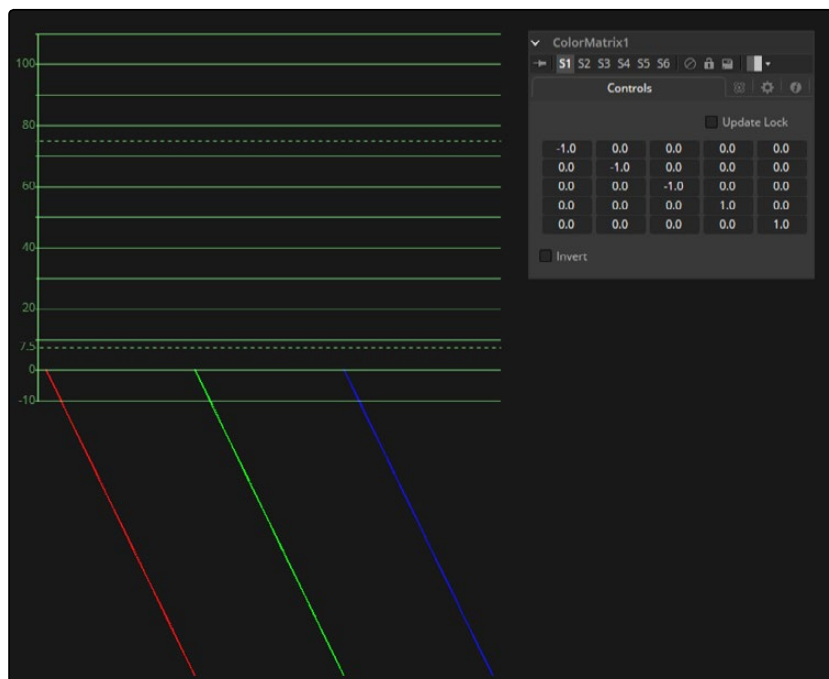
→ 03: Adding 1 to each channel keeps the inversion, but moves the values back into a positive range.
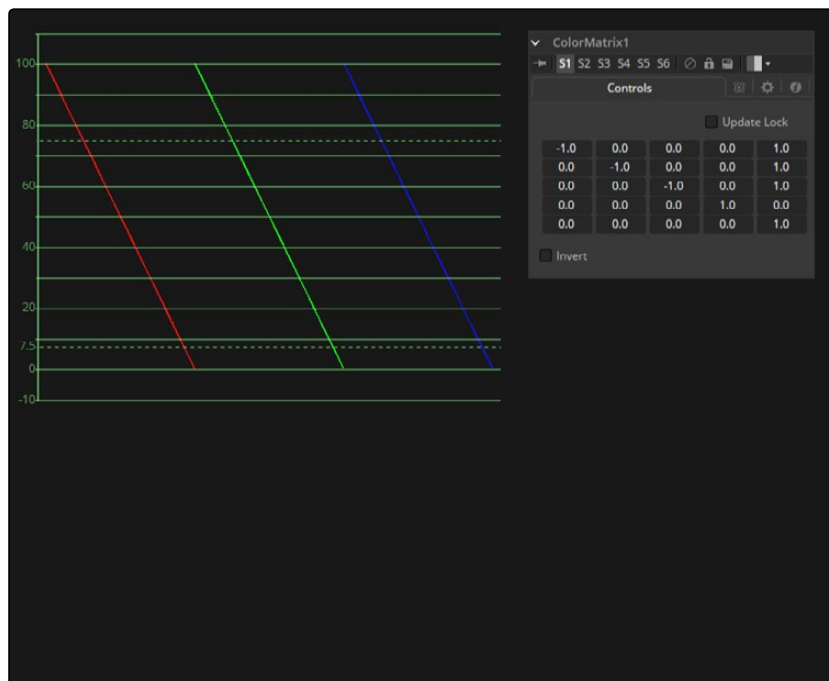
Example 2 – Brightness per Channel

Let's influence the brightness of each channel individually. This subtracts 0.2 from the Red channel, adds 0.314 to the Green channel and adds 0.75 to the Blue channel while keeping Alpha as it is.
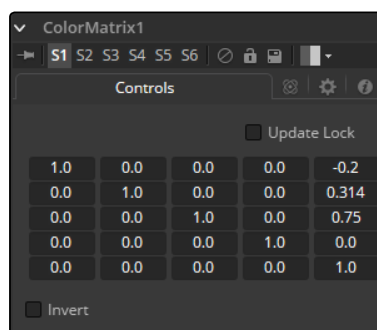
Example 3 – Copying Values

Of course we can also copy color values back and forth between individual channels. Let's make the Red channel contain the luminance values of the image based on thirds and the Green channel

contain the luminance values based on the proper black-and-white conversion method, whereas in the Blue channel we use a third method based on getting more information from Red and less from Blue. We also lower the Blue channel's brightness by 0.1 and replace the Alpha Channel with the original Blue channel.
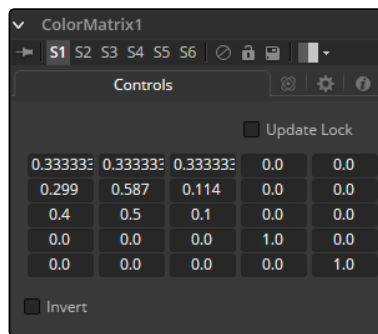
Color Space [CS]

The Color Space tool provides the ability to work on an image in a variety of alternate color space formats. By default, Fusion uses the RGB color space, and most tools and displays interpret the primary channels of an image as Red, Green and Blue.

Changing the color space from RGB will cause most images to look odd, as Fusion's Viewers will still interpret the primary channels as Red, Green and Blue. For example, viewing an image converted to YUV in one of the Viewers will show the Y channel as Red, the U channel as Green and the V channel as Blue.

Several elements of the Fusion interface refer to the RGB channels directly. The four checkboxes used to restrict the effect of the tool to a single color channel are one example. When a conversion is applied to an image, the labels of these elements remain R, G and B, but the values they represent are from the current color space. (Red is Hue, Green is Luminance, Blue is Saturation for a RGB to HLS conversion. The Alpha value is never changed by the color space conversion.)

Controls
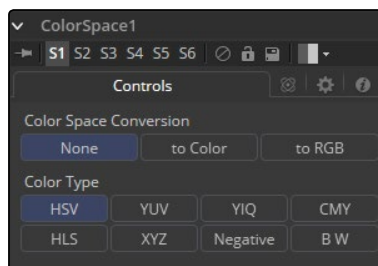
Color Space Conversion

This button array has three options.

None

The Color Space tool has no effect on the image.

To Color

The input image will be converted to the color space selected in the Color Type control found below.

To RGB

The input image will be converted back to the RGB color space from the type selected in the Color Type control below (for example, YUV to RGB).

Color Type

These buttons are used to select the color space conversion applied when the To Color conversion is selected.

HSV (Hue, Saturation and Value)

Each pixel in the HSV color space is described in terms of its Hue, Saturation and Value components. Value is defined as the quality by which we distinguish a light color from a dark one or brightness. Decreasing saturation roughly corresponds to adding white to a paint chip on a palette. Increasing value is roughly similar to adding black.

YUV (Luma, Blue Chroma and Red Chroma)

The YUV color space is used in the analog broadcast of PAL video. This format is often used to color correct images, due to its familiarity to a large percentage of video engineers. Each pixel is described in terms of its Luminance, Blue Chroma and Red Chroma components.

YIQ (Luma, In Phase and Quadrature)

The YIQ color space is used in the analog broadcast of NTSC video. This format is much more rare than YUV and almost never seen in production. Each pixel is described in terms of its Luminance, Chroma (in-phase or red-cyan channel) and Quadrature (magenta-green) components.

CMY (Cyan, Magenta and Yellow)

Although more common in print, the CMY format is often found in computer graphics from other software packages. Each pixel is described in terms of its Cyan, Magenta and Yellow components. CMY is non-linear.

HLS (Hue, Luminance and Saturation)

Each pixel in the HLS color space is described in terms of its Hue, Luminance and Saturation components. The differences between HLS and HSV color spaces are minor.

XYZ (CIE Format)

This mode is used to convert a CIE XYZ image to and from RGB color spaces. CIE XYZ is a weighted space, rather than a non-linear one, unlike the other available color spaces. Non-linear in this context means that equal changes in value at different positions in the color space may not necessarily produce the same magnitude of change visually to the eye.

Expressed simply, the CIE color space is a perceptual color system, with weighted values obtained from experiments where subjects were asked to match an existing light source using three primary light sources.

This color space is most often used to perform gamut conversion and color space matching between image display formats because it contains the entire gamut of perceivable colors.

Negative

The color channels are inverted. The color space remains RGBA.

BW

The image is converted to black and white. The contribution of each channel to the luminance of the image is adjustable via slider controls that appear when this option is selected. The default values of these sliders represent the usual perceptual contribution of each channel to an image's luminance. The color space of the image remains RGBA

Copy Aux [CpA]

CopyAux copies aux channel groups into RGBA channels. CopyAux is only available in Fusion Studio.

It is mostly a convenience tool as the copying can also be accomplished with more effort using a ChannelBoolean tool. Although CopyAux has quite a few options, most of the time you will only adjust the channel to copy and ignore the rest.

Before Fusion 6.31, to access aux channels you used a ChannelBoolean to copy them into the RGBA channels. Often this would also involve a ChangeDepth tool to make sure that the RGBA channels that were receiving the aux channel were float32. Now in Dimension, CopyAux accomplishes the same result in fewer mouse clicks, allowing you to work faster. Where ChannelBooleans deals with individual channels, CopyAux deals with channel groups. By default, the CopyAux tool will automatically promote the depth of its output to match the depth of the aux channel.

CopyAux also supports static normalization ranges. The advantage of static normalization versus the dynamic normalization that Fusion's Viewers do is that colors remain constant over time. For example, if you are viewing Z or WorldPos values for a ball, you will see a smooth gradient from white to black. Now imagine that some other 3D object is introduced into the background at a certain time. Dynamic normalization will turn the ball almost completely white while the background object is now the new black. Dynamic normalization also causes flicker problems while viewing vector/disparity channels, which can make it difficult to compare the aux channels of two frames at different times visually.

Controls
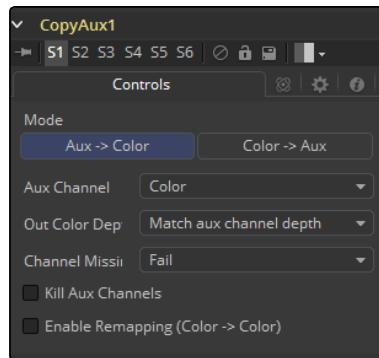
Mode

Mode determines whether the aux channel is copied into the RGBA color channel or vice versa. Using this option, you can use one CopyAux to bring an aux channel into color, do some compositing operations on it, and then use another CopyAux to write the color back in the aux channel. When the Mode is set to "Color>Aux," all the inputs except AuxChannel are hidden.

Aux Channel

The Aux Channel is to be copied from or written to depending on the current Mode. When the aux channel abcd has one valid component, it will be copied as aaa1, two valid components as ab01, three valid components as abc1, and four components as abcd. For example, the Z channel will be copied as zzz1, texture coordinates as uv01, and normals as nxnynz1.

Out Color Depth

Out Color Depth controls the color depth of the output image. Most aux channels contain float values or, if they are integer valued, they can contain values beyond 255. When you copy float values into an int8 or int16 image, this can be a problem since negative values and values over 1.0 can get clipped. In addition, precision can be lost. This option determines what happens if the depth of RGBA channels of the input image is insufficient to contain the copied aux channel.

Be careful about copying float channels into integer image formats, as they can get clipped if you do not set up CopyAux correctly. For the purpose of this tool, all aux channels are considered to be float32 except ObjectID/MaterialID, which are considered to be int16.

Match Aux Channel Depth

The bit depth of the RGBA channels of the output image will be increased to match the depth of the aux channel. In particular, this means that the RGBA channels of the output image will be either int16 or float32. It is wise to be careful when using this option as, for example, if you normally have int8 color channels, you will now be using 2x or 4x more memory for the color channels. In particular, the Z, Coverage, TextureCoordinate, Normal, Vector, BackVector, WorldPosition, and Disparity channels will always be output as float and the Material/ObjectID channels will be output as int16.

Match Source Color Depth

The bit depth of the RGBA channels of the output image will be the same as the input image. This can have some unexpected consequences. For example, if your input image is int8, the XYZ components of normals which are floating-point numbers in the [-1, 1] range will be clipped to a non-negative numbers [0, 1] range. As a more extreme example, consider what will happen to Z values. Z values are floating point numbers stored in the [-1e30, 0] range and they will all get truncated to the [0, 1] range, which means your Z channel will be full of zeroes.

Force Float32

The bit depth of the RGBA channels of the output image will always be float32.

Channel Missing

Channel Missing determines what happens if a channel is not present. For example, this determines what happens if you chose to copy Disparity to Color and your input image does not have a Disparity aux channel.

Fail

The tool fails and prints an error message to the console.

Use Default Value

This fills the RGBA channels with the default value of zero for everything except Z for which it is-1e30.

Kill Aux Channels
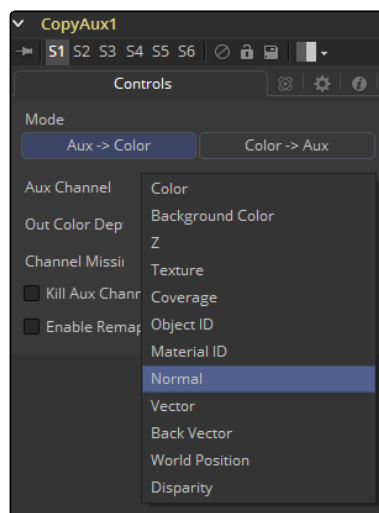
When this is checked, CopyAux will copy the requested channel to RGBA and then output a resulting image that is purely RGBA with all other channels being killed. This is useful if you want to increase the number of frames of CopyAux that can be cached for playback, for example to play back a long sequence of disparity. A handy tip is that you can use the "Kill Aux" feature also with just Copy Color > Color for a longer color playback.

Enable Remapping

When remapping is enabled, the currently selected aux channel will be rescaled, linearly mapping the range according to the From and To slider selections as explained below. The Remapping options are applied before the conversion operation. This means you could set the From. Min/From. Max values to -1, 1 to rescale your normals into the [0, 1] range, or set them to [-1000, 0] to rescale your Z values from [-1000, 0] into the [0, 1] range before the clipping occurs.

Note that the Remapping options are per channel options. That means the default scale for Normals can be set to [-1, +1] > [0, 1] and for Z it can be set [-1000, 0] > [0, 1]. When you flip between normals and Z, both options will be remembered. One way this could be useful is that you can set up all of your remapping ranges and save this as a setting that you can reuse. The remapping can be useful to squash the aux channels into a static [0, 1] range for viewing or, for example, if you wish to compress normals into the [0, 1] range in order to store them in an int8 image.

From. Min

This is the value of the aux channel that will correspond to To. Min.

From. Max

This is the value of the aux channel that will correspond to To. Max. It is possible to set the max value less than the min value to achieve a flip/inversion of the values.

Detect Range

This scans the current image to detect the min/max values and then sets the From. Min/From. Max Value controls to these values.

Update Range

This scans the current image to detect the min/max values and then enlarges the current [From. Min, From. Max] region so that it contains the min/max values from the scan.

To. Min

This is the minimum output value, whichdefaults to 0.

To. Max

This is the maximum output value, which defaults to 1.

Invert

After the values have been rescaled into the [To. Min, To. Max] range, this inverts/flips the range.

Gamut [GMT]

The Gamut tool converts color from different gamuts to other color gamuts as well as removing or adding the appropriate gamma to entirely linearize incoming images.

Controls
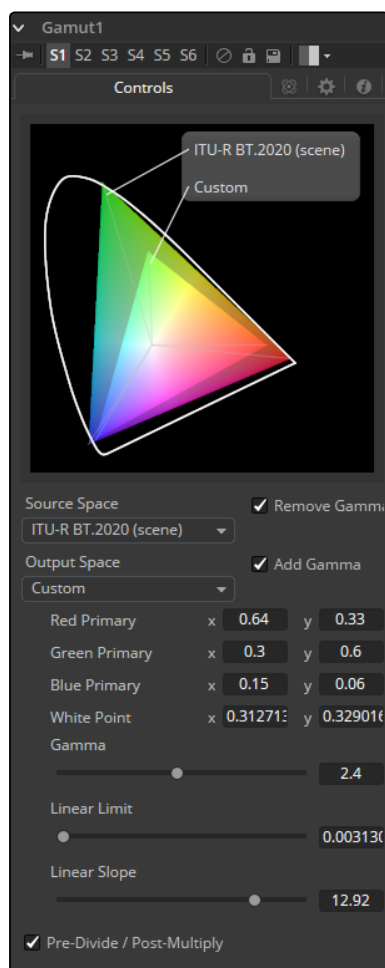
Source Space

Source Space determines the input color space of the image. Leave this at "No Change" if you want to just add Gamma using the Output Space control.

DCI-P3

The DCI-P3 color space is most commonly used in association with DLP projectors, and is frequently provided as a color space available with 2K DLP projectors, and as an emulation mode for 10-bit LCD monitors such as the HP Dreamcolor. This color space is defined in the SMPTE-431-2 standard.

Custom

The custom gamut allows you to describe the color space according to CIE 1931 primaries and white point, which are expressed as XY coordinates, as well as by gamma, limit and slope. For example, the DCI-P3 gamut mentioned above would have the following values if described as a Custom color space.

Red Primary	0.68	0.32
Green Primary	0.265	0.69
Blue Primary	0.15	0.06
White Point	0.314	0.351
Gamma	2.6	
Linear Limit	0.0313	

To understand how these controls work you could view the tool attached to a gradient background in Waveform mode and observe how different adjustments modify the output.

Output Space

Output Space is the converted gamut to the desired color space. Leave this at No Change if you want to just remove Gamma using the Source Space control.

Remove/Add Gamma

Select these checkboxes to do the gamut conversion in a linear or non-linear gamma, or simply remove or add the appropriate gamma values without changing the color space.

Pre-Divide/Post-Multiply

Selecting this checkbox will cause the image's pixel values to be divided by the alpha values prior to the color correction, and then re-multiplied by the alpha value after the correction. This helps to avoid the creation of illegally additive images, particularly around the edges of a blue/green key or when working with 3D rendered objects.
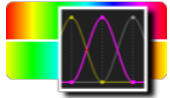
Hue Curves [HCv]

The Hue Curves tool allows you to adjust the color in an image using a series of spline curves. Splines are provided to control the images Hue, Saturation and Luminance as well as each individual color channel. An additional set of curves allows you to apply suppression to individual color channels.

The advantage of the Hue Curves tool over other color correction tools in Fusion is that the splines can be manipulated to restrict the tools effect to a very narrow portion of the image, or expanded to include a wide-ranging portion of the image. Additionally, these curves can be animated to follow changes in the image over time. Since the primary axis of the spline is defined by the image's Hue, it is much easier to isolate a specific color from the image for adjustment.

Controls
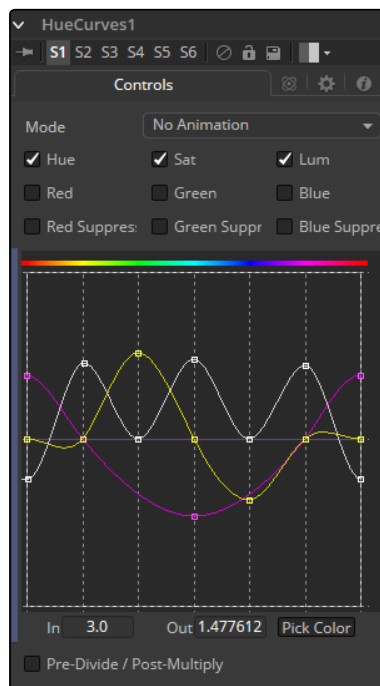
Mode

The Mode options changes between Animate and Dissolve modes. The default mode is Static, where adjustments to the curves are applied consistently over time. Setting the Mode to Animate or Dissolve allows for the color curve to be animated over time.

Dissolve mode is essentially obsolete and is included for compatibility reasons only.

Color Channel Checkboxes

These checkboxes define which Splines are editable and are included in the Pick Color process.

Any number of activated splines can be edited simultaneously, however in most cases it's more convenient to have only the currently modified spline active to avoid unwanted changes to other splines.

When using the Pick Color button a point will be created on all active splines, representing the selected color.

Spline Window

This Look Up Table (LUT) control is the main interface element of the Hue Curves tool, which hosts the various splines. In appearance the tool is very similar to the Color Curves tool, but in this case the horizontal axis represents the image's Hue, while the vertical axis represents the degree of adjustment. The Spline Window shows the curves for the individual channels. It is basically a miniature Spline Editor. In fact, the curves shown in this window can also be found and edited in the Spline Editor.

The spline curves for all components are initially flat, with key points placed horizontally at each of the primary colors. From left to right these are: Red, Yellow, Green, Cyan, Blue, and Magenta. Due to the cyclical nature of the Hue gradient, the leftmost key point in each curve is connected to the rightmost key point of the curve.

Right clicking in the LUT Control will display a contextual menu containing options for resetting the curves, importing external curves, adjusting the smoothness of the selected key points and more. For detailed information of how a Spline Control works in general, please consult the Tool Controls chapter of the manual.

In and Out

Use the In and Out controls to manipulate the precise values of a selected point. To change a value, select a point and enter the in/out values desired.

Pick

Left clicking and dragging from the Pick Color button will change the current mouse cursor to an eyedropper. While still holding down the left mouse button, drag the cursor to a Viewer to pick a pixel from a displayed image. This will cause key points, which are locked on the horizontal axis, to appear on the currently active curves. The key points will represent the position of the selected color on the curve. Use the contextual menu's 'Lock Selected Points' toggle to unlock points and restore the option of horizontal movement.

Points are only added to enabled splines. To add points only on a specific channel, disable the other channels before making the selection.

Pre-Divide/Post-Multiply

Selecting this checkbox will cause the image's pixel values to be divided by the alpha values prior to the color correction, and then re-multiplied by the alpha value after the correction. This helps to avoid the creation of illegally additive images, particularly around the edges of a blue/green key or when working with 3D rendered objects.

OCIO CDL Transform [OCD]

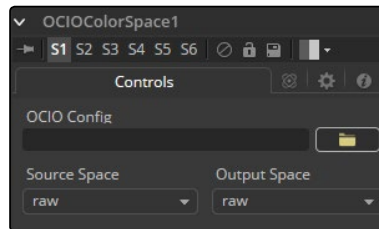Fusion supports the Open Color IO workflow specified by Sony Imageworks. In general, the color pipeline is made up from a set of color transformations defined by OCIO-specific config files, commonly named with a ".ocio" extension, which allows users to easily share color settings within or between facilities. The path to the config file to be used is normally specified by a user-created environment variable called "OCIO," though some tools allow overriding this. If no other *.ocio config files are located, the DefaultConfig.ocio file in Fusion's LUTs directory will be used.

For in-depth documentation of the format's internals, please refer to the official pages on opencolorio.org.

The OCIO CDLTransform allows users to create, save, load, and apply CDL files.

Controls
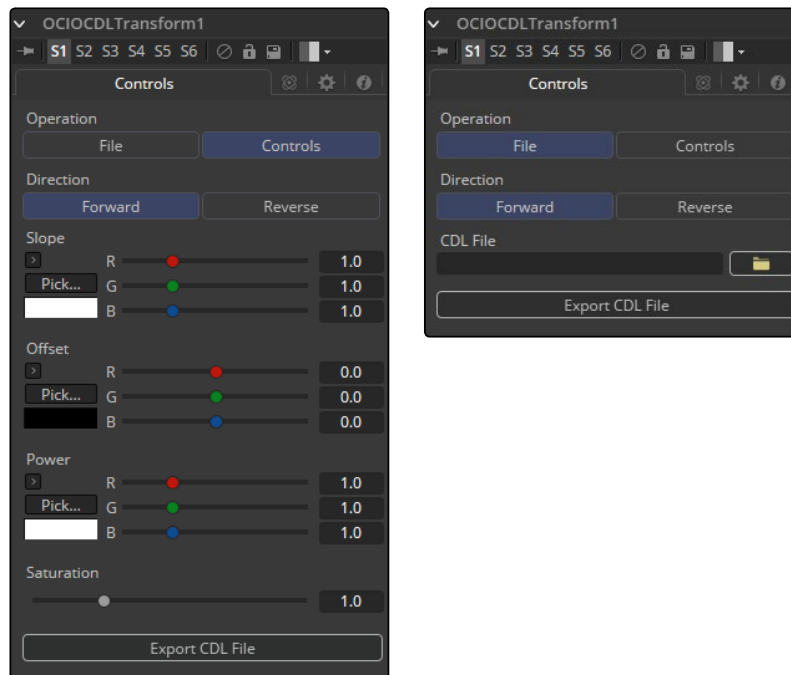
Operation
Toggles between File and Controls. In File mode, standard ASC-CDL files can be loaded. In Controls mode, manual adjustments can be made to Slope, Offset, Power and Saturation, and the CDL file can be saved.

Direction
Toggles between Forward and Reverse. Forward applies the corrections specified in the tool, while reverse tries to remove those corrections. Keep in mind that not every color correction can be undone.

Imagine all slope-values have been set to 0.0, resulting in a fully black image. Reversing that operation is not possible, neither mathematically nor visually.

Slope

Multiplies the color values. This is the same as Gain in the BrightnessContrast tool.

Offset
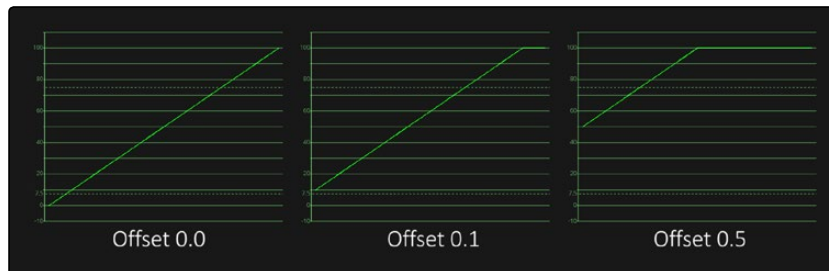
Adds to the color values. This is the same as Brightness in the BrightnessContrast tool.

Power

Applies a Gamma Curve. This is an inverse of the Gamma function of the BrightnessContrast tool.

Saturation

Enhances or decreases the color saturation. This works the same as Saturation in the BrightnessContrast tool.

Export File

Allows the user to export the settings as a CDL file.

OCIO ColorSpace [OCC]

Fusion supports the Open Color IO workflow specified by Sony Imageworks.

In general, the color pipeline is made up from a set of color transformations defined by OCIO-specific config files, commonly named with a ".ocio" extension, which allows users to easily share color settings within or between facilities. The path to the config file to be used is normally specified by a user-created environment variable called "OCIO," though some tools allow overriding this.

If no other *.ocio config files are located, the DefaultConfig.ocio file in Fusion's LUTs directory will be used. For in-depth documentation of the format's internals, please refer to the official pages on opencolorio.org. The OCIOColorSpace allows for sophisticated color space conversions, based on an OCIO Config File. Sample configs can be obtained from opencolorio.org/downloads.html

The functionality of the OCIOColorSpace tool is also available as a ViewLUT tool from the ViewLUT Menu.

Controls

OCIO Config

Displays a File > Open dialog to load the desired Config File.

Source Space

Based on the Config file, the available source color spaces will be listed here.

The content of this list is solely based on the loaded profile and hence can vary immensely.

Output Space

Based on the Config file, the available output color spaces will be listed here.

The content of this list is solely based on the loaded profile and hence can vary immensely.

The ViewLUT Version of the Tool
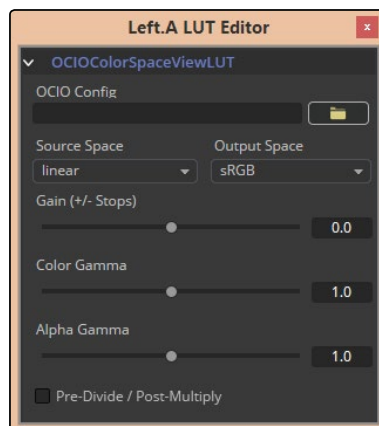
OCIO FileTransform [OCF]

Fusion supports the Open Color IO workflow specified by Sony Imageworks.

In general, the color pipeline is made up from a set of color transformations defined by OCIO-specific config files, commonly named with a ".ocio" extension, which allows users to easily share color settings within or between facilities. The path to the config file to be used is normally specified by a user-created environment variable called "OCIO," though some tools allow overriding this.

If no other *.ocio config files are located, the DefaultConfig.ocio file in Fusion's LUT directory will be used. For in-depth documentation of the format's internals, please refer to the official pages on opencolorio.org. The OCIOFileTransform allows the user to load and apply a variety of Look Up Tables.

The functionality of the OCIOFileTransform tool is also available as a ViewLUT tool from the ViewLUT Menu.

Controls
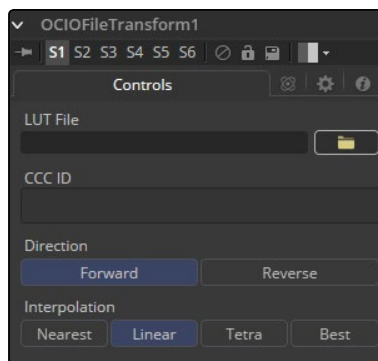
LUT File
Displays a File > Open dialog to load the desired LUT.
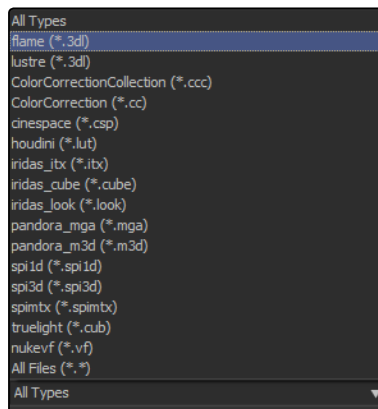
CCC ID

Direction

Toggles between Forward and Reverse. Forward applies the corrections specified in the tool, while reverse tries to remove those corrections. Keep in mind that not every color correction can be undone. Imagine all slope values have been set to 0.0, resulting in a fully black image. Reversing that operation is not possible, neither mathematically nor visually.

Interpolation

Allows user to select the color interpolation to achieve the best quality/render time ratio.

The ViewLUT Version of the Tool
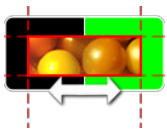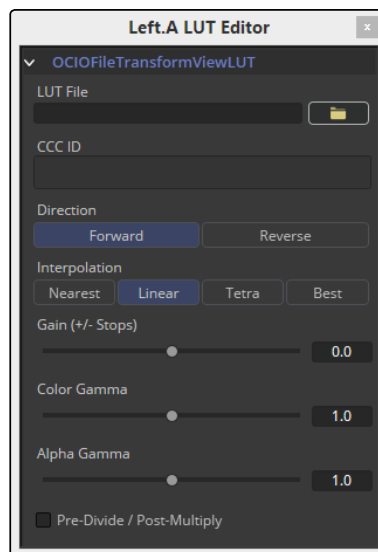
Set Canvas Color [SCv]

Set Canvas Color is used to set the color of the workspace - all the area beyond the defined pixels within an image (the DoD). This area usually extends to infinity. By default, the canvas color used is Black/no Alpha (transparent).

Some tools may change an image's canvas color, for example, inverting a mask will change the mask's canvas from black to white. Set Canvas Color allows you to control and override this.

Controls Tab
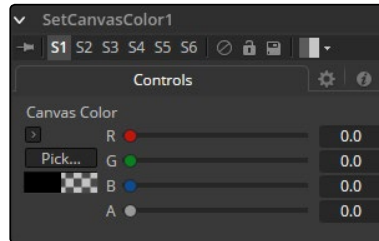
Color Picker

Use these controls to adjust the Color and the Alpha value for the image's canvas. It defaults to Black with zero Alpha.

White Balance [WB]

The White Balance tool can be used to automatically remove color casts in the image caused by the incorrect setup of a camera, problems in a camera's CCD, or bad lighting conditions. Correction can be done by selecting a color temperature, or by choosing a neutral color from the original image that exhibits the color cast to be corrected.

> Important When picking neutral colors using the Custom method, make sure you are picking from the source image, not the results of the White Balance tool. This ensures that the image doesn't change while you are still picking, and that the White Balance tool gets an accurate idea of the original colors it needs to correct.

Balance Tab
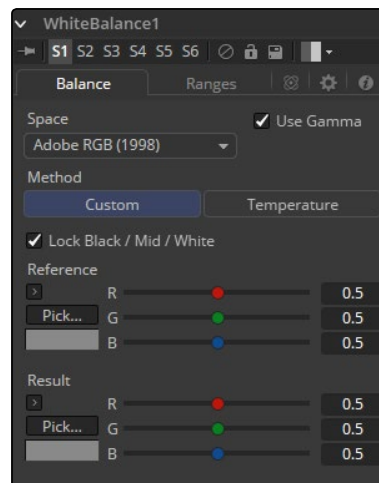
Color Space

Use this menu to select the Color Space of the source image, if it is known. This can make the correction more accurate since the tool will be able to take the natural gamma of the color space into account as part of the correction. If the color space that the image uses is unknown, leave this menu at its default value.

Method

The white balance tool can operate using one of two methods, a Custom method and a color Temperature method.

Custom

The Custom method requires the selection of a pixel from the scene that should have been pure gray.

The tool uses this information to calculate the color correction required to convert the pixel so that it actually is gray. When that correction is applied to the entire image, it generally white balances the entire shot.

Temperature

The color Temperature method requires that the actual color temperature of the shot be specified.

Lock Black/Mid/White

This checkbox locks the Black, Mid and White points together so that the entire image is affected equally. Unchecking the control will provide individual controls for white balancing each range separately. This control affects both methods equally.

Black/Mid/White Reference

These controls only appear if the Custom method is selected. They are used to select a color from a pixel in the source image. The White Balance tool will color correct the image so that the selected color is transformed to the color set in the Result color picker below. Generally, this is gray. A color that is supposed to be pure gray but is not truly gray for one reason or another should be selected.

If the Lock Black/Mid/White checkbox is deselected, different references can be selected for each color range.

For example, try to select a pixel for the black and white references that is not clipped in any of the color channels. In the high end, an example would be a pixel that is light pink with values of 255, 240, 240. The pixel is saturated/clipped in the Red, even though the color is not white. Similarly, a really dark blue-gray pixel might be 0, 2, 10. It is clipped in Red as well, even though it is not black.

Neither example would be a good choice as a reference pixel because there would not be enough headroom left for the White Balance tool.

Black/Mid/White Result

These controls only appear if the Custom method is selected. They are used to select the color to which the tool will balance the reference color. This generally defaults to pure, midrange gray.

If the Lock Black/Mid/White checkbox is deselected, different results can be selected for each color range.

Temperature control
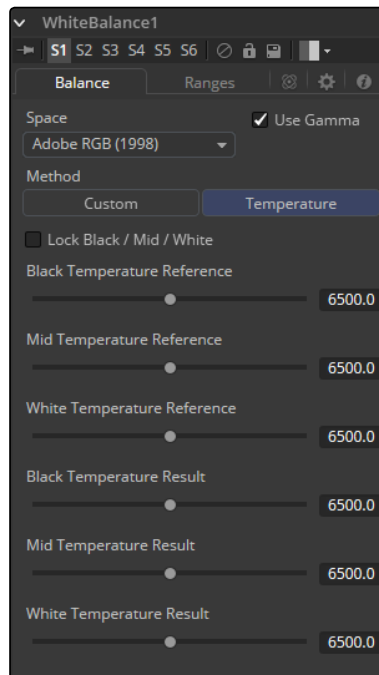
Temperature Reference

Use this control to set the color Temperature of the source image. If the Lock Black/Mid/White checkbox is deselected, different references can be selected for each color range.

Temperature Result

Use this control to set the target color temperature for the image. If the Lock Black/Mid/White checkbox is deselected, different results can be selected for each color range.

Use Gamma

This checkbox selects whether the tool will take the gamma of the image into account when applying the correction, using the default gamma of the color space selected in the menu at the top of the tab.

Ranges Tab
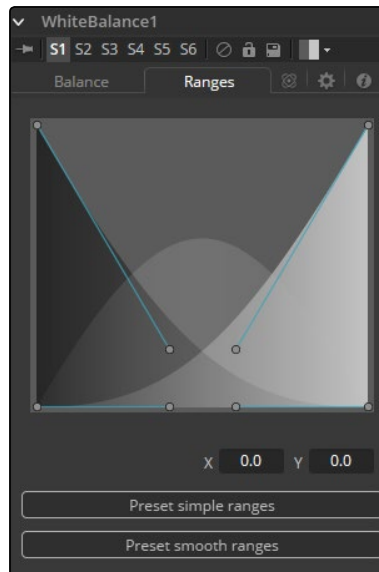
Ranges

Use the controls in the Ranges tab to customize the range of pixels in the image considered to be shadows, midtones and highlights by the tool. The use of the controls in this tab is documented in detail in the Color Corrector tools documentation.

Composite Tools

7

Composite Tools

Composite Tools

Menu	Submenu
3D	▶
Blur	▶
Color	▶
Composite	▶
Creator	▶
Deep Pixel	▶
Effect	▶
Film	▶
Filter	▶
Flow	▶
Fuses	▶
I/O	▶
LUT	▶
Macro	▶
Mask	▶
Matte	▶
Metadata	▶
Miscellaneous	▶
Optical Flow	▶
Paint	▶
Particles	▶
Position	▶
Primatte	▶
Stereo	▶
Tracking	▶
Transform	▶
Warp	▶

Composite submenu: Dissolve, Merge

Dissolve

Merge
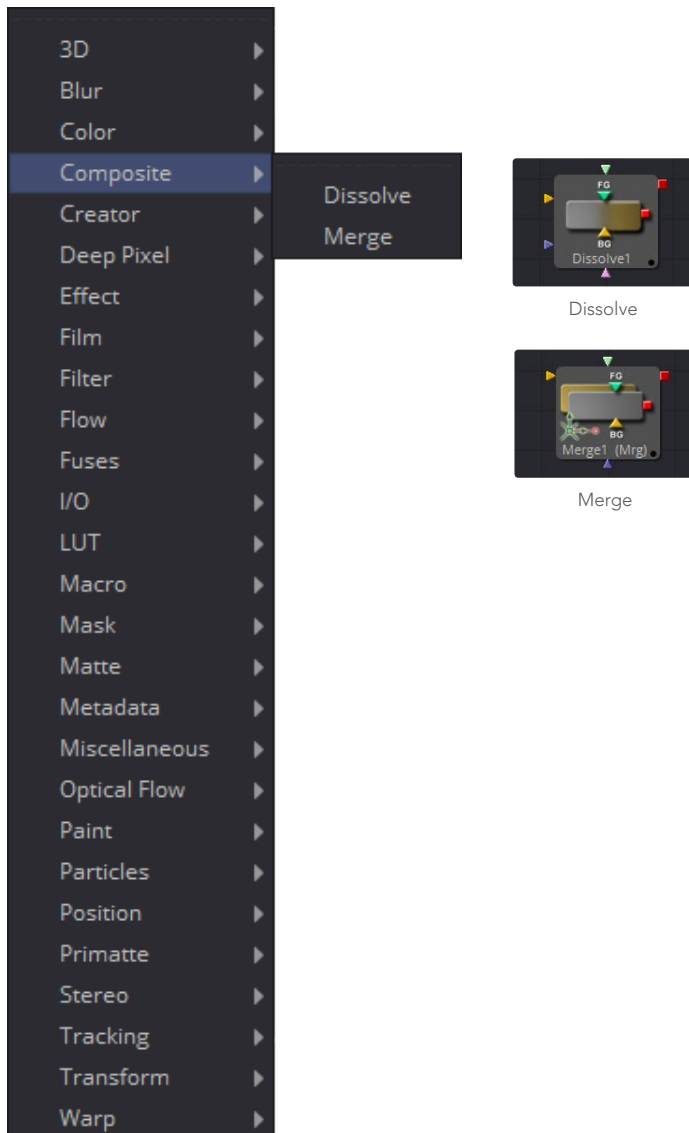
Dissolve [DX]

The Dissolve tool is used to mix two images together, providing a gradual transition between two clips. A slider controls the amount of mix between the foreground and background layers. Dissolves are commonly used to transition between one clip and another and are a very common effect in editing. The Gradient Wipe setting allows arbitrary animated dissolve patterns based on the luminance of a third input. Use this with geometric shapes, fire, water ripples, rain, Perlin noise, particle systems or a video clip of your choice to get a variety of unique and creative transitions. Soft-edged effect masks may also be used to add to the possible effects.

One useful attribute of the Dissolve tool is that, unlike all other tools in Fusion, it does not require a valid background at all times, but will output either background or foreground as appropriate. This allows you to use it as an easy automatic switcher tool. You may connect clips to both background and foreground. Use the Background/Foreground control to determine priority of which is output, and if one clip terminates early, the other is automatically output instead. Animating the Background/Foreground control allows manual switching.

The tool tile provides three image inputs: Foreground, Background and Gradient Map. The Gradient Map input is required only when Gradient Wipe is selected. The Dissolve tool works best when both foreground and background inputs are images with the same resolution. If input images of different sizes are mixed together, the output size will be large enough to cover both images. If full Foreground or Background is selected, that image is output untouched, at its native size. Animating the Foreground/Background slider in this case may cause undesirable resolution changes.

For example, attempt to dissolve between an NTSC image (background) and a PAL image (foreground) and the output of the Dissolve tool will be NTSC when the slider is set to full Background. It will suddenly jump to PAL when set to full Foreground. Mix between FG and BG and the resolution of the output image will be the largest dimension from each image; in this case the output will be 720 x 576 (PAL sized).

It is recommended to ensure all inputs of the Dissolve tool are the same resolution and pixel aspect.

Controls
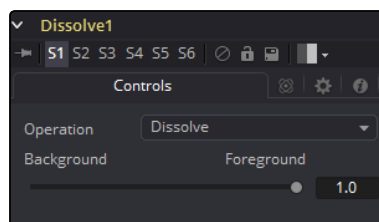
Operation

The Operation drop-down menu contains one of seven different methods for mixing the Foreground and Background inputs. The two images are mixed together using the value of the Background/ Foreground slider to determine the percentage each image contributes.

Dissolve

The standard Dissolve mode is the equivalent of a cross dissolve, one clip fades out as another clip fades in.

Additive Dissolve

Similar in look to a standard film dissolve, an Additive Dissolve adds the second clip and then fades out the first one.

Erode

The Erode method transitions between the two images by growing the darkest areas of the background image to reveal the foreground image. The effect appears similar to a filmstrip burning out.

Random Dissolve

A randomly generated dot pattern is used to perform the mix of the images.

Random Noise Dissolve

A moving random dot pattern is used to perform the mix of the images.

Gradient Wipe

The dissolve is controlled by the luminance values of the image in the Gradient Map input. The edges of this dissolve can be softened. The density and the color of the border can be adjusted independently.

SMPTE Wipe

The SMPTE Wipe is similar to the basic effect wipes found on many video effects switchers. There is a horizontal wipe and a vertical wipe provided. The wipes can have soft edges and borders added. The density and the color of the border can be adjusted independently.

Background/Foreground

This control determines whether the output is the background image, the foreground image, or a mix between the two. The type of mix is determined by the Operation control. If one of the input images is not currently available, the other one will be output regardless of the setting of this slider.

Gradient/SMPTE wipe controls

The following controls appear only when Gradient Wipe or SMPTE Wipe are selected.
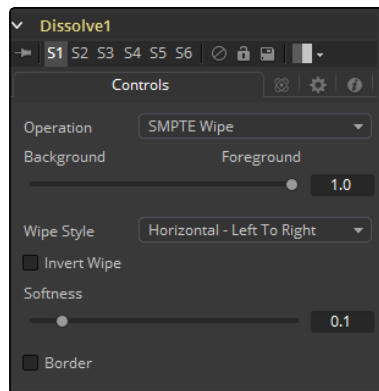
Wipe Style

(SMPTE Wipe only) The drop-down list allows the selection of two wipe styles: Horizontal - Left to Right and Vertical - Top to Bottom. The direction of the wipes can be reversed by using the Invert Wipe checkbox.

Invert Wipe

(SMPTE Wipe only) When checked, the direction of the wipe will be reversed.

Softness

Use this control to soften the edge of the transition.

Border

Select the Border to enable coloring of the transition's edge and to reveal the associated controls. The effect is to create a border around the transition edge.

Border Softness

The Border Softness slider controls the width and density of the border. Higher values will create a denser border and lower values will create a thinner one.

Border Color

Use Border Color to select the color used in the border.
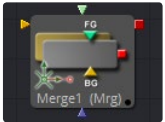
Merge [MRG]

The Merge tool combines two images based on the alpha (opacity) channel associated with the one in front. This tool takes two inputs - a background and a foreground image. The Operation mode of the merge determines what method is used to combine the images.

Instead of providing you with a dozen tools for each different method used to combine images, Fusion uses a single Merge tool that supports the standard over, in, held out, atop and xor methods for compositing images, as well as many common blending modes like screen, dissolve, multiply and overlay.

The Merge tool can handle both additive (premultiplied) and subtractive (non-premultiplied) compositing. Use Merge to blend between the additive and subtractive results, providing solutions for some otherwise tricky problems.

This tool can also be used to composite images based on information from the Z-buffer channel of the images, if available. Rather than relying on the foreground and background order to determine layer order, Z-merging compares the depth value of each pixel to determine which is the foreground pixel and which is the background pixel.

Merge Tab
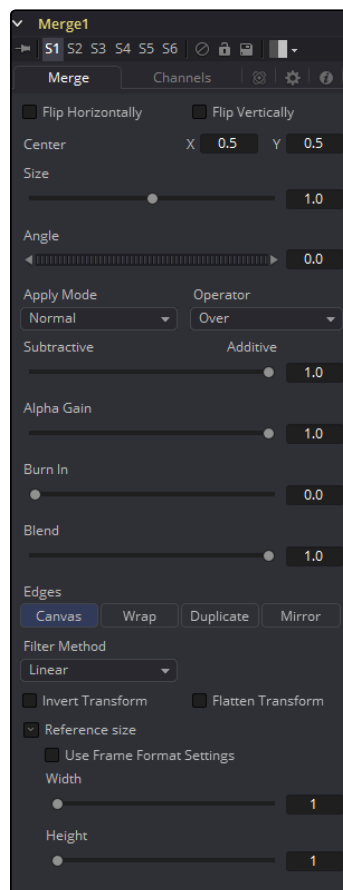
Center X and Y

This control determines the position of the foreground image in the composite. The default is 0.5, 0.5, which centers the foreground image in the exact center of the background image. The value shown is always the actual position in normalized coordinates, multiplied by the reference size. See below for a description of the reference size controls.

Size

Use this control to increase or decrease the Size of the foreground image before it is composited over the background. The range of values for this slider is 0.0 to 5.0, but any value greater than 0 can be entered manually. A size of 1.0 gives a pixel-for-pixel composition, where a single pixel in the foreground is the same size as a single pixel in the background.

Angle

Use this control to rotate the foreground image before it is combined with the background.

Apply Modes

The Apply Mode setting determines the math used when blending or combining the foreground and background pixels.
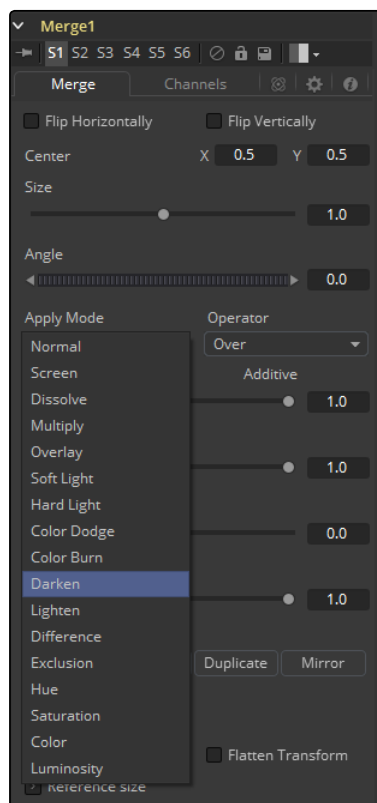
Normal

The Default merge mode uses the foreground's alpha channel as a mask to determine which pixels are transparent and which are not. When this is active, another menu shows possible operations, including: over, in, held out, atop and xor.

Screen

Screen merges the images based on a multiplication of their color values. The alpha channel is ignored and layer order becomes irrelevant. The resulting color is always lighter. Screening with black leaves the color unchanged, whereas screening with white will always produce white. This effect creates a similar look to projecting several film frames onto the same surface.

Dissolve

Dissolve mixes two image sequences together. It uses a calculated average of the two images to perform the mixture.

Multiply

Multiply the values of a color channel. This will give the appearance of darkening the image as the values are scaled from 0 to 1. White has a value of 1, so the result would be the same. Gray has a value of 0.5, so the result would be a darker image or, in other words, an image half as bright.

Overlay

Overlay multiplies or screens the color values of the foreground image, depending on the color values of the background image. Patterns or colors overlay the existing pixels while preserving the highlights and shadows of the color values of the background image. The background image is not replaced but is mixed with the foreground image to reflect the original lightness or darkness of the background image.

Soft Light

Soft Light darkens or lightens the foreground image, depending on the color values of the background image. The effect is similar to shining a diffused spotlight on the image.

Hard Light

Hard Light multiplies or screens the color values of the foreground image, depending on the color values of the background image. The effect is similar to shining a harsh spotlight on the image.

Color Dodge

Color Dodge uses the foreground's color values to brighten the background image. This is similar to the photographical practice of dodging by reducing the exposure of an area of a print.

Color Burn

Color Burn uses the foreground's color values to darken the background image. This is similar to the photographical practice of burning by increasing the exposure of an area of a print.

Darken

Darken looks at the color information in each channel and selects the background or foreground image's color value, whichever is darker, as the result color. Pixels lighter than the merged colors are replaced, and pixels darker than the merged color do not change.

Lighten

Lighten looks at the color information in each channel and selects the background or foreground image's color values, whichever is lighter, as the result color value. Pixels darker than the merged color are replaced, and pixels lighter than the merged color do not change.

Difference

Difference looks at the color information in each channel and subtracts the foreground color values from the background color values or the background from the foreground, depending on which has the greater brightness value. Merging with white inverts the color. Merging with black produces no change.

Exclusion

Exclusion creates an effect similar to, but lower in contrast than, the Difference mode. Merging with white inverts the base color values. Merging with black produces no change.

Hue

Hue creates a result color with the luminance and saturation of the background color values and the hue of the foreground color values.

Saturation

Saturation creates a result color with the luminance and hue of the base color and the saturation of the blend color.

Color

Color creates a result color with the luminance of the background color value and the hue and saturation of the foreground. This preserves the gray levels in the image and is useful for coloring monochrome images.

Luminosity

Luminosity creates a result color with the hue and saturation of the background color values and the luminance of the foreground color values. This mode creates an inverse effect from that of the Color mode.

Operator Modes
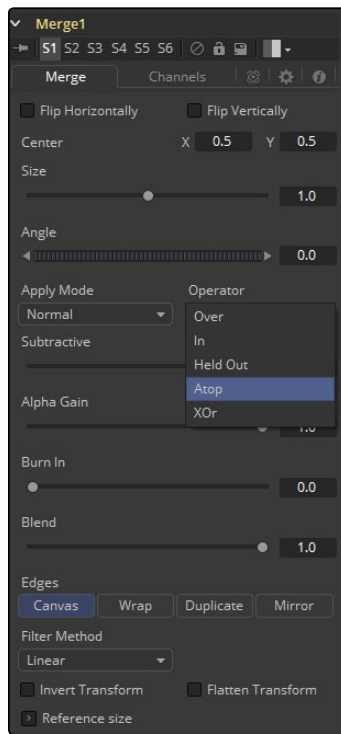
This menu is used to select the Operation mode of the merge. Changing the Operation mode changes how the foreground and background are combined to produce a result. The menu will only be visible when the Merge tool's Apply mode is set to Normal.

For an excellent description of the math underlying the Operation modes, read Compositing Digital Images, Porter, T., and T. Duff, SIGGRAPH 84 proceedings, pages 253-259. Essentially, the math is as described below. Note that some modes not listed in the Operator drop-down (Under, In, Held In, Below) are easily obtained by swapping the foreground and background inputs (with Command-T or Ctrl-T) and choosing a corresponding mode.

The formula used to combine pixels in the merge is always fg * x + bg * y. The different operations determine exactly what x and y are, as shown in the description for each mode.

Over

The Over mode adds the FG layer to the BG layer by replacing the pixels in the BG with the pixels from the Z wherever the FG's alpha channel is greater than 1.

```
x = 1, y = 1–[foreground alpha]
```

In

The In mode multiplies the alpha channel of the BG input against the pixels in the FG. The color channels of the FG input are ignored. Only pixels from the FG are seen in the final output. This essentially clips the FG using the mask from the BG.

```
x = [background alpha], y = 0
```

Held Out

Held Out is essentially the opposite of the In operation. The pixels in the FG image are multiplied against the inverted alpha channel of the BG image. Accomplish exactly the same result using the In operation and a Matte Control tool to invert the matte channel of the BG image.

```
x = 1-[background alpha], y = 0
```

ATop

ATop places the FG over the BG only where the BG has a matte.

```
x = [background alpha], y = 1-[foreground alpha]
```

XOr

XOr combines the FG with the BG wherever either the FG or the BG have a matte, but never where both have a matte.

```
x = 1-[background alpha], y = 1-[foreground alpha]
```

Subtractive and Additive

This slider controls whether Fusion performs an Additive or a Subtractive merge. An Additive merge assumes that the foreground image is pre-multiplied, meaning that the pixels in the color channels have been multiplied by the pixels in the alpha channel. The result is that transparent pixels are always black, since any number multiplied by 0 is always going to be 0.

When the Merge tool can assume the image is pre-multiplied, it can perform an Additive merge. This obscures the background (by multiplying with the inverse of the foreground alpha), then simply adds the pixels from the foreground.

If the images are not pre-multiplied then usually all that is required is a Subtractive merge. This method is similar to additive, but the foreground image is first multiplied by its own alpha, to eliminate any background pixels outside the alpha area.

Fusion defaults to Additive merging for most operations, assuming that the images are pre-multiplied. Using Subtractive merging on a pre-multiplied image may result in darker edges, whereas using Additive merging with a non-premultiplied image will cause any non-black area outside the foreground's alpha to be added to the result.

Although the Additive/Subtractive option could easily have been a checkbox to select one mode or another, Fusion allows for blending between the Additive and Subtractive modes, an operation that can occasionally be useful for dealing with problem images.

Alpha Gain

Alpha Gain linearly scales the values of the foreground's alpha channel. In Subtractive merges, this controls the density of the composite, similarly to Blend. In Additive merges, this effectively reduces the amount that the background is obscured by, thus brightening the overall result. In an Additive merge with Alpha Gain set to 0.0, the foreground pixels are simply added to the background.

Burn In

The Burn In control adjusts the amount of alpha used to darken the background, without affecting the amount of foreground added in. At 0.0, the merge behaves like a straight alpha blend, whereas at 1.0, the foreground is effectively added onto the background (after alpha multiplication if in Subtractive mode).

This gives the effect of the foreground image brightening the background image, as with Alpha Gain. In fact, for Additive merges, increasing the Burn In gives an identical result to decreasing Alpha Gain.

Filter Modes

Nearest Neighbor

This skips or duplicates pixels as needed. This produces the fastest but crudest results.

Box

This is a simple interpolation resize of the image.

Linear

This uses a simplistic filter, which produces relatively clean and fast results.

Quadratic

This filter produces a nominal result. It offers a good compromise between speed and quality.

Cubic

This produces better results with continuous tone images but is slower than Bi-Cubic. If the images have fine detail in them, the results may be blurrier than desired.

Catmull-Rom

This produces good results with continuous tone images that are resized down. Produces sharp results with finely detailed images.

Gaussian

This is very similar in speed and quality to Bi-Cubic.

Mitchell

This is similar to Catmull-Rom but produces better results with finely detailed images. It is slower than Catmull-Rom.

Lanczos

This is very similar to Mitchell and Catmull-Rom but is a little cleaner and also slower.

Sinc

This is an advanced filter that produces very sharp, detailed results, however it may produce visible 'ringing' in some situations.

Bessel

This is similar to the Sinc filter but may be slightly faster.

Window Method

Some filters, such as Sinc and Bessel, require an infinite number of pixels to calculate exactly. To speed up this operation, a windowing function is used to approximate the filter and limit the number of pixels required. This control appears when a filter that requires windowing is selected.

Hanning

This is a simple tapered window.

Hamming

Hamming is a slightly tweaked version of Hanning.

Blackman

A window with a more sharply tapered falloff.

Kaiser

A more complex window, with results between Hamming and Blackman.

Most of these filters are useful only when making an image larger. When shrinking images, it is common to use the Bi-Linear filter, however the Catmull-Rom filter will apply some sharpening to the results and may be useful for preserving detail when scaling down an image.

Different Resize Filters. From left to right:
Nearest Neighbor, Box, Linear, Quadratic, Cubic, Catmull-Rom, Gaussian, Mitchell, Lanczos, Sinc, Bessel

Blend

This is a cloned instance of the Blend slider in the Common Controls tab. Changes made to this control are simultaneously made to the one in the common controls.

The Blend slider mixes the result of the tool with its input, blending back the effect at any value less than 1.0. In this case it will blend the background with the merged result.

Invert Transform

Select the Invert Transform control to invert any position, rotation or scaling transformation. This option is useful when connecting the merge to the position of a tracker for the purpose of match moving.

Flatten Transform

The Flatten Transform option prevents this tool from concatenating its transformation with subsequent tools. The tool may still concatenate transforms from its input, but it will not concatenate its transformation with the tool at its output. See the Transformations chapter earlier in this manual for details on concatenated transformation.

Reference Size

The controls under the Reference Size reveal do not directly affect the image. Instead they allow you to control how Fusion represents the position of the Merge tool's center.

Normally, coordinates are represented as values between 0 and 1, where 1 is a distance equal to the full width or height of the image. This allows for resolution independence, because the size of the image can be changed without having to change the value of the center.

One disadvantage to this approach is that it complicates making pixel accurate adjustments to an image. To demonstrate, imagine an image that is 100 x 100 pixels in size. To move the center of the foreground element to the right by 5 pixels, we would change the X value of the merge center from 0.5, 0.5 to 0.55, 0.5. We know the change must be 0.05 because 5/100 = 0.05.

If you specify the dimensions of the background image in the Reference Size controls, this changes the way the Center control values are displayed so that it shows the actual pixel positions in its X and Y fields.

Extending the example, set the width and height to 100 each and the center will now be shown as 50, 50, and we would move it 5 pixels toward the right by entering 55, 50.

Internally, the Merge tool still stores this value as a number between 0 to 1 and, if the center control's value were to be queried via scripting or the center control were to be published for use by other tools, the original normalized value would be retrieved. The change is only visible in the value shown for merge center in the tool control.

Use Frame Format Settings

Select this to force the merge to use the composition's current frame format settings to set the reference width and reference height values.

Width and Height

Set these sliders to the width and height of the image to change the way that Fusion displays the values of the Merge tool's center control.

Channels Tab

Perform Depth Merge

When checked, the Z-buffer channel of both images will be used to determine the composite order. Alpha channels are still used for transparency, but the values of the Z-buffer channel will determine the ordering of image elements. If a Z-buffer channel is not available for either image, the setting of this checkbox will be ignored, and no depth compositing will take place.

Depth merging is off by default. If an image has an associated Z-buffer channel, and that channel is not to be used to perform a depth merge, turn this checkbox off.

Foreground Z-Offset

This slider sets an offset applied to the foreground image's Z value. Click the Pick button to pick a value from a displayed image's Z-channel, or enter a value using the slider or input boxes. Raising the value causes the foreground image's Z-buffer to be offset further away along the Z-axis, whereas lowering the value causes the foreground to move closer.

Subtractive and Additive

When Z-compositing, it is possible for image pixels from the background to be composited in the foreground of the output because the Z-buffer for that pixel is closer than the Z of the foreground pixel. This slider controls whether these pixels are merged in an Additive or a Subtractive mode, in exactly the same way as the comparable slider in the Merge tab.

When merged over a background of a different color, the original background will still be visible in the semi-transparent areas. An Additive merge will maintain the transparencies of the image but will add their values to the background.

Creator Tools
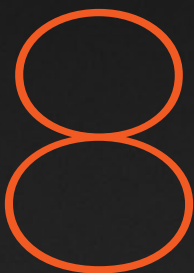
Creator Tools

Creator Tools

Favorites ▶		
3D ▶		
AT ▶		
AT 3D ▶		
Blur ▶		
Color ▶		
Composite ▶		
Creator ▶	Background	
Deep Pixel ▶	DaySky	
Effect ▶	FastNoise	
Film ▶	Mandelbrot	
Filter ▶	Plasma	
Flow ▶	Text+	
Fuses ▶		
I/O ▶		
Krokodove ▶		
Macros ▶		
Mask ▶		
Matte ▶		
Metadata ▶		
Miscellaneous ▶		
OpenCL ▶		
Paint ▶		
Particles ▶		
Position ▶		
Primatte ▶		
Stereo ▶		
Tracking ▶		
Transform ▶		
Warp ▶		

Background

Day Sky

Fast Noise

Mandelbrot

Plasma

Text Plus
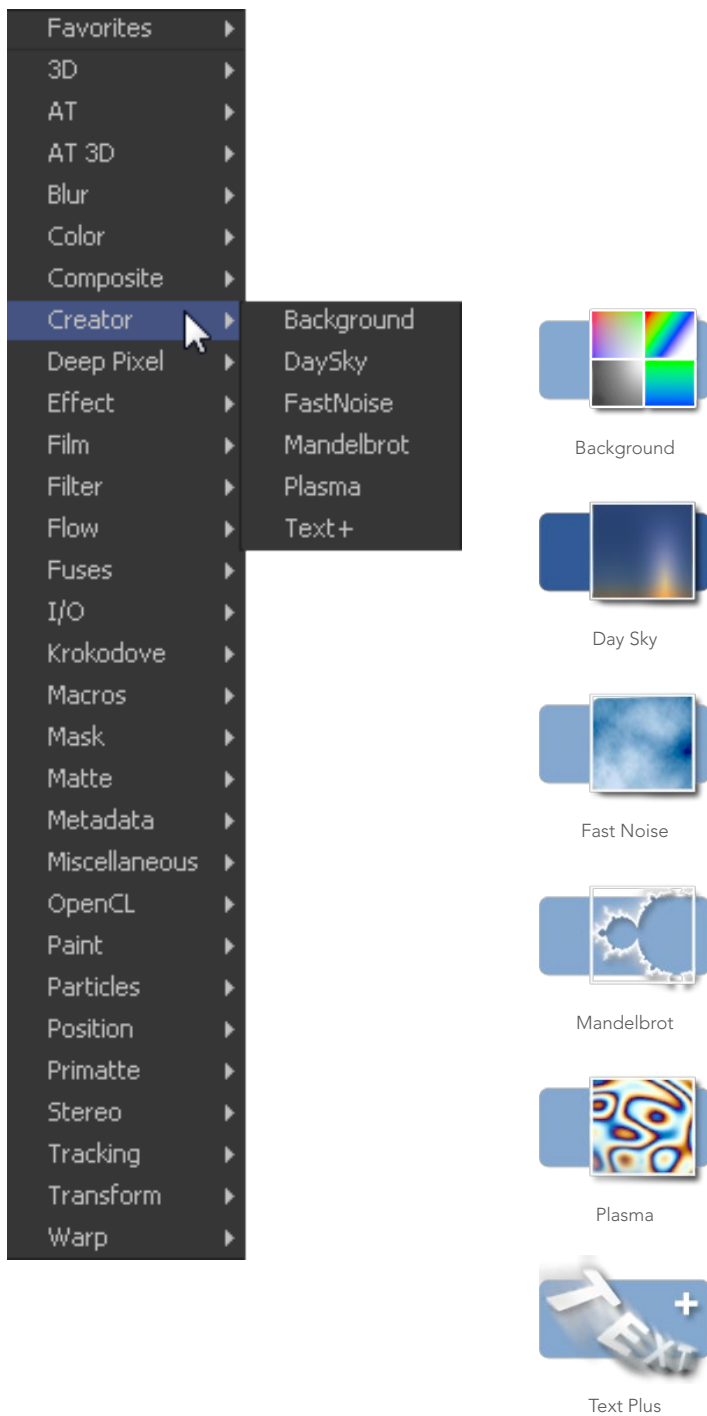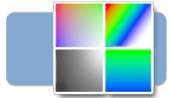
Background [BG]

The Background tool can be used to produce anything from simple color backgrounds to complex loopable gradients.

Color Tab
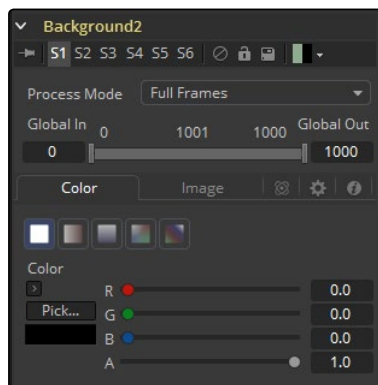
Mode

This control is used to select the mode used by the background tool when the image is generated. Four selections are available.

> → Solid Color: This default creates a single color image.

> → Horizontal: This creates a two color horizontal gradation.

> → Vertical: This creates a two color vertical gradation.

> → Four Corner: This creates a four color corner gradation.

Gradient

This creates a background from a custom gradient.
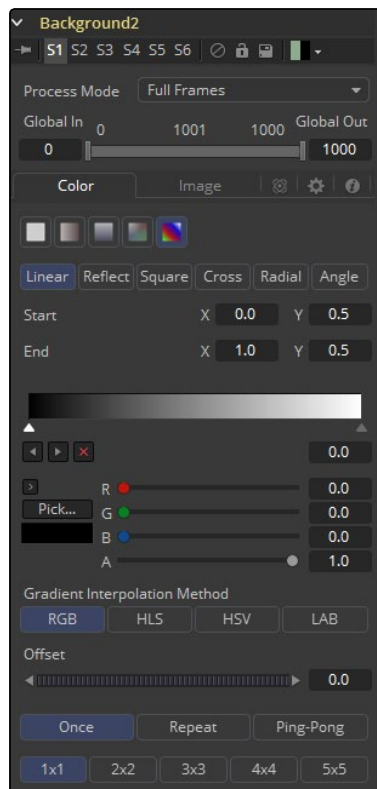
Color

These controls are used to select the color of the Background tool. Depending on the mode selected, one to four color controls will be displayed to create linear color ramp backdrops. Select one and pick a color from the preset menu or create them. Alternatively, enter values in RGB via the keyboard by clicking in the values box and typing in the value. Each color has its own alpha value slider to adjust the transparency of each color.

Custom Gradient Controls

The Custom Gradient controls that appear are described in depth in the Tool Controls chapter of this manual. Consult this chapter for details on setting up a custom gradient for use in the Background tool.

Image Tab

The controls in this tab are used to set the resolution, color depth and pixel aspect of the image produced by the tool.

Process Mode

Use this menu control to select the Fields Processing mode used by Fusion to render changes to the image. The default option is determined by the Has Fields checkbox control in the Frame Format preferences. For more information on fields processing, consult the Frame Formats chapter.

Global In and Out

Use this control to specify the position of this tool within the project. Use Global In to specify on which frame that the clip starts and Global Out to specify on which frame this clip ends (inclusive) within the project's Global Range.

The tool will not produce an image on frames outside of this range.

Use Frame Format Settings

When this checkbox is selected, the width, height and pixel aspect of the image created by the tool will be locked to values defined in the composition's Frame Format preferences. If the Frame Format preferences change, the resolution of the image produced by the tool will change to match. Disabling this option can be useful to build a composition at a different resolution than the eventual target resolution for the final render.

Width/Height

This pair of controls is used to set the Width and Height dimensions of the image to be created by the tool.

Pixel Aspect

This control is used to specify the Pixel Aspect ratio of the created images. An aspect ratio of 1:1 would generate a square pixel with the same dimensions on either side (like a computer display monitor) and an aspect of 0.9:1 would create a slightly rectangular pixel (like an NTSC monitor).

Depth

The Depth button array is used to set the pixel color depth of the image created by the Creator tool. 32-bit pixels require 4 times the memory of 8-bit pixels, but have far greater color accuracy. Float pixels allow high dynamic range values outside the normal 0..1 range, for representing colors that are brighter than white or darker than black. See the Frame Formats chapter for more details.

Right-click on the Width, Height or Pixel Aspect controls to display a menu listing the file formats defined in the preferences Frame Format tab. Selecting any of the listed options will set the width, height and pixel aspect to the values for that format accordingly.

Day Sky [DS]

The DaySky generator is a practical implementation of the research paper, A Practical Analytical Model for Daylight, by Preetham, Shirley, and Smits. A copy of the original paper can be found at the website for the Visual Simulation Group at the University of Utah [http://www.cs.utah.edu/~shirley/papers/sunsky/].

This tool aims to produce a simulation of the daylight produced at a specific time and location on the earth, and generates a high dynamic range image that represents a map of that light. It is not a sky generator, although it could be combined with a cloud generator or noise tool to produce one.

Controls Tab
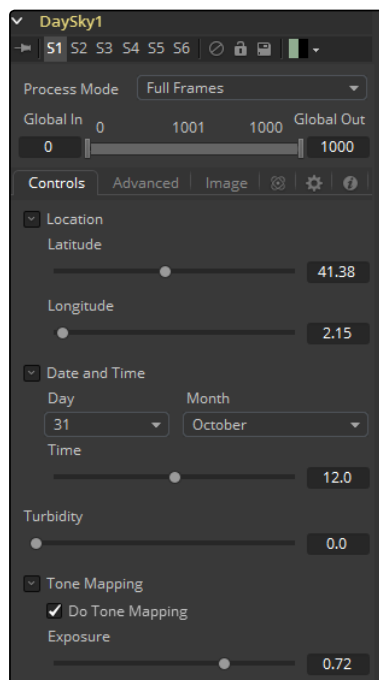
Latitude, Longitude

Use these sliders to specify the Latitude and Longitude used to create the Day Sky simulation.

Day, Month, Time

Use these controls to specify the Day, Month and Time for the DaySky simulation.

Turbidity

Turbidity causes light to be scattered and absorbed rather than transmitted in straight lines through the simulation. Increasing the turbidity will give the sky simulation a murky feeling, as if smoke or atmospheric haze were present.

Do Tone Mapping

Deselect this checkbox to disable any tone mapping applied to the simulation. Since the simulation is calculated in 32-bit floating-point color space, it generates color values well above 1.0 and well below 0.0. Tone Mapping is a process that takes the full dynamic range of the resulting simulation and compresses the data into the desired exposure range while attempting to preserve as much detail from the highlights and shadows as possible.

Generally, this option should only be deselected if the resulting image will later be color corrected as part of a floating-point color pipeline.

Exposure

Use this control to select the exposure used for Tone Mapping.

Advanced Tab
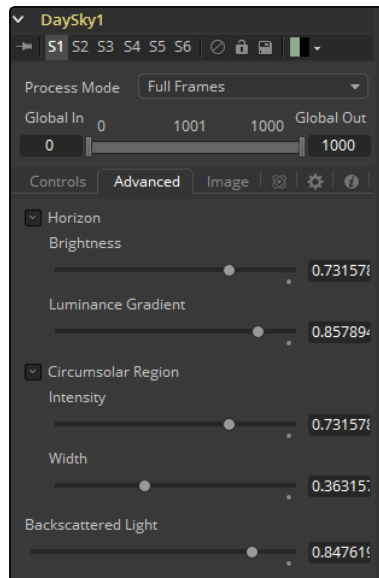
Horizon Brightness

Use this control to adjust the brightness of the horizon relative to the sky.

Luminance Gradient

Use this control to adjust the width of the gradient separating the horizon from the sky.

Circumsolar Region Intensity

Use this control to adjust the intensity or brightness of the sky nearest to the sun.

Circumsolar Region Width

Use this control to adjust the width or size of the area in the sky affected by the sun.

Backscattered Light

Use this control to increase or decrease the amount of backscatter light in the simulation.

Image Tab

The controls in this tab are used to set the resolution, color depth and pixel aspect of the image produced by the tool.

Process Mode

Use this menu control to select the Fields Processing mode used by Fusion to render changes to the image. The default option is determined by the Has Fields checkbox control in the Frame Format preferences. For more information on fields processing, consult the Frame Formats chapter.

Global In and Out

Use this control to specify the position of this tool within the project. Use Global In to specify on which frame that the clip starts and Global Out to specify on which frame this clip ends (inclusive) within the project's Global Range.

The tool will not produce an image on frames outside of this range.

Use Frame Format Settings

When this checkbox is selected, the width, height and pixel aspect of the image created by the tool will be locked to values defined in the composition's Frame Format preferences. If the Frame Format preferences change, the resolution of the image produced by the tool will change to match. Disabling this option can be useful to build a composition at a different resolution than the eventual target resolution for the final render.

Width/Height

This pair of controls is used to set the Width and Height dimensions of the image to be created by the tool.

Pixel Aspect

This control is used to specify the Pixel Aspect ratio of the created images. An aspect ratio of 1:1 would generate a square pixel with the same dimensions on either side (like a computer display monitor) and an aspect of 0.9:1 would create a slightly rectangular pixel (like an NTSC monitor).

Depth

The Depth button array is used to set the pixel color depth of the image created by the creator tool. 32-bit pixels require 4 times the memory of 8-bit pixels, but have far greater color accuracy. Float pixels allow high dynamic range values outside the normal 0..1 range, for representing colors that are brighter than white or darker than black. See the Frame Formats chapter for more details.

Right-click on the Width, Height or Pixel Aspect controls to display a menu listing the file formats defined in the preferences Frame Format tab. Selecting any of the listed options will set the width, height and pixel aspect to the values for that format accordingly.

Fast Noise [FN]

The Fast Noise tool is a very fast and flexible Perlin Noise generator. It can be useful for a wide range of effects, from clouds and swirling fog to waves, water caustics, stylized fire and smoke and other organic textures. It is also invaluable as a noise source for other effects, such as heat shimmer, particle systems and dirtiness maps.

Noise Tab
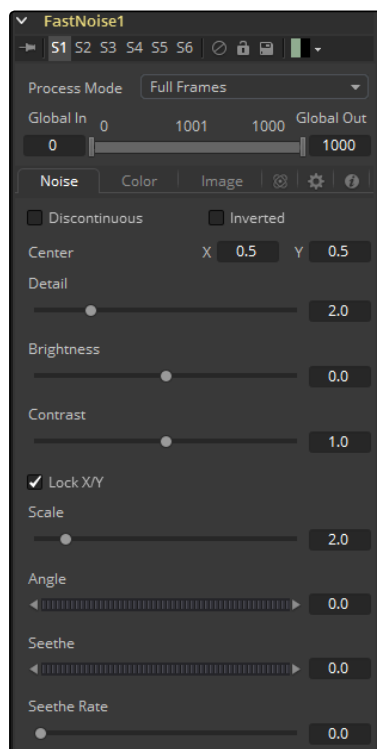
Discontinuous

Normally, the noise function interpolates between values to create a smooth continuous gradient of results. Enable this checkbox to create hard discontinuity lines along some of the noise contours. The result will be a dramatically different effect.

Inverted

Select this checkbox to invert the noise, creating a negative image of the original pattern. This is most effective when Discontinuous is also enabled.

Center

Use the Center coordinate control to pan and move the noise pattern.

Detail

Increase the value of this slider to produce a greater level of detail in the noise result. Larger values add more layers of increasingly detailed noise without affecting the overall pattern. High values take longer to render but can produce a more natural result.

Brightness

This control adjusts the overall brightness of the noise map, before any gradient color mapping is applied. In Gradient mode, this has a similar effect to the Offset control.

Contrast

This control increases or decreases the overall Contrast of the noise map, prior to any gradient color mapping. It can exaggerate the effect of the noise, and widen the range of colors applied in Gradient mode.

Lock and Scale X/Y

The size of the noise map can be adjusted using the Scale slider, changing it from gentle variations over the whole image to a tighter overall texture effect. The Scale slider can be separated into independent X- and Y-axis scale sliders by clicking on the Lock X/Y checkbox immediately above, which can be useful for a brushed-metal effect.

Angle

Use the Angle control to rotate the noise pattern.

Seethe

Adjust this thumbwheel control to interpolate the noise map against a different noise map. This will cause a crawling shift in the noise, like it was drifting or flowing. This control must be animated to affect the gradient over time, or you can use the Seethe Rate control below.

Seethe Rate

As with the Seethe control above, the Seethe Rate also causes the noise map to evolve and change. The Seethe Rate defines the rate at which the noise changes each frame, causing an animated drift in the noise automatically, without the need for spline animation.

Color Tab
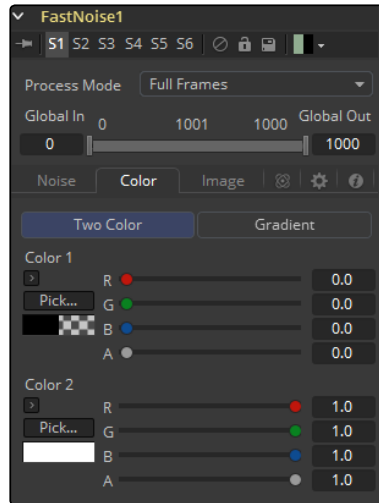
Two Color

A simple two color gradient is used to color the noise map. The noise function will smoothly transition from the first color into the second.

Gradient

The Advanced Gradient control in Fusion is used to provide much more control over the color gradient used with the noise map. The controls that appear are when this mode is selected are described in depth in the Tool Controls chapter of this manual. Consult this chapter for details on setting up a custom gradient for use in the Fast Noise tool.

Image Tab

The controls in this tab are used to set the resolution, color depth and pixel aspect of the image produced by the tool.

Process Mode

Use this menu control to select the fields processing mode used by Fusion to render changes to the image. The default option is determined by the Has Fields checkbox control in the Frame Format preferences. For more information on fields processing, consult the Frame Formats chapter.

Global In and Out

Use this control to specify the position of this tool within the project. Use Global In to specify on which frame that the clip starts and Global Out to specify on which frame this clip ends (inclusive) within the project's Global Range.

The tool will not produce an image on frames outside of this range.

Use Frame Format Settings

When this checkbox is selected, the width, height and pixel aspect of the image created by the tool will be locked to values defined in the composition's Frame Format preferences. If the Frame Format preferences change, the resolution of the image produced by the tool will change to match. Disabling this option can be useful to build a composition at a different resolution than the eventual target resolution for the final render.

Width/Height

This pair of controls is used to set the Width and Height dimensions of the image to be created by the tool.

Pixel Aspect

This control is used to specify the Pixel Aspect ratio of the created images. An aspect ratio of 1:1 would generate a square pixel with the same dimensions on either side (like a computer display monitor) and an aspect of 0.9:1 would create a slightly rectangular pixel (like an NTSC monitor).

Depth

The Depth button array is used to set the pixel color depth of the image created by the creator tool. 32-bit pixels require 4 times the memory of 8-bit pixels, but have far greater color accuracy. Float pixels allow high dynamic range values outside the normal 0..1 range, for representing colors that are brighter than white or darker than black. See the Frame Formats chapter for more details.

Right-click on the Width, Height or Pixel Aspect controls to display a menu listing the file formats defined in the preferences Frame Format tab. Selecting any of the listed options will set the width, height and pixel aspect to the values for that format accordingly.

Mask Map Inputs

These external connections allow you to use masks to control the value of the Noise Detail and Brightness controls individually for each pixel. This can allow some interesting and creative effects.

Noise Detail Map

A soft-edged mask connected to the Noise Detail Map will give a flat noise map (zero detail) where the mask is black, and full detail where it is white, with intermediate values smoothly reducing in detail. It is applied before any gradient color mapping. This can be very helpful for applying maximum noise detail in a specific area, while smoothly falling off elsewhere.

Noise Brightness Map

A mask connected to this input can be used to control the noise map completely, such as boosting it in certain areas, combining it with other textures, or if Detail is set to 0, replacing the Perlin Noise map altogether.

Mandelbrot [MAN]

This tool creates an image pattern based on the Mandelbrot fractal theory set.

Generation Tab
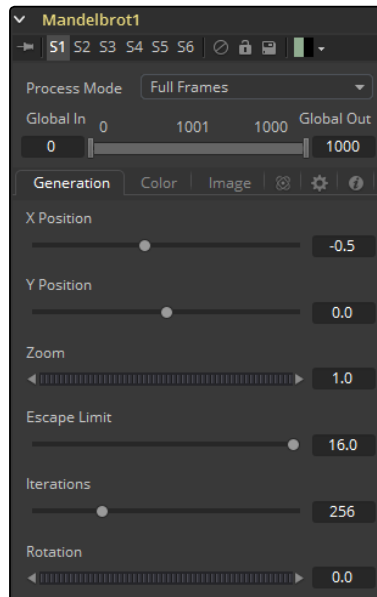
Position X and Y

This designates the image's horizontal and vertical position or seed point.

Zoom

Zoom magnifies the pattern in or out. Every magnification is recalculated so that there is no practical limit to the zoom.

Escape Limit

Defines a point where the calculation of the iteration is aborted. Low values lead to blurry halos.

Iterations

This determines the repetitiveness of the set. When animated, it simulates a growing of the set.

Rotation

This rotates the pattern. Every new angle requires recalculation of the image.

Color Tab
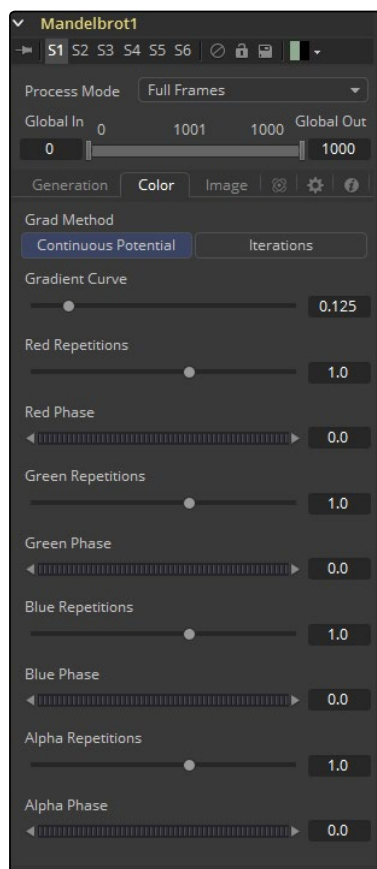
Grad Method

Use this control to determine the type of gradation applied at the borders of the pattern.

Continuous Potential

This causes the edges of the pattern to blend to the background color.

Iterations

This causes the edges of the pattern to be solid.

Gradient Curve

This affects the width of the gradation from the pattern to the background color.

R/G/B/A Phase/Repetitions

Set the color values of the pattern generators.

Image Tab

The controls in this tab are used to set the resolution, color depth and pixel aspect of the image produced by the tool.

Process Mode

Use this menu control to select the Fields Processing mode used by Fusion to render changes to the image. The default option is determined by the Has Fields checkbox control in the Frame Format preferences. For more information on fields processing, consult the Frame Formats chapter.

Global In and Out

Use this control to specify the position of this tool within the project. Use Global In to specify on which frame that the clip starts and Global Out to specify on which frame this clip ends (inclusive) within the project's Global Range.

The tool will not produce an image on frames outside of this range.

Use Frame Format Settings

When this checkbox is selected, the width, height and pixel aspect of the image created by the tool will be locked to values defined in the composition's Frame Format preferences. If the Frame Format preferences change, the resolution of the image produced by the tool will change to match. Disabling this option can be useful to build a composition at a different resolution than the eventual target resolution for the final render.

Width/Height

This pair of controls is used to set the Width and Height dimensions of the image to be created by the tool.

Pixel Aspect

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Depth

The Depth button array is used to set the pixel color depth of the image created by the creator tool. 32-bit pixels require 4 times the memory of 8-bit pixels, but have far greater color accuracy. Float pixels allow high dynamic range values outside the normal 0..1 range, for representing colors that are brighter than white or darker than black. See the Frame Formats chapter for more details.

Right-click on the Width, Height or Pixel Aspect controls to display a menu listing the file formats defined in the preferences Frame Format tab. Selecting any of the listed options will set the width, height and pixel aspect to the values for that format accordingly.

Plasma [PLAS]

This background generation tool uses four circular patterns to generate images similar to Plasma. It is useful as a deforming pattern for the Shadow and Deform tools and to create a variety of other useful shapes and patterns. See also the Fast Noise tool.

Circles Tab
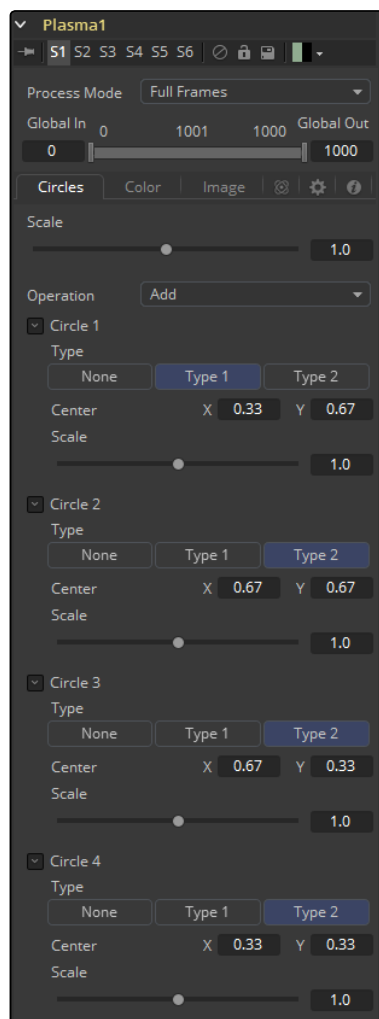
Scale

The Scale control is used to adjust the size of the pattern created.

Operation

The options in this menu determine the mathematical relationship between the four circles whenever they intersect.

Circle Type

Select the type of circle to be used.

Circle Center

Report and change the position of the circle center.

Circle Scale

Determine the size of the circle to be used for the pattern.

Color Tab
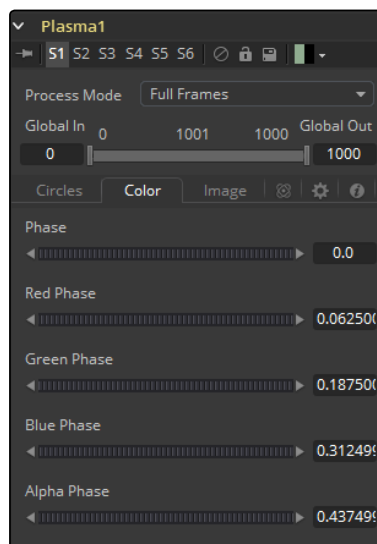
Phase

Phase changes the color phase of the entire image. When animated, this creates psychedelic color cycles.

R/G/B/A Phases

Changes the phase of the individual color channels and the alpha. When animated, this creates color cycling effects.

Image Tab

The controls in this tab are used to set the resolution, color depth and pixel aspect of the image produced by the tool.

Process Mode

Use this menu control to select the Fields Processing mode used by Fusion to render changes to the image. The default option is determined by the Has Fields checkbox control in the Frame Format preferences. For more information on fields processing, consult the Frame Formats chapter.

Global In and Out

Use this control to specify the position of this tool within the project. Use Global In to specify on which frame that the clip starts and Global Out to specify on which frame this clip ends (inclusive) within the project's Global Range.

The tool will not produce an image on frames outside of this range.

Use Frame Format Settings

When this checkbox is selected, the width, height and pixel aspect of the image created by the tool will be locked to values defined in the composition's Frame Format preferences. If the Frame Format preferences change, the resolution of the image produced by the tool will change to match. Disabling this option can be useful to build a composition at a different resolution than the eventual target resolution for the final render.

Width/Height

This pair of controls is used to set the Width and Height dimensions of the image to be created by the tool.

Pixel Aspect

This control is used to specify the Pixel Aspect ratio of the created images. An aspect ratio of 1:1 would generate a square pixel with the same dimensions on either side (like a computer display monitor) and an aspect of 0.9:1 would create a slightly rectangular pixel (like an NTSC monitor).

Depth

The Depth button array is used to set the pixel color depth of the image created by the creator tool. 32-bit pixels require 4 times the memory of 8-bit pixels, but have far greater color accuracy. Float pixels allow high dynamic range values outside the normal 0..1 range, for representing colors that are brighter than white or darker than black. See the Frame Formats chapter for more details.

Right-click on the Width, Height or Pixel Aspect controls to display a menu listing the file formats defined in the preferences Frame Format tab. Selecting any of the listed options will set the width, height and pixel aspect to the values for that format accordingly.

Text Plus [Txt+]

Fusion's Text tool is an advanced character generator capable of 3D transformations, multiple styles and several layers of shading. Text can be laid out to a user-defined frame, circle or along a path.

Any True Type or Postscript 1 font installed on the computer can be used to create text. Support for multibyte and Unicode characters allows text generation in any language, including right to left and vertically oriented text.

This tool generates a 2D image. To produce extruded 3D text with optional beveling, see the Text 3D tool.

Text Tab

Size

This control is used to increase or decrease the size of the text. This is not like selecting a point size in a word processor. The size is relative to the width of the image.

Font

The Font controls are used to select the font used by Fusion to create the text. Fusion has limited support for third-party font managers. Fonts managed by a third-party font manager may need to move the Mac OS X or Windows Fonts folder.

Underline and Strikeout

These checkboxes enable the addition of emphasis styles to the font used.

Styled Text

The edit box in this tab is where the text to be created is entered. Any common character can be typed into this box. The common OS clipboard shortcuts (Command-C or Ctrl-C to copy, Command-X or Ctrl-X to Cut, Command-V or Ctrl-V to paste) will also work, however right-clicking on the edit box displays a custom contextual menu.

The Styled Text contextual menu has the following options.

Animate

Use this command to set to a keyframe on the entered text and animate the content over time.

Character Level Styling

This command enables Character Level Styling, which will place a set of controls in the Modifiers tab. Use these controls to affect changes in the font, color, size and transformations applied to individual characters.

Comp Name

Comp Name puts the name of the composition in the edit box and is generally used to create slates.

Follower

Follower is a text modifier that can be used to ripple animation applied to the text across each character in the text. See Text Modifiers at the end of this section.

Publish

Publish the text for connection to other text tools.

Text Scramble

A text modifier ID is used to randomize the characters in the text. See Text Modifiers at the end of this section.

Text Timer

A text modifier is used to count down from a specified time or to output the current date and time. See Text Modifiers at the end of this section.

Time Code

A text modifier is used to output Time Code for the current frame. See Text Modifiers at the end of this section.

Connect To

Use this option to connect the text generated by this Text tool to the published output of another tool.

Write On

This range control is used to quickly apply simple Write On and Write Off effects to the text. To create a Write On effect, animate the End portion of the control from 1 to 0 over the length of time required. To create a Write Off effect, animate the Start portion of the range control from 0 to 1.

International Font Controls

This drop-down menu can be used to select a language specific to a subset of a font.

Direction

This menu provides options for determining the Direction in which the text is to be written.

Line Direction

These menu options are used to determine the text flow from top-bottom, bottom-top, left-right or right-left.

Force Monospaced

This slider control can be used to override the kerning (spacing between characters) that is defined in the font. Setting this slider to zero (the default value) will cause Fusion to rely entirely on the kerning defined with each character. A value of one will cause the spacing between characters to be completely even, or Monospaced.

Do Font Defined Kerning

This enables kerning as specified in the true type font and is on by default.

Advanced Font Controls

Leave the Font Defined Glyphs, Reordering and Ligation checkbox selected unless instructed to do otherwise by support.

Manual Font Kerning/Placement

Right-clicking on this label will display a contextual menu that can be used to animate the kerning of the text. See the Toolbar section of this tool's documentation later in this chapter for details on manual kerning.

Layout Tab

The controls used to position the text are located in the Layout Tab. One of four layout types can be selected using the button array.
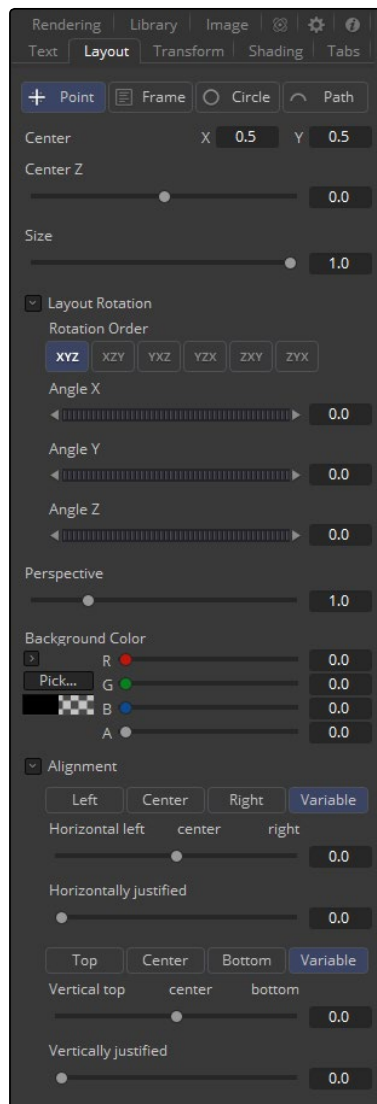
Point

Point layout is the simplest of the layout modes. Text is arranged around an adjustable center point.

Frame

Frame layout allows you to define a rectangular frame used to align the text. The alignment controls are used to justifying the text vertically and horizontally within the boundaries of the frame.

Circle

Circle Layout places the text around the curve of a circle or oval. Control is offered over the diameter and width of the circular shape. When the layout is set to this mode, the Alignment controls determine whether the text is positioned along the inside or outside of the circle's edge, and how multiple lines of text are justified.

Path

Path layout allows you to shape your text along the edges of a path. The path can be used simply to add style to the text, or it can be animated using the Position on Path control that appears when this mode is selected.

Center X, Y and Z

These controls are used to position the center of the layout element in space. X and Y are onscreen controls and Center Z is a slider in the tool controls.

Size

This slider is used to control the scale of the layout element.

Layout Rotation

Select this checkbox and another set of options appears to set the Rotation options of the text.

Rotation Order

This button array allows you to select the order in which 3D rotations are applied to the text.

Angle X, Y and Z

These Angle controls can be used to adjust the angle of the Layout element along any axis.

Width and Height

The Width control is visible when the Layout mode is set to Circle or Frame. The Height control is only visible when the Layout mode is set to Frame. They are used to adjust the dimensions and aspect of the Layout element.

Perspective

This slider control is used to add or remove Perspective from the rotations applied by the Angle X, Y and Z controls.

Fit Characters

This menu control is only visible when the Layout type is set to Circle. This menu is used to select how the characters are spaced to fit along the circumference.

Position On Path

The Position On Path control is used to control the position of the text along the path. Values less than zero or greater than one will cause the text to move beyond the path in the same direction as the vector of the path between the last two keyframes.

Background Color

This label only appears when the Layout type is set to Path. It is used to provide access to a contextual menu that provides options for connecting the path to other paths in the flow, and animating the shape of the path over time.

The text generated by this tool is normally rendered against black. This color picker control can be used to set a new background color.

Right-Click Here for Shape Animation

Consult the Motion Paths chapter of this manual for details.

Horizontal and Vertical Alignment

Two identical sets of controls are used to control Vertical and Horizontal Alignment of the text. Use the first array of buttons to choose the alignment of the text. The slider beneath controls the justification.

Transform Tab
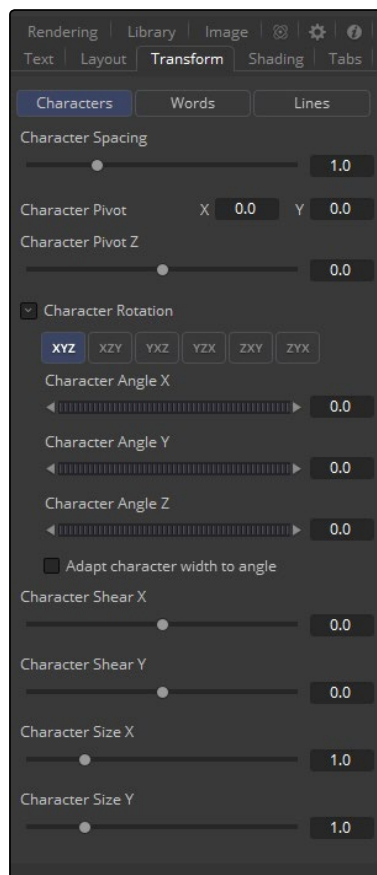
Select Transform

There are three buttons to determine the portion of the text affected by the transformations applied in this tab. Transformations can be applied to line, word and character levels simultaneously. This menu is only used to keep the number of visible controls to a reasonable number.

Characters

Each character of text is transformed along its own center axis.

Words

Each word is transformed separately on the word's center axis.

Lines

Each line of the text is transformed separately on that line's center axis.

Spacing

The Spacing slider is used to adjust the amount of space between each line, word or character. Values less than one will usually cause the characters to begin overlapping.

Pivot X, Y and Z

This provides control over the exact position of the axis. By default, the axis is positioned at the calculated center of the line, word or character. The Axis control works as an offset, such that a value of 0.1, 0.1 in this control would cause the axis to be shifted downward and to the right for each of the text elements. Positive values in the Z-axis slider will move the axis further along the axis (away from the viewer). Negative values will bring the axis of rotation closer.

Rotation Order

These buttons are used to determine the order in which transforms are applied. X, Y and Z would mean that the rotation is applied to X, then Y, and then Z.

Angle X, Y and Z

These controls can be used to adjust the angle of the text elements in any of the three dimensions.

Shear X and Y

Adjust these sliders to modify the slanting of the text elements along the X- and Y-axis.

Size X and Y

Adjust these sliders to modify the size of the text elements along the X- and Y-axis.

Shading Tab

The Shading tab provides controls to adjust the shading, texture and softness of the text. Transformations can be controlled from this tab as well, applying additional transformations to as many as eight separate text shading elements independently. The Number menu is used to select the element affected by adjustments to the controls in this tab.
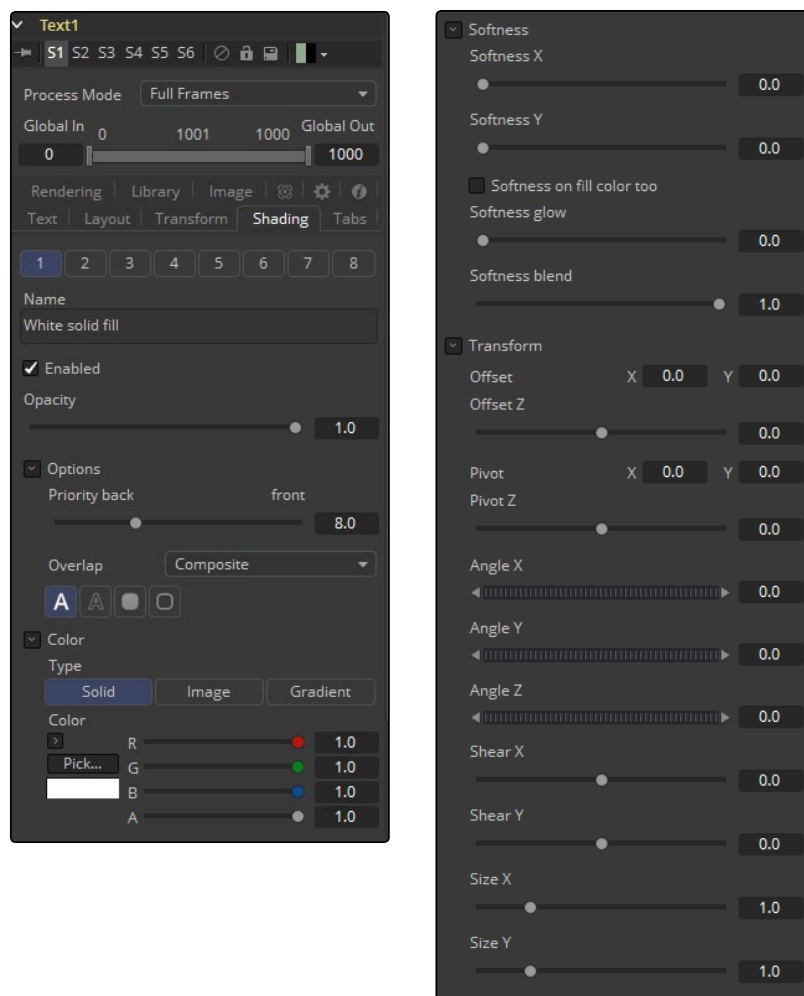
Name

This text label can be used to assign a more descriptive name to each shading element.

Enabled

Select this checkbox to enable or disable each layer of shading elements. Element 1 is enabled by default. The controls for a shading element will not be displayed unless this checkbox is selected.

Opacity

The Opacity slider controls the overall transparency of the shading element. It is usually better to assign opacity to a shading element than to adjust the alpha of the color applied to that element.

Priority Back/Front

This slider determines the layer's order for the shading elements, also known as the Z-order. Slide the control to the right to bring an element closer to the front. Move it to the left to tuck one shading element behind another.

Overlap

This menu is used to select how the renderer deals with an Overlap between two characters in the text.

Composite

This Overlap option will merge the shading over top of itself.

Solid

This option sets the pixels in the overlap region to pure opaque.

Transparent

This option sets the pixels in the overlap region to pure transparent.

Element Type (Buttons)

There are four options available from this menu, providing control over how the shading element is applied to the text. Different controls will appear below depending on the element type selected.

Text Fill

The shading element is applied to the entire text. This is the default mode.

Text Outline

The shading element is drawn as an outline around the edges of the text.

Border Fill

The shading element fills a border surrounding the text. Five additional controls are provided with this shading mode.

Border Outline

The Border Outline mode draws an outline around the border that surrounds the text. It offers several additional controls.

Overlap

(All Types) Overlap is used to determine how the shading is handled when portions of the same shading element overlap. Setting this menu to transparent will cause the pixels' color and alpha channels to be set to 0 (transparent).

Thickness

(Outline only) Use this slider control to adjust the thickness of the outline. Higher values equal thicker outlines.

Adapt Thickness To Perspective

(Outline only) Selecting this checkbox will cause your outline to become thinner where the text is farther away from the camera, and thicker where it is closer. This will create a much more realistic outline for text transformed in 3D but takes significantly longer to render.

Outside Only

(Outline only) Selecting this checkbox will cause the outline to be drawn only on the outside edge of the text. By default the outline is centered on the edge and partially overlaps the text.

Join Style

(Outline only) This menu provides options for how the corners of the outline are drawn. Options include Sharp, Rounded and Beveled.

Line Style

(Outline only) This menu offers additional control over the style of the line. In addition to the default solid line, a variety of dash and dot patterns are available.

Shape

(Border Fill only) Shape creates a solid rectangular image around the character.

Shape

(Border Outline only) Creates a rectangular outline around each character.

Level

(Border Fill only) This is used to control the portion of the text border filled.

Text

This draws a border around the entire text.

Line

This draws a border around each line of text.

Word

This draws a border around each word.

Character

This draws a border around each character.

Extend Horizontal and Extend Vertical

(Border only) Use this slider to change the dimensions of each border.

Round

(Border only) This slider is used to round off the edges of the border.

Color Types

In addition to solid shading, it is also possible to map an external image onto the text. This menu is used to determine if the color of the shading element is derived from a user-selected color or if it comes from an external image source. Different controls will be displayed below depending on the Color Type selected.

Solid Mode

When the Type menu is set to Solid mode, color selector controls are provided to select the color of the text.

Image Mode

The output of a tool in the flow will be used to texture the text. The tool used is chosen using the Color Image control revealed when this option is selected.

Color Image

(Image Mode only) This Color Image text box is used to enter the name of the tool in the flow that will provide the image. You can type the name in with the keyboard, drag the tool from the flow into the text box or right-click and select Connect To from the contextual menu to select the image to be used.

Image Size

(Image Mode only) The Image Size menu is used to select how the image is mapped to the text.

Full Image

This option applies the entire image to the text.

Text

This option applies the image to fit the entire set of text.

Line

This option applies the image per line of text.

Word

This option applies the image per each word of text.

Character

This option applies the image per individual character.

Softness X and Y

These sliders control the softness of the text outline used to create the shading element. Control is provided for the X- and Y-axis independently.

Softness On Fill Color Too

Selecting this checkbox will cause blur (softness) to be applied to the shading element as well. The effect is best seen when applied to a shading element colored by an external image.

Softness Glow

This slider will apply a glow to the softened portion of the shading element.

Softness Blend

This slider controls the amount that the result of the softness control is blended back with the original. It can be used to tone down the result of the soften operation.

Transform Controls

Selecting the Transform button in the Shading tab will display controls for performing transformations to the shading elements. These controls work in exactly the same way as their equivalents in the Alignment and Layout Tabs, with the addition of a Center Offset control.

Offset X, Y and Z

These controls are used to apply offset from the text's global center (as set in the Layout tab) for the shading elements. A value of X0.0, Y0.1 in the coordinate controls would place the shading element center 10 percent of the image further down the screen along the Y-axis. Positive values in the Z-Offset slider control will push the center farther away from the camera, while positive values will bring it closer to the camera.

Tabs Tab

The controls in the Tabs area are used to configure the horizontal screen positions of 8 separate tab stops. Any tab characters in the text will conform to these positions.

Because the Tab key is used by Fusion to advance to the next control, it is not possible to enter a tab directly into the Styled Text input. Enter a tab using one of the following methods.
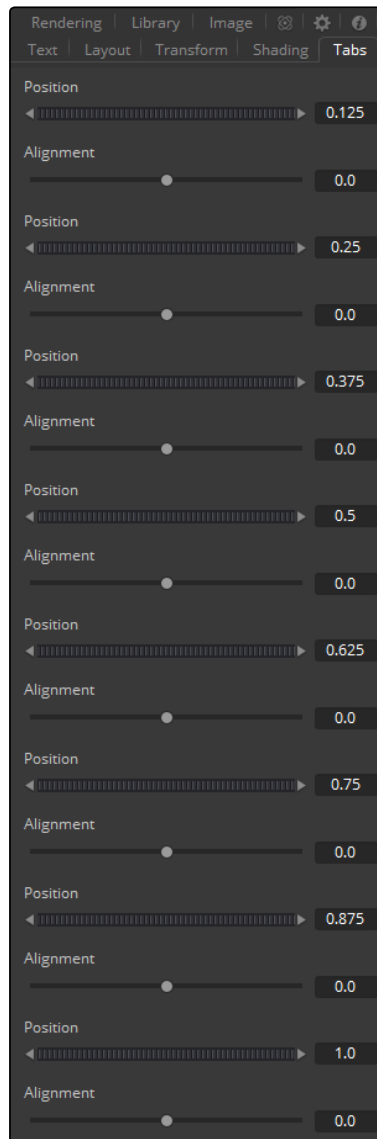
Copy and Paste

Copy a tab from another document, such as Notes on Mac OS X or Notepad on Windows, and paste it into the text box.

Position

This control is used to set the horizontal position of the tab in the frame. The values range from 0.0 to 1.0, where 0 is the far left side and 1 is the far right side of the frame. The position of the tab will be indicated in the Viewer by a thin vertical white line when the Text tool is selected and the Tabs tab is open.

Alignment

Each tab can be set to either left aligned, right aligned or centered. This slider ranges from -1.0 to 1.0, where -1.0 is a left aligned tab, 0.0 is a centered tab and 1.0 is a right aligned tab. Small white boxes at the top of the tab lines indicate that there are tabs present in the flow. Clicking within these boxes will toggle the alignment of the tab between the three states.

Rendering Tab
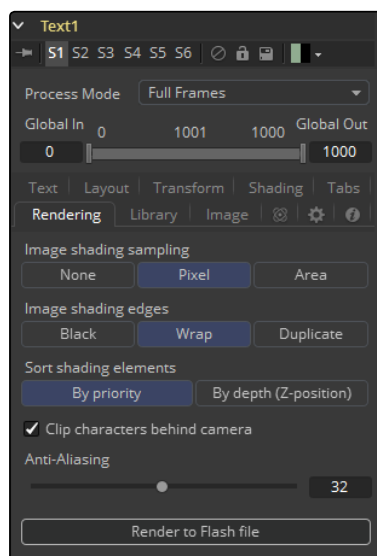
Image Shading Sampling

Use this button array to select the sampling type for shading rendering and transformations. The default of Pixel shading is sufficient for 90% of tasks. To reduce detectable aliasing in the text, set the sampling type to Area. This is slower but may produce better quality results. A setting of None will render faster, but with no additional sampling applied, so the quality will be lower.

Image Shading Edges

Use this button array to choose how transformations applied to image shading elements are handled when they wrap off the text's edges.

Sort Shading Elements

This button selection determines the ordering of the shading elements. The default is By Priority, which organizes the shading elements back to front, according to the priority back/front slider in each shading element's controls.

Selecting the By Depth (Z-Position) option will re-organize these according to each element's Z-position, as set by the element's transformations.

Clip Characters Behind Camera

This checkbox determines whether characters that go beyond the plane of the camera will be clipped, or if they will reflect back toward the center of the image. This should normally be enabled for clipping, but some interesting effects can be produced when clipping is disabled.

Anti-Aliasing

This slider is used to increase or decrease the amount of anti-aliasing applied to the text. Higher values mean exponentially longer render times, while lower values reduce render times at the expense of quality.

Render to Flash File

Click this button to render the output of the Text tool to an Adobe Flash file.

Library Tab

The Shading Library is used to store and retrieve the settings of a Text tool for easy re-use.

Put

To add a new text element to the library, click on the Put button. All of the current settings for the tool will be saved according to the name assigned. A thumbnail will appear in the Shading Library showing how that style looks on the letter A.

Get

Click on a shading element in the library, then click on the Get button to apply those settings to the current tool. Get will replace all of the text as well as the style.

Shading

Clicking on Shading will replace the shading elements only, without affecting the text entered. Right-click in the Shading Library window for a list of display options.

Text+ Toolbar

When the Text tool is selected, a toolbar will appear in the Viewer.
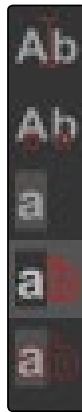
Allow Typing In Preview Window

Enable this button to type and edit text directly in the Viewer, click on the text to produce a cursor that can be positioned within the text. The cursor can be moved using the arrow keys. Type normally.

Allow Manual Kerning

This button enables Manual Kerning, which overrides the automatic kerning normally applied to text. A small red dot will appear beneath each character of text in the Viewer. Drag on the dot to reposition a character. Also select multiple characters and move them together. Hold the Option or Alt key down while dragging to constrain motion to a single axis.

Use the arrow keys on the keyboard to make manual adjustments to the position of the selected characters. Hold the Command or Ctrl key down while pressing arrow keys to move the character in smaller increments. Shift will move the characters in larger increments.

To animate the position of each character, right-click on the control label Manual Font Kerning/ Placement beneath the Text tab's Advanced Font controls and select Animate from the contextual menu. A new key will be set on the animation spline each time a character is moved. All characters are animated with the same spline, as with polyline mask animation.

No Text Outline

This button disables the drawing of any outline around the edges of the text. The outline is not a part of the text. It is an onscreen control used to help identify the position of the text.

Text Outline Outside Frame Only

This button draws an outline around the edges of text, which is outside the visible frame. This is useful for locating text that has moved off screen and is no longer rendering a visible result.

Show Always Text Outline

This button draws an outline around the edges of text at all times, whether the text is visible within the frame or not.

DeepPixel Tools

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DeepPixel Tools

DeepPixel Tools

Ambient Occlusion

Depth Blur

Fog

Shader

Texture
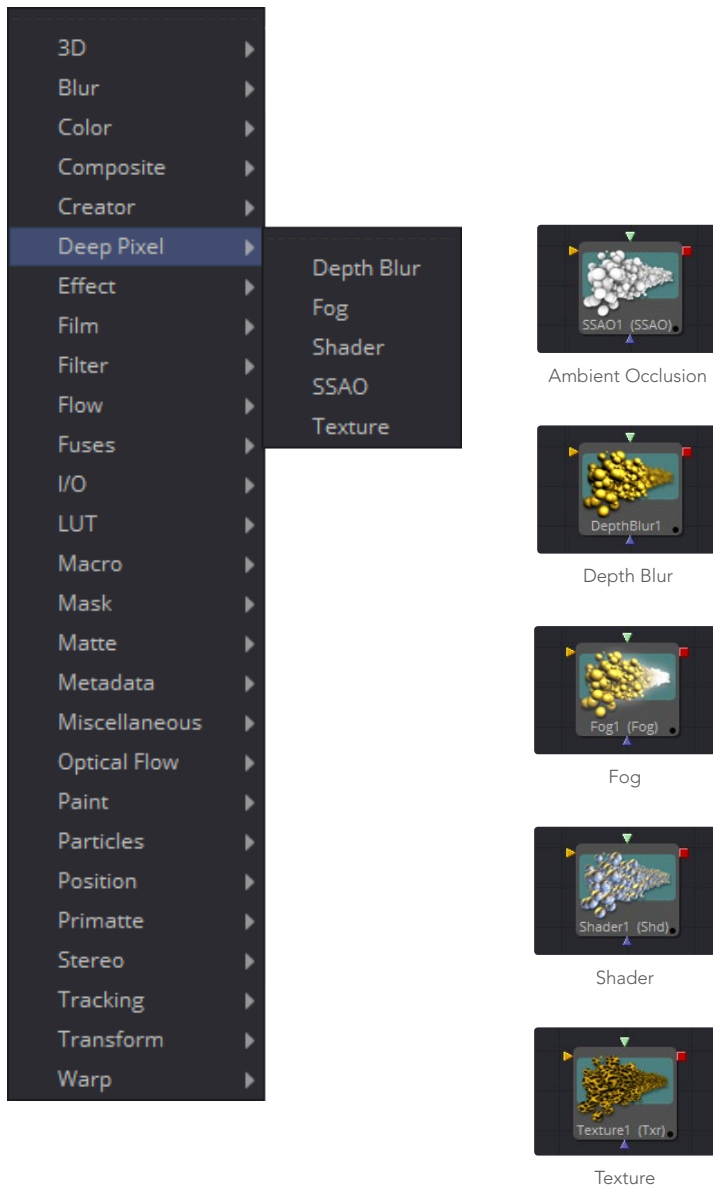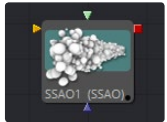
Ambient Occlusion

Ambient Occlusion (AO) is the lighting caused when a scene is surrounded by a uniform diffuse spherical light source. Think of the scene as being surrounded by a humongous sphere that uniformly emits light from its surface. AO captures the low frequency lighting. It does not capture sharp shadows or Diffuse or Specular lighting. For this reason, AO is usually combined with Diffuse and Specular lighting to create a full lighting solution.

The Ambient Occlusion tool generates global lighting effects in 3D-rendered scenes as a post effect. It approximates expensive raytraced global illumination quickly. Being a post effect, it exposes similar aliasing issues like the Shader, Texture, and VolumeFog tool. Hence, artifacts may appear in certain situations.

Usage

The AO tool rarely works out of the box, but requires some tweaking. The setup process involves adjusting the KernelRadius and NumberOfSamples to get the desired affect.

The KernelRadius depends on the natural 'scale' of the scene. Initially there might appear to be no AO at all. At this point either the KernelRadius is too small or too big and working values have to be found.

Inputs

→ **Image (required):** Requires RGBA, Z-Depth and Normals.

→ **Scene (required):** The Scene or 3D Camera the image was rendered with.

If any of these are not supplied, the tool will fail with a descriptive error.

Controls
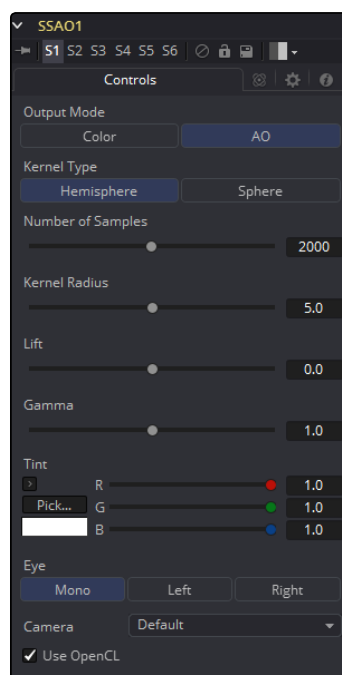
Output Mode

→ Color: The incoming image with Ambient Occlusion applied

→ AO: Outputs the pure Ambient Occlusion as a grayscale image.

White corresponds to regions in the beauty pass that should be bright, while black correspond to regions that should be darker. This allows you to create a lighting equation by combining separate ambient/diffuse/specular passes. Having the AO as a separate buffer allows for creative freedom to combine the passes in various ways.

Kernel Type

To determine the AO, rays are cast outward from a point on the surface being shaded outwards to a large enclosed sphere.

The number of unoccluded rays, that is those rays that reach the sphere, determines the AO factor.

Hemisphere

Rays are cast toward a hemisphere oriented to the surfaces normal. This option is more realistic than "Sphere" and should be used unless there is a good reason otherwise. Flat surfaces will receive 100% ambient intensity, while other parts will be darkened.

Sphere

Rays are cast toward a sphere centered about the point being shaded. This option is provided to produce a stylistic effect. Flat surfaces will receive 50% ambient intensity, while other parts will be made darker or brighter.

Number of Samples

Increase the number of samples until artifacts in the AO pass disappear. Higher values can generate better results but also increase render time.

Kernel Radius

The Kernel Radius controls the size of the filter kernel in 3D space. For each pixel, it controls how far one searches in 3D space for occluders. Most likely, the Filter Kernel is finicky and may need to be adjusted manually for each individual scene.

If made too small, nearby occluders can be missed. If made too large, the quality of the AO will decrease and the number of samples needs to be increased dramatically to get the quality back.

This value is dependent on the scene Z-depth. That means with huge Z values in the scene, the kernel size needs to be large as well. With tiny Z values, a small kernel size like 0.1 should be sufficient.

Lift/Gamma/Tint

Used to adjust the AO for artistic effects.

Use OpenCL

Ambient Occlusion is very slow on the CPU, but performs much better on the GPU. Activate this switch to utilize the OpenCL power of your Graphics Card

Kernel Radius 0.01   Kernel Radius 0.1   Kernel Radius 1   Multiplied together
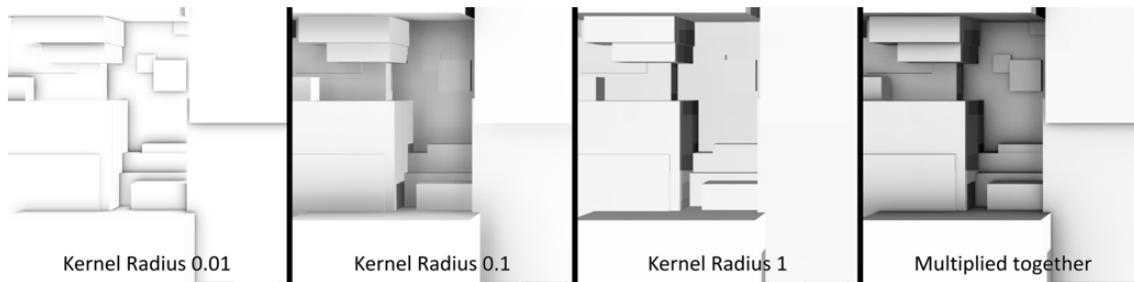
Tip Combining multiple AO passes with different kernel radii can produce better effects.

Known Issues

Transparency/Translucency:

AO is designed to work with opaque objects. There will be two kinds of problems: those with transparent receivers and those with transparent occluders. You can work around some of these problems by splitting out the transparent/translucent objects into separate scenes and only computing AO on the opaque objects.

Particles:

Do not use AO on particles, unless the particles are solid opaque geometry. This is just the transparency problem again. Antialiased edges (another form of transparency) will also cause problems with AO. There's not much you can do about this.

Supersampling:

See Antialiased edges. In order for this to work, the AO needs to be computed in the big image before it is downsampled to the final image.

View Dependence:

AO methods work in view space and the results are view dependent. This is a limitation of the technique itself. This means the amount of darkening can vary depending on the view location when in reality it should be constant. If at a point on an object the AO is 0.5, moving the camera could change it to 0.4.

Baking of AO:

The UV renderer can be used to bake AO into the textures on models.

Depth Blur

The Depth Blur tool is primarily used to create focal length or depth-of-field effects. It blurs 3D rendered images based on included Z-channel values, and can also be used for general per-pixel blurring effects by means of the Blur Channel controls. If the Blur Image input is connected, channels from that image will be used to control the blur.

Controls
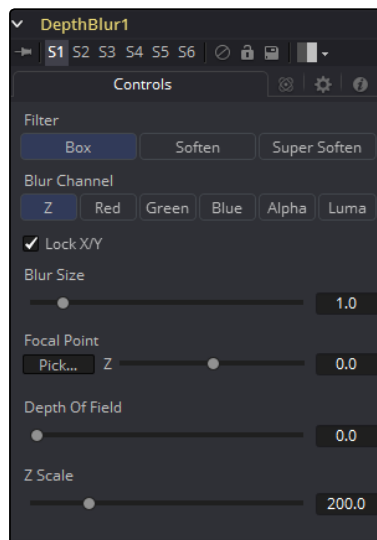
Filter

These buttons are used to select the filter used for applying the blur.

Box

This applies a depth-based box blur effect to the image.

Soften

This applies a depth-based general softening filter effect.

Super Soften

This applies a depth-based high quality softening filter effect.

Blur Channels

Select one of these options to determine the channel used to control the level of blur applied to each pixel. The channel from the main image input is used, unless a tool is connected to the tool's Blur Image input on the flow.

Lock X/Y

When toggled on, this control locks the X and Y Blur sliders together for symmetrical blurring.

Blur Size

This slider is used to set the strength of the horizontal and vertical blurring applied to the image.

Focal Point

This control is only visible when the Blur channel is set to use the Z buffer.

Use this control to select the distance of the simulated point of focus. Lowering the value causes the Focal Point to be closer to the camera, raising the value causes the Focal Point to be farther away.

Drag the Pick button (the pointer changes to a dropper) over the displayed image and select a Z-buffer value. If the image does not contain a valid Z-buffer, no change will occur in the value.

Depth of Field

This control is used to determine the depth of the area in focus. The focal point is positioned in the middle of the region and all pixels with a Z-value within the region stay in focus. For example, if the focal point was selected from the image and set to a value of 300, and the depth of field is set to 200, any pixel with a Z-value between 200 and 400 would remain in focus.

Z Scale

Scales the Z-buffer value by the selected amount. Raising the value causes the distances in the Z channel to expand. Lowering the value causes it to contract. This is useful for exaggerating the depth effect. It can also be used to soften the boundaries of the blur. Some images with small depth values may require the Z scale to be set quite low, below 1.0.
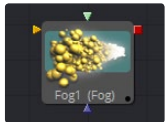
Fog

The Fog tool is used to create simulated fog effects on 3D rendered images that contain a valid Z-buffer channel. The fog can be placed in front of or behind various elements of a rendered image based on the selected Z-channel planes. For more information, see the Auxiliary Channels chapter.

The second image input on the Fog tool can be used to provide an image that is used as the source of the fog. If no image is provided, the fog consists of a single color. Generally, a noise map of some sort is provided here.

Controls
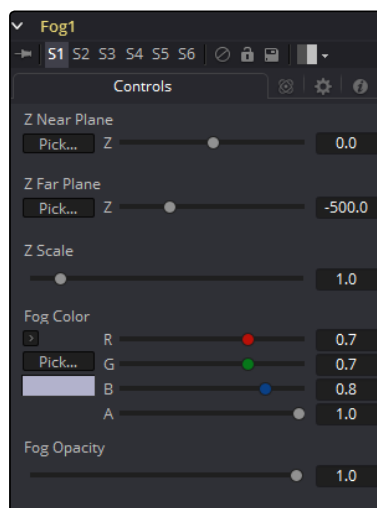
Z-Buffer Near Plane and Far Plane

These controls are used to select the extents of the fog within the scene. To pick a value, drag the Pick button to an area on the image being viewed where the plane is to be located.

The Near Plane is used to select the depth where the fog thins out to nothing. The Far Plane is used to select the depth at which the fog becomes opaque.

Z Depth Scale

This option scales the Z-buffer values by the selected amount. Raising the value causes the distances in the Z channel to expand, whereas lowering the value causes it to contract. This is useful for exaggerating the fog effect.

Fog Color

This option displays and controls the current fog color. Alpha adjusts the fog's transparency value.

Fog Opacity

Use this control to adjust the opacity of the fog.

Shader

The Shader tool can control the lighting, reflection mapping and 3D shading of elements in a rendered image. The reflection map image (connected to the green input) can be projected onto all elements in the scene, or to elements selected by the Object and Material ID channels in the common controls. Effect masking can also be used to limit the effect of this tool.

The Shader tool relies on the presence of the X, Y and Z normal map channels in 3D rendered images. If these channels are not present, this tool has no effect.

For more information, see the Auxiliary Channels chapter in the User Manual.

Light Tab
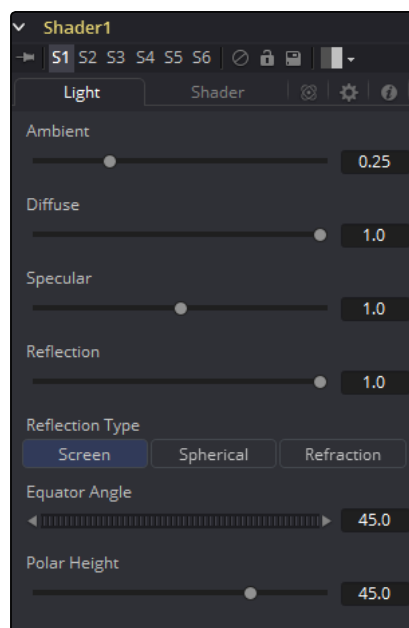
Ambient

Ambient controls the amount of Ambient color present in the scene or for the selected object. This is a base level of light, added to all pixels, even in completely shadowed areas.

Diffuse

This option controls the amount of Diffuse color present in the scene or for the selected object. This is the normal color of the object, reflected equally in all directions.

Specular

This option controls the amount of Specular color present in the scene or for the selected object. This is the color of the glossy highlights reflected toward the eye from a light source.

Reflection

This option controls the amount of Reflection contribution in the scene or for the selected object. High levels make objects appear mirrored, low levels overlay subtle reflections giving a polished effect. It has no effect if no reflection map is connected.

Reflection Type

Select from these three buttons to determine the type of reflection mapping used to project the image in the second input.

Screen

Screen causes the reflection map to appear as if it were projected on to a screen behind the point of view.

Spherical

Spherical causes the reflection map to appear as if it were projected on to a huge sphere around the whole scene.

Refraction

Refraction causes the reflection map to appear as if it were refracting or distorting according to the geometry in the scene.

Equator Angle

Equator Angle controls the left to right angle of the light generated and mapped by the Shader tool for the scene or the selected object.

Polar Height

Polar Height controls the top to bottom angle of the light generated and mapped by the Shader tool for the scene or the selected object.

Shader Tab
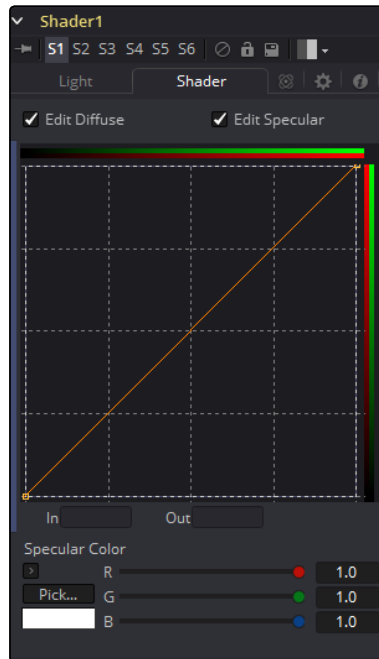
Edit Diffuse and Specular

Toggle these controls on to enable editing of the Shader curves for the individual channels in the Shader spline window.

In and Out

These options are used to display and edit point values on the spline.

Specular Color

Use the Diffuse curve to manipulate the diffuse shading and the Specular curve to affect the specular shading. Drag a box over a number of points to group select them. Right-clicking displays a menu with options for adjusting the spline curves. For a complete description of the options and controls for the spline windows, see the documentation for the LUT Editor in the Controls chapter of the manual.
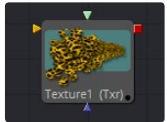
Texture

The Texture tool can control the texture mapping of elements in a rendered image. The texture-map image (connected to the green input) can be wrapped around objects to replace the current texture. The Texture tool relies on the presence of U and V Map channels in 3D rendered images. If these channels are not present, this tool has no effect.

Note: Background pixels may have U and V values of 0.0, which will set those pixels to the color of the texture's corner pixel. To restrict texturing to specific objects, use an effect mask based on the alpha of the object, or its Object or Material ID channel. For more information, see the Auxiliary Channels chapter.

Texture Tab
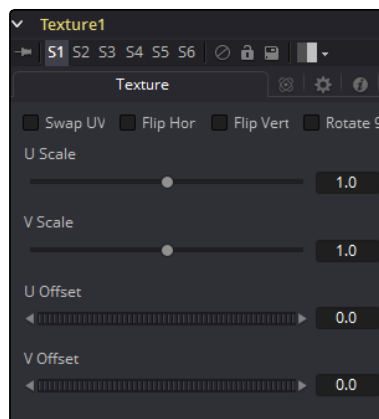
Swap UV

When this checkbox is selected the U and V channels of the source image are swapped.

Flip Horizontal and Vertical

The texture-map image is flipped horizontally and/or vertically when this control is toggled on.

Rotate 90

The texture-map image is rotated 90 degrees when this checkbox is enabled.

U and V Scale

These controls change the scaling of the U and V coordinates used to map the texture. Changing these values effectively enlarges and shrinks the texture map as it is applied.

U and V Offset

Adjust these controls to offset the U and V coordinates. Changing the values causes the texture to appear to move along the geometry of the object.

Effect Tools

10

Effect Tools

Effect Tools

Highlight	Shadow
Hot Spot	Trails
Pseudo Color	TV
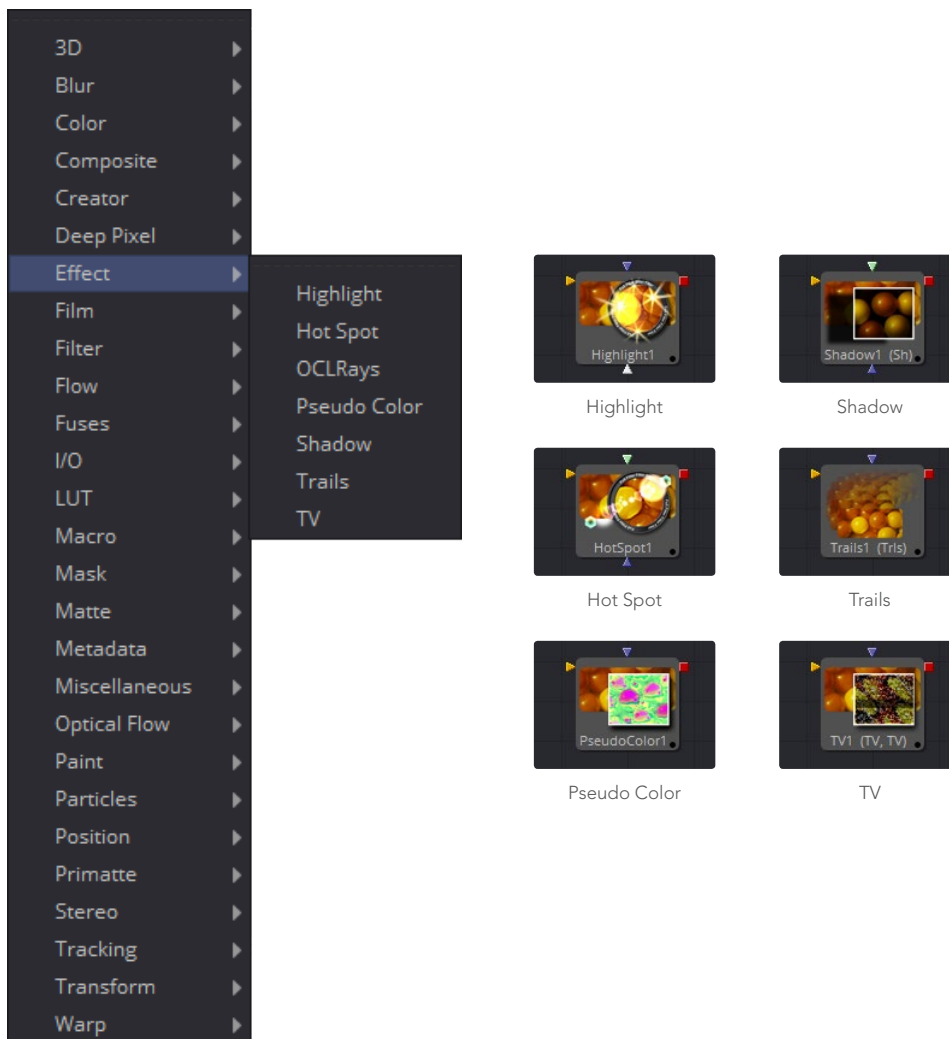
Highlight [HɪL]

The Highlight filter creates star-shaped highlights in bright regions of the image, similar to a lens star filter effect.

Settings Tab
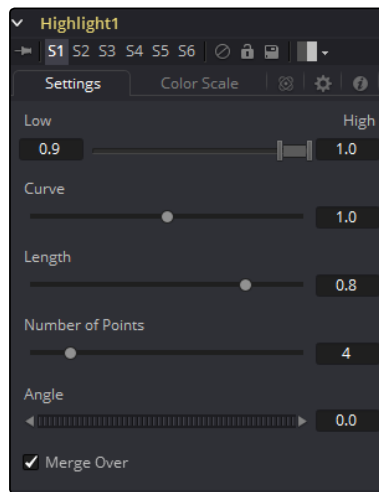
Low and High

This range control designates the range of Luminance values in the image that will generate highlights. Values less than the Low value will not receive highlights. Values above the High value will receive the full highlight effect.

Curve

The Curve value changes the drop off over the length of the highlight. Higher values will cause the brightness of the flares to drop off closer to the center of the highlight, whereas lower values will drop off further from the center.

Length

This designates the Length of the flares from the highlight.

Number of Points

This determines the Number of flares emanating from the highlight.

Angle

Use this control to rotate the highlights.

Merge Over

When this checkbox is on, it will overlay the effect on the original image. With the checkbox off, the output will be the highlights only. This is useful for downstream color correction of the highlights.

Color Scale Tab
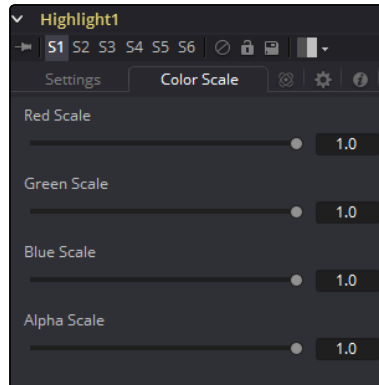
Red, Green and Blue Scale

Moving the sliders of one or all of these channels down will change the falloff color of the highlight.

Alpha Scale

Moving the Alpha slider down will make highlight falloff more transparent.

Highlight Masks

The Highlight tool offers an additional mask input called the Highlight Mask. This is a pre-mask that determines what pixels can be affected by the highlight before the highlight is applied. Unlike regular masks, it will not crop off highlights from source pixels when the highlight extends past the masks edges.
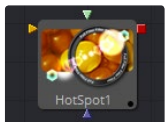
Hot Spot [Hᴏᴛ]

The Hot Spot tool is used to create lens flare, spotlight and burn/dodge effects of various types.

In the real world, lens flares occur when extremely bright light sources present in the scene by the reflections are reflected off elements inside the lens of the camera. One might see lens flares in a shot when viewing a strong light source through a camera lens, like the sun or a bright star.

Hot Spot Tab
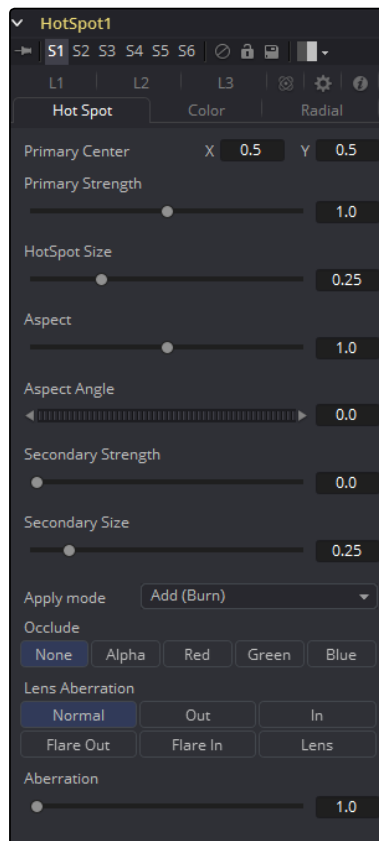
Primary Center X and Y

This is the position of the Primary Hot Spot within the scene. Secondary lens elements and reflections are positioned relative to the position of the primary.

Primary Strength

This control determines the brightness of the primary hotspot.

Hotspot Size

This control determines the diameter of the primary hotspot. A value of 1.0 represents a circle the full width of the image.

Aspect

This controls the Aspect of the spot. A value of 1.0 produces a perfectly circular hotspot. Values above 1.0 will elongate the circle horizontally and values below 1.0 will elongate the circle vertically.

Aspect Angle

This control can be used to rotate the primary hotspot.

Secondary Strength

This control determines the strength, which is to say the brightness, of the secondary hotspot. The secondary hotspot is a reflection of the primary hotspot. It will always be positioned on the opposite side of the image from the primary hotspot.

Secondary Size

This determines the size of the secondary hotspot.

Apply Mode

This control determines how the hotspot affects the underlying image.

Add (Burn)

This causes the spots created to brighten the image.

Subtract (Dodge)

This causes the spots created to dim the image.

Multiply (Spotlight)

This causes the spots created to isolate a portion of the image with light and to darken the remainder of the image.

Occlude

Use this button array to select which channel of the image connected to the Hotspot tool's Occlusion input is used to provide the occlusion matte.

Occlusion happens when the source of the hotspot is blocked by something between it and the camera. When the source of a hotspot is occluded, the hotspot simply winks out.

Occlusion can be controlled from Alpha or R, G or B channels of any image connected to the Occlusion input on the tool's tile. The white pixels in the image will occlude the hotspot. Gray pixels will partially suppress the hotspot.

Lens Aberration

Aberration changes the shape and behavior of the primary and secondary hotspots.

In and Out Modes

Elongates the shape of the hotspot into a flare. The hotspot stretches toward the center of the image when in In mode, stretching toward the corners when in Out mode.

Flare In and Flare Out Modes

This option is a lens distortion effect that is controlled by the movement of the lens effect. Flare In will cause the effect to become more severe the closer the hotspot gets to the center. Flare Out causes the effect to increase, as the hotspot gets closer to the edges of the image.

Lens

This mode emulates a round, ringed lens effect.

Aberration

The Aberration slider controls the overall strength of the lens aberration effect.

Color Tab
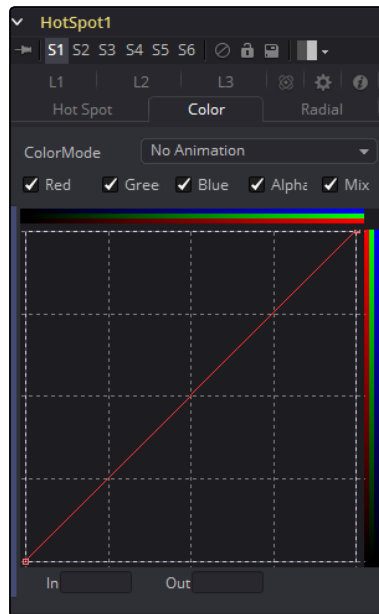
Color Channel and Mix

When selected, these checkbox controls enable the editing of the chosen splines in the LUT below.

Red, Green, Blue and Alpha Splines

The Red, Green, Blue and Alpha splines are used to adjust the color of the spotlight along the radius of the hotspot.

The vertical axis represents the intensity or strength of the color channel, from a value of 0 at the bottom to 1 at the top. The horizontal axis represents the position along the radius of the hotspot, from the outside edge on the left to the inside on the right.

So the default curve of the tool indicates that the red, green, blue and alpha channels all have a linear falloff from the outside edge of the curve to the inside edge.

Mix Spline

The Mix spline is used to determine the influence of the controls that the Radial tab will have along the radius of the hotspot. The horizontal axis represents the position along the circle's circumference, with 0 being 0 degrees and 1.0 being 360 degrees. The vertical axis represents the amount of the radial hotspot to blend with the color hotspot. A value of 0 is all radial hotspot, while a value of 1.0 is all color hotspot.

Note: Right-clicking in the LUT will display a contextual menu with options related to modifying spline curves.

A complete description of LUT editor controls and options can be found in the Tool Controls chapter of this manual.

Radial Tab
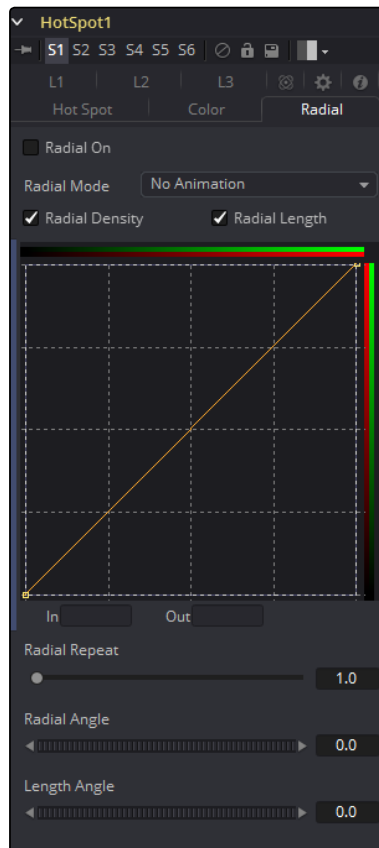
Radial On

When selected, this control enables the Radial splines. Otherwise the radial matte created by the splines is not applied to the hotspot, and the Mix spline in the color controls will have no affect on the hotspot.

Radial Length and Radial Density Splines

The key to these splines is realizing that the LUT Editor's horizontal axis represents a position around the circumference of the hotspot. A value of 0.0 is 0 degrees and 1.0 is 360 degrees. With that in mind, the length determines the radius of the light making up the hotspot along the circumference, and the density represents how bright the light is along the circumference.

Radial Repeat

This control will repeat the effect of the radial splines by X number of times. For example, a repeat of 2.0 causes the spline to take effect between 0 and 180 degrees instead of 0 and 360, repeating the spline again between 180 and 360.

Length Angle

This control will rotate the effect of the Radial Length spline around the circumference of the hotspot.

Density Angle

This control will rotate the effect of the Radial Density spline around the circumference of the hotspot.

Note: Right-clicking in the spline area will display a contextual menu containing options related to modifying spline curves.

A complete description of LUT Editor controls and options can be found in the Tool Controls chapter of this manual.

L1, L2 and L3 Tab
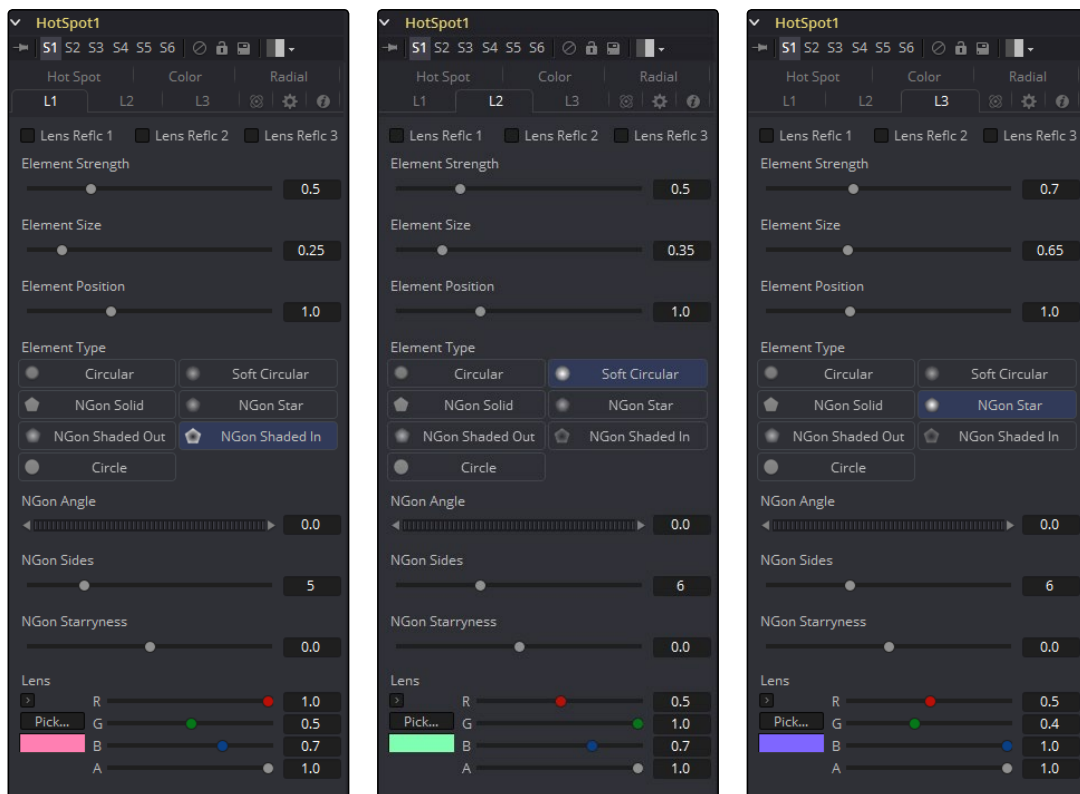
Lens Reflect 1-3

When selected, the reflection caused by the element is enabled.

Element Strength

This determines the brightness of element reflections.

Element Size

This determines the size of element reflections.

Element Position

This determines the distance of element reflections from the axis. The axis is calculated as a line between the hotspot position and the center of the image.

Element Type

Use this array of buttons to choose the shape and density of the element reflections. The presets available are described below.

Circular

This creates slightly soft-edged circular shaped reflections.

Soft Circular

This creates very soft-edged circular shaped reflections.

Circle

This creates a hard-edged circle shape.

NGon Solid

This creates a filled polygon with a variable number of sides.

NGon Star

This creates a very soft-edged star shape with a variable number of sides.

NGon Shaded Out

This creates soft-edged circular shapes.

NGon Shaded In

This creates a polygon with a variable number of sides, which has a very soft reversed (dark center, bright radius) circle.

NGon Angle

This control is used to determine the angle of the NGon shapes.

NGon Sides

This control is used to determine the amount of sides used when the Element Type is set to Ngon Star, Ngon Shaded Out, and Ngon Shaded In.

NGon Starriness

This control is used to bend polygons into star shapes. The higher the value the more star-like the shape.

Lens Color Controls

These controls determine the color of the lens that affects the colors of the reflections. To choose a lens color, pick one from a displayed image, or enter RGBA values using the sliders or input boxes.
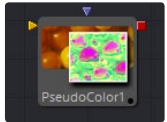
Pseudo Color [PsCl]

The Pseudo Color tool provides the ability to produce variations of color based on waveforms generated by the tool's controls. Static or animated variances of the original image can be produced. The tool's controls are separated into four identical tabs, one for each of the color channels.

R/G/B/A Tabs
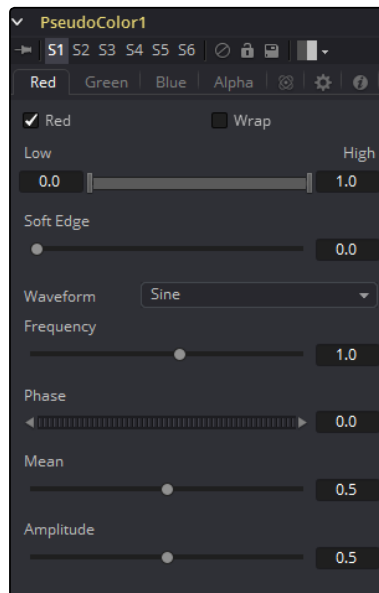
Color Check Box

When selected, the Pseudo Color tool will affect this color channel.

Wrap

When selected, waveform values that exceed allowable parameter values will be wrapped to the opposite extreme.

High and Low

High and Low determine the range to be affected by the tool in a specific color channel.

Soft Edge

This slider determines the soft edge of color transition.

Waveform

This selects the type of Waveform to be created by the generator. Four waveforms are available: Sine, Triangle, Sawtooth and Square.

Frequency

This controls the Frequency of the waveform selected. Higher values will increase the number of occurrences of the variances.

Phase

This modifies the Phase of the waveform. Animating this control will produce color cycling effects.

Mean

This determines the level or Mean value of the waveform selected. Higher values will increase the overall brightness of the channel until the allowed maximum is reached.

Amplitude

Amplitude increases or decreases the overall power of the waveform.

Shadow [SH]

Shadow is a versatile tool used in the creation of shadows that are based on the alpha channel information from an image. It is also possible to use an additional image to control the shadow's apparent depth.

The Shadow tool is designed to cast simple 2D shadows. Use a Spotlight tool and an Image Plane tool for full 3D shadow casting.

Controls

Shadow Offset

This control sets the apparent distance of the shadowed object from the background. Adjusting the position of the Shadow Offset crosshair in the views is the quickest way to create simple drop shadows.

Softness

Softness controls how blurry the shadow's edges appear. The further the background is from the object, the fuzzier it becomes.

Shadow Color

Use this control to select the color of the shadow. The most realistic shadows are usually the ones that are not totally black and razor sharp.

Light Position

This control sets the position of the light relative to the shadow-casting object. The Light Position is only taken into consideration when the Light Distance slider is NOT set to infinity (1.0).

Light Distance

This slider will vary the apparent distance of the light between infinity (1.0) and being at zero distance from the shadow-casting object. The advantage of setting the Light Distance is that the resulting shadow is more realistic-looking with the further parts of the shadow being longer than those that are closer.

Minimum Depth Map Light Distance

This control is active when an image is connected to the shadow's Depth Map input. The slider is used to control the amount that the depth map contributes to the Light Distance. Dark areas of a depth map make the shadow deeper. White areas bring it closer to the camera.

Z Map Channel

This menu is used to select which color channel of the image connected to the tool's Z Map input will be used to create the shadows depth map. Selections exist for the RGB and A, Luminance, and Z-buffer channels.

Output

The Output image can either contain the image with shadow applied or the shadow only.

Changing the setting in the output drop-down list controls which mode will be used. This method is useful when color correction, perspective or other effects need to be applied to the resulting shadow before it is merged back with the object.

For example, Shadow Alpha controls the shadow's degree of transparency.
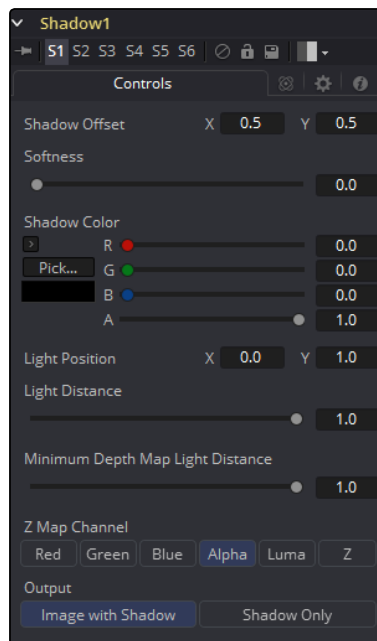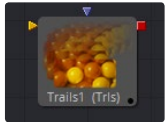
Trails [TRLS]

The Trails tool is used to create a ghost-like after-trail of the image. This creates an interesting effect when applied to moving images with an alpha channel. Unlike a directional blur, only the preceding motion of an image is displayed as part of the effect.

Controls
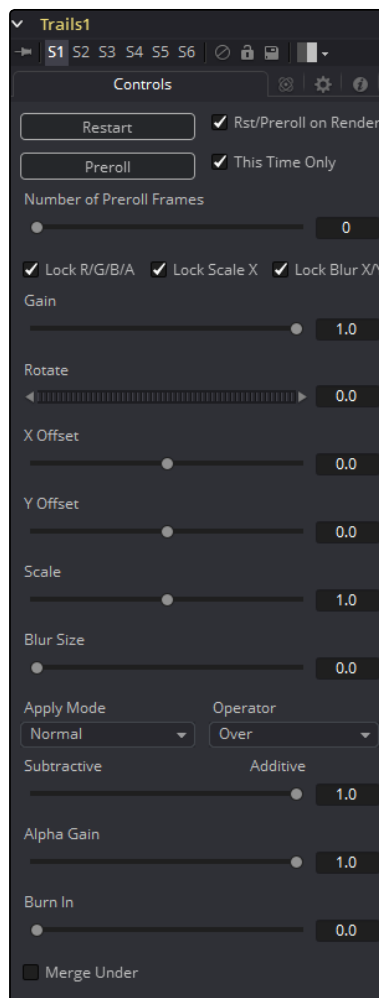
Restart

This control clears the image buffer and displays a clean frame, without any of the ghosting effect.

Preroll

This will make the Trails tool pre-render the effect by the number of frames on the slider. This will make the Trails tool pre-render the effect by the number of frames on the slider.

Reset/Pre-Roll on Render

When this checkbox is enabled, the Trails tool will reset itself when a preview or final render is initiated. It will Pre-roll the designated number of frames.

This Time Only

Selecting this checkbox will make the pre-roll use this current frame only and not the previous frames.

Number of Pre-roll Frames

This determines the number of frames to pre-roll.

Lock RGBA

When selected, this checkbox allow the Gain of the color channels to be controlled independently. This allows for tinting of the Trails effect.

Lock Scale X/Y

When selected, this checkbox allows the X- and Y-axis scaling of the image buffer to be manipulated separately for each axis.

Lock Blur X/Y

When selected, this checkbox allows the blurring of the image buffer to be controlled separately for each axis.

Gain

The Gain control affects the overall intensity and brightness of the image in the buffer. Lower values in this parameter will create a much shorter, fainter trail, whereas higher values will create a longer, more solid trail.

Rotate

The Rotate control rotates the image in the buffer before the current frame is merged into the effect.

Offset X/Y

These controls offset the image in the buffer before the current frame is merged into the effect. Control is given over each axis independently.

Scale

The Scale control resizes the image in the buffer before the current frame is merged into the effect.

Blur Size

The Blur Size control applies a blur to the image in the buffer before the current frame is merged into the effect.

Apply Mode

This menu is used to determine the method used by the Trails tool when merging one sample over another. The methods in this menu are documented more completely in the Merge tool's documentation in the Composite Tools chapter of this manual.

Operator Mode

This menu is used to select to determine how the foreground and background are combined to produce a result. The menu will only be visible when the tool's Apply mode is set to Normal.

For an excellent description of the math underlying the operation modes, read Compositing Digital Images, Porter, T., and T. Duff, SIGGRAPH 84 proceedings, pages 253-259. Essentially, the math is as described below. Note that some modes not listed in the Operator dropdown (Under, In, Held In, Below) are easily obtained by swapping the foreground and background inputs (with Command-T or Ctrl-T and choosing a corresponding mode.

The formula used to combine pixels in the merge is always fg * x + bg * y. The different operations determine exactly what x and y are, as shown in the description for each mode.

Over

The Over mode adds the FG layer to the BG layer by replacing the pixels in the BG with the pixels from the Z wherever the FG's alpha channel is greater than 1.

        x = 1, y = 1-[foreground alpha]

In

The In mode multiplies the alpha channel of the BG input against the pixels in the FG. The color channels of the FG input are ignored. Only pixels from the FG are seen in the final output. This essentially clips the FG using the mask from the BG.

        x = [background alpha], y = 0

Held Out

Held Out is essentially the opposite of the In operation. The pixels in the FG image are multiplied against the inverted alpha channel of the BG image. Accomplish exactly the same result using the In operation and a Matte Control tool to invert the matte channel of the BG image.

        x = 1-[background alpha], y = 0

ATop

ATop places the FG over the BG only where the BG has a matte.

        x = [background alpha], y = 1-[foreground alpha]

XOr

XOr combines the FG with the BG wherever either the FG or the BG have a matte, but never where both have a matte.

        x = 1-[background alpha], y = 1-[foreground alpha]

Subtractive/Additive, Alpha Gain, Burn In

For details on these controls and their effect, consult the documentation for the Merge tool in the Composite Tools chapter.

Merge Under

This merges the current image under the generated trail, rather than the usual, over top operation.

TV [TV]

The TV tool is a simple tool designed to mimic some of the typical flaws seen in analog television broadcasts and screens.

Controls
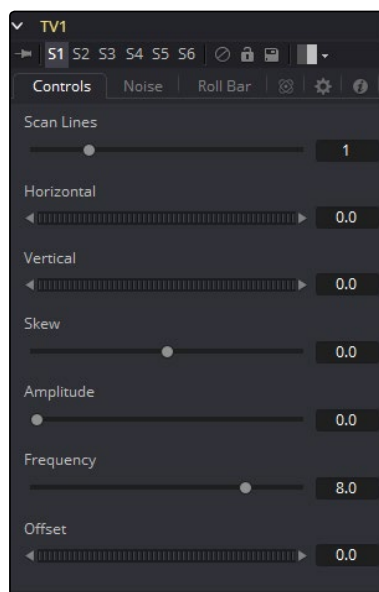
Scan Lines

This slider is used to emulate the interlaced look by dropping lines out of the image. Setting it to black, with a transparent alpha, drops a line. A value of 1 (default) will drop every second line. A value of 2 shows one line, then drops the second and third and repeats. A value of zero turns off the effect.

Horizontal

Use this slider to apply a simple Horizontal offset to the image.

Vertical

Use this slider to apply a simple Vertical offset to the image.

Skew

This slider is used to apply a diagonal offset to the image. Positive values skew the image to the top left. Negative values skew the image to the top right. Pixels pushed off frame wrap around and reappear on the other side of the image.

Amplitude

The Amplitude slider can be used to introduce smooth sine wave-type deformation to the edges of the image. Higher values will increase the intensity of the deformation. Use frequency to determine how often the distortion is repeated.

Frequency

The Frequency slider sets the frequency of the sine wave used to produce distortion along the edges of the image when the amplitude control is greater than 1.

Offset

Use Offset to adjust the position of the sine wave, causing the deformation applied to the image via the Amplitude and Frequency controls to see across the image.

Noise Tab
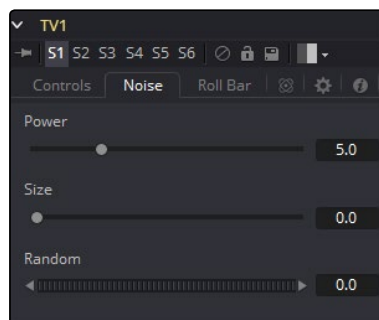
Power

Increase the value of this slider above 0 to introduce noise into the image. The higher the value, the stronger the noise.

Size

Use this slider to scale the noise map larger.

Random

If this thumbwheel control is set to 0, the noise map will be static. Change the value over time to cause the static to change from frame to frame.

Roll Bar Tab
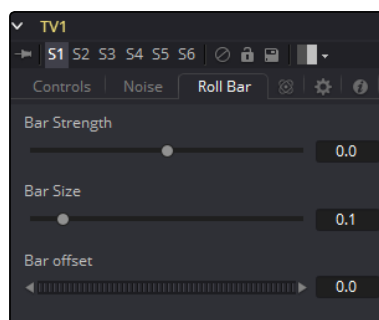
Bar Strength

At the default value of 0 no bar is drawn. The higher the value, the darker the area covered by the bar will become.

Bar Size

Increase the value of this slider to make the bar taller.

Bar Offset

Animate this control to scroll the bar across the screen.

Film Tools

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Film Tools

Film Tools

Cineon Log

Film Grain

Grain

Light Trim

Remove Noise
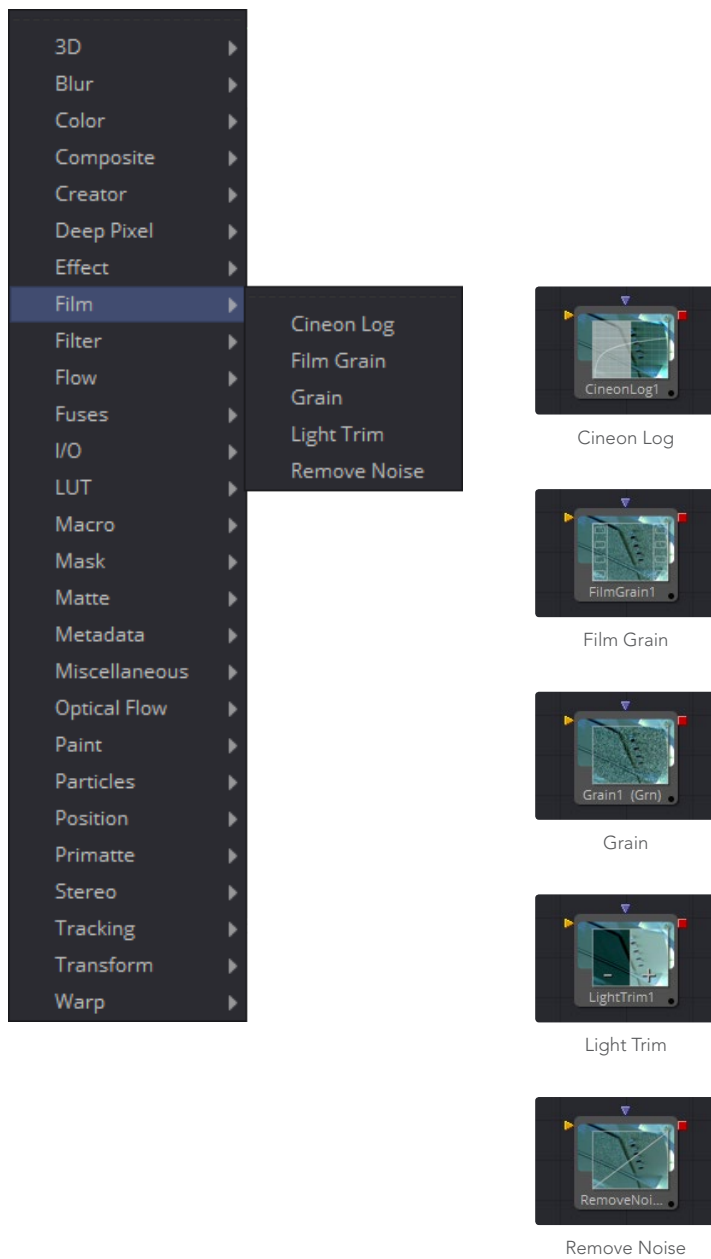
Cineon Log [Log]

The Cineon Log Tool is used to convert image data from logarithmic to linear. Use this tool if the log-lin conversion was bypassed in a Cineon Loader to return processing to Linear.

Controls
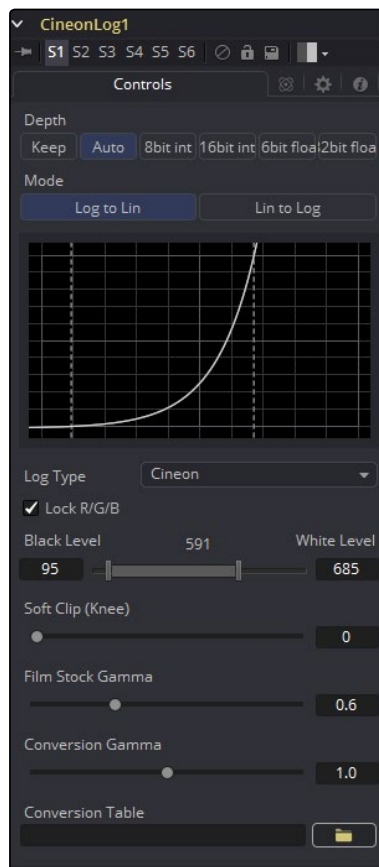
Mode

These buttons offer two options, one for converting log images to linear and one for converting linear images to logarithmic.

Lock RGB

When selected, the settings in this tab will affect all of the color channels equally. De-select this control to convert the Red, Green and Blue channels of the image using separate settings for each channel.

Black Level and White Level

Use this control to set the black point and white point in the log image before converting. Pixels with values in log space below the Black Level will become out of range values below 0.0. Pixels with values above the White Level will become out of range values above 1.0 after conversion.

When processing in floating point color space, the out of range values stored in the Cineon format are preserved through the conversion. In 16-bit or 8-bit mode, the out of range values are clipped.

Soft Clip (Knee)

The Soft Clip control is used to draw values that are out of range back into the image. This is done by smoothing the conversion curve at the top and bottom of the curve, allowing more values to be represented.

Applying a soft clip of any value other than 1 will immediately cause the tool to process at 16-bit integer, eliminating all out of range values that do not fit within the soft clip.

Film Stock Gamma, Conversion Gamma and Conversion Table

These controls are used to set the response curves of the logarithmic data during conversion. In addition to the settings above, a custom ASCII file Look Up Table can be created with specific conversion values. The ASCII LUT file can be loaded using the File Folder Icon button.

Black Rolloff

Since a mathematical log() operation on a value of zero or lower will result in invalid values, Fusion will clip values below 1e-38 (0 followed by 38 zeros) to 0 to ensure correct results. This is almost never an issue, since values that small have no visual impact on an image. To see such tiny values you would have to add three Brightness Contrast tools, each with a gain set to 1,000,000. Even then the values would hover very close to zero.

We have seen processes where instead of cropping these very small values, they are instead scaled. So values between 0.0 and 1e-16 are scaled be between 1e-18 and 1e-16. The idea is to crush the majority of the visual range in a float image into values very near to zero, then expand them again, forcing a gentle ramp to produce a small ramp in the extreme black values. Should you find yourself facing a color pipeline using the process, here is how you can mimic it with the help of a custom tool.

The process involves converting the log image to linear with a very small gamma and a wider than normal black level to white level. (e.g., conversion gamma of 0.6, black of 10, white of 1010) This will crush most of the images range into very very small values. This is followed by a custom tool (described below), then by a linear to log conversion that reverses the process, but uses a slightly higher black level. The difference between the black levels defines the falloff range.

Since this will lift the blacks, the image is usually then converted back to linear one more time, using more traditional values (i.e., 95-685) to reset the black point.

The custom tool should use the following equation in the Red, Green and Blue expressions:

```
if (c1< 1e−16, 1e−18 + (c1/1e−16)*(1e−16 − 1e−18), c1)
```

Falloff Comparison
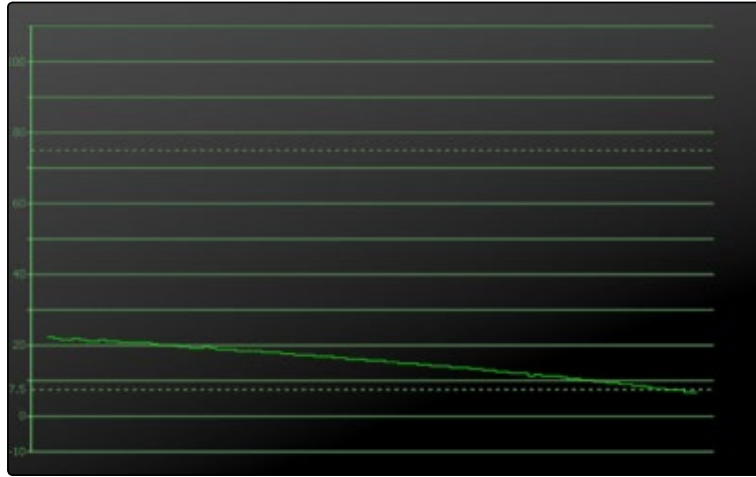
The falloff from the native Fusion process
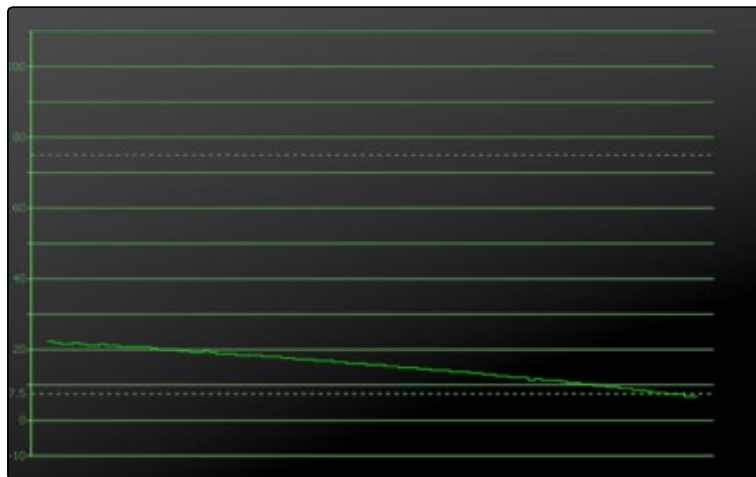
The falloff from the ramped clipping process

Film Grain [FGR]

The Film Grain tool takes a new approach to grain, which should be more closely aligned with the grain profiles of modern film stocks. This provides you with more control over the final appearance of the grain.

Note: The Film Grain tool does not replace the original Grain tool, which is still provided to allow older compositions to load and render, but in almost every case, use of the new Film Grain tool is now encouraged.

Controls Tab
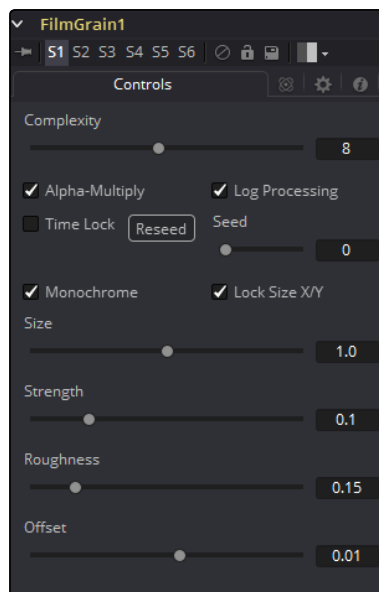
Complexity

The complexity of the Grain indicates the number of 'layers' of grain applied to the image. With a complexity of 1, only one grain layer is calculated and applied to the image. When complexity is set to 4, the tool calculates four separate grain layers and applies the mean combined result of each pass to the final image. Higher complexities produce visually more complex results, without the apparent regularity often perceivable in digitally-produced grain.

Alpha Multiply

When the Alpha Multiply checkbox is enabled, the Film Grain tool will multiply its results by the source images alpha channel. This is necessary when working with post multiplied images to ensure that the grain does not affect areas of the image where the alpha is 0.0 (transparent).

Note: Since it is impossible to say what the final value of semi-transparent pixels in the image are until after they are composited with their background, you should avoid applying log-processed grain to the elements until after they have been composited. This will ensure that the strength of the grain is accurate.

Log Processing

When this checkbox is enabled (default), the grain applied to the image will have its intensity applied non-linearly to match the grain profile of most film. Roughly speaking, the intensity of the grain will increase exponentially from black to white. When this checkbox is disabled the grain will be applied uniformly, regardless of the brightness of the affected pixel.

One of the primary features of grain in film is that the appearance of the grain varies radically with the exposure, so that there appears to be very little grain present in the blacks, with the amount and deviation of the grain increasing as the pixels exposure increases. In a film negative the darkest portions of the developed image will appear completely opaque, and this obscures the grain. As the negative becomes progressively clearer, more of the grain becomes evident in the result. Chemical differences in the response to light of the Red, Green and Blue layers of the film also cause each color component of the film to present a different grain profile, typically with the Blue channel presenting the largest amount of grain.

As a result, the most important control in the new Film Grain tool is the Log Processing checkbox, which should be enabled when matching film, and disabled when working with images that require a more linear grain response. Having this checkbox enabled will closely mimic the results of preceding the old grain tool with a Linear > Log conversion and following with a Log > Linear conversion immediately after.

Seed

The Seed slider and Randomize button are presented whenever a Fusion tool relies on a random result. Two tools with the same seed values will produce the same random results. Click on the Randomize button to randomly select a new seed value, or adjust the slider to manually select a new seed value.

Monochrome

When the Monochrome checkbox is enabled (default) the grain will be applied to the Red, Green and Blue color channels of the image equally. When deselected, individual control over the Size, Strength and Roughness of the grain in each channel becomes possible.

Lock Size X/Y

Deselect the Lock Size X/Y checkbox to control the size of the Grain along the X- and Y-axis individually.

Size

The Grain Size is calculated relative to the size of a pixel, so that changing the resolution of the image does not impact the relative appearance of the grain. The default Grain Size of 1.0 will produce grain kernels that cover roughly 2 pixels.

Strength

Grain is expressed as a variation from the original color of a pixel. The stronger the grain's strength, the wider the possible variation from the original pixel value. For example, given a pixel with an original value of p, and a grain tool with complexity=1 size=1; roughness=0; log processing=off; the grain will produce an output value of p +/- strength. In other words, a pixel with a value of 0.5 with a grain strength of 0.02 could end up with a final value between 0.48 and 0.52.

Once again, that's a slight over simplification, especially when the complexity exceeds 1. Enabling the Log Processing checkbox will also cause that variation to be affected such that there will be less variation in the blacks and more variation in the whites of the image.

Note: When visualizing the effect of the grain on the image, the more mathematically inclined may find it helps to picture a sine wave, where each lobe of the sine wave covers 1 pixel when the Grain Size is 1.0. The Grain Size controls the frequency of the sine wave, while the Grain Strength controls its amplitude. Again, this is something of an oversimplification.

Roughness

The Roughness slider applies low frequency variation to give the impression of clumping in the grain. Try setting the Roughness to 0, and you will observe that the grain produced has a very even luminance variation across the whole image. Increase the roughness to 1.0 and you will observe the presence of 'cellular' differences in the luminance variation.

Offset

The Offset control helps to match the intensity of the grain in the deep blacks by offsetting the values before the intensity (strength) of the grain is calculated. So an offset of 0.1 would cause a pixel with a value of 0.1 to receive grain as if its value was actually 0.2.

Processing Examples

Log Processing On
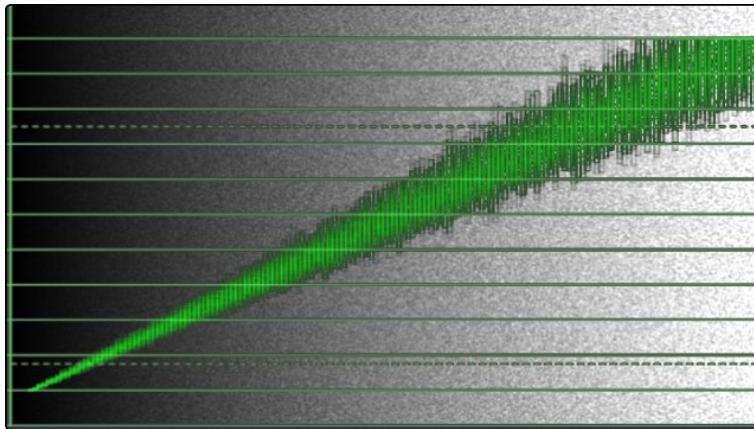
In the default setting, the different amounts of Grain are
applied to the blacks and the whites of the image.

Log Processing Off
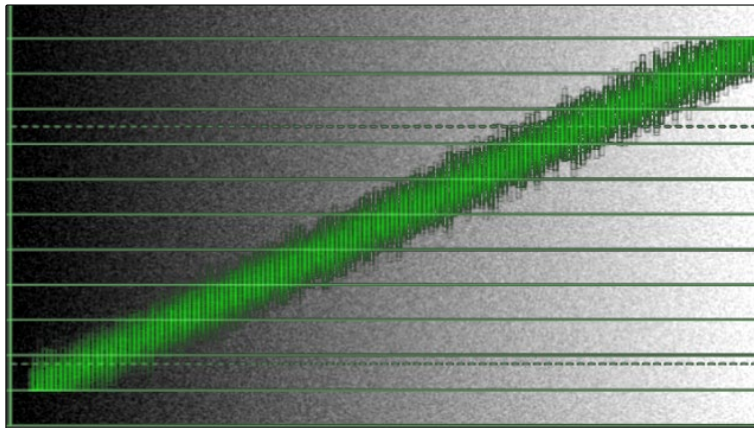
When Log processing is off, the Grain is applied evenly
to the entire image as shown here.
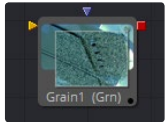
Grain [GRN]

The Grain tool offers comprehensive film grain emulation. This is useful for introducing simulated grain into a video or computer-generated image and matching existing grain in a given scene.

Grain Tab
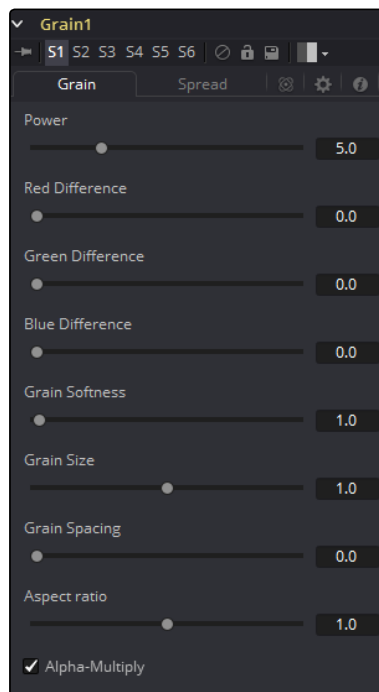
Power

This slider determines the strength of the grain. A higher value increases visibility, making the grain more prevalent.

RGB Difference

Separate Red, Green and Blue sliders are used to modify the strength of the effect on a per channel basis.

Grain Softness

This slider controls the blurriness or fuzziness of the grain. Smaller values cause the grain to be more sharp or coarse.

Grain Size

This slider determines the size of the grain particles. Higher values increase the grain size.

Grain Spacing

This slider determines the density or amount of grain per area. Higher values cause the grain to appear more spaced out.

Aspect Ratio

This slider adjusts the aspect of the grain so that it can be matched with anamorphic images.

Alpha-Multiply

When enabled, this checkbox will multiply the image by the alpha, clearing the black areas of any grain effect.

Spread Tab
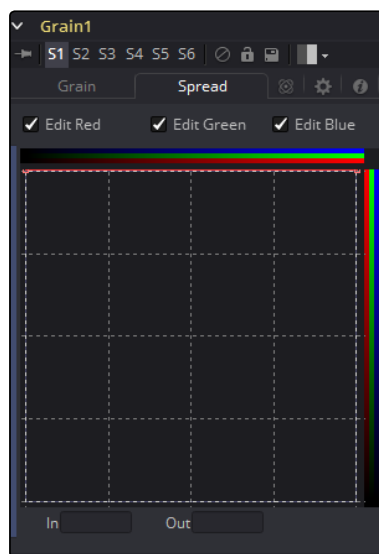
Edit RGB Checkboxes

Separate Red, Green and Blue to enable the custom curves for each channel. More grain would appear in the Blue channel than the Red, and the Green channel would receive the least. This curve mimics usual film responses. Right-clicking in the spline area will display a contextual menu containing options related to modifying spline curves. A complete description of the LUT Editor control and its options can be found in the Tool Controls chapter of this manual.

In and Out

This control gives direct editing of points on the curve by setting In/Out point values.

Spread Examples

Default Spread
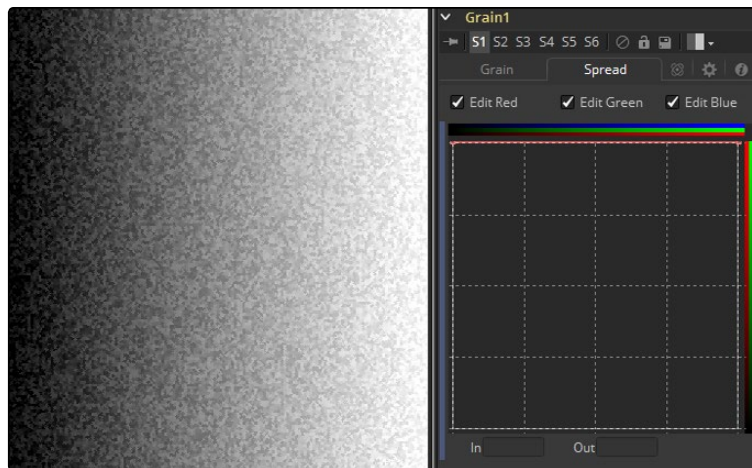
In the default setting, the Grain is applied evenly to the entire image as shown here. However, film often shows a different amount of grain in the blacks, mids and whites.

Bell-Shaped Spread
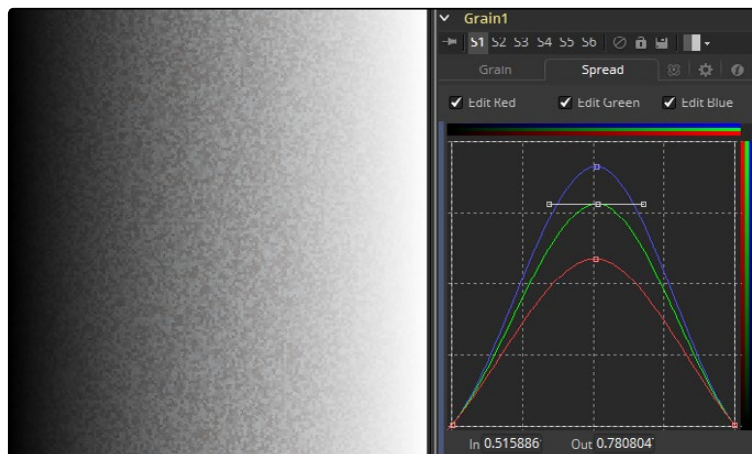
Setting a bell shape is often a good starting point to create more realistic looking grain. Here we have a non-uniform distribution with different amounts of grain in the Red, Green and Blue channel as well.

In both examples, the Grain's power has been over-exaggerated to show the effect a bit better.
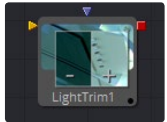
Light Trim [LT]

This tool emulates film scanner light trims. By design, this tool works best with logarithmic data, such as the images stored by the Cineon file system. When logarithmic data is provided, the Light Trim tool can be used to increase or decrease the apparent exposure level of the image.

Controls
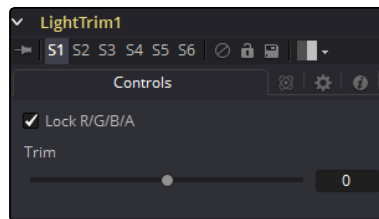
Lock RGBA

When selected, the Lock RGBA control collapses control of all image channels into one slider. This selection is on by default. To manipulate the various color channels independently, de-select this checkbox.

Trim

This slider shifts the color in film, optical printing and lab printing points. 8 points equal one stop of exposure.
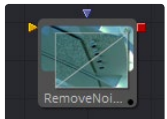
Remove Noise [RN]

The Remove Noise tool provides simple noise management. The basic principle of its operation is the tool blurs the image channels, then compares the blurred image to the original to extract the noise. A sharpness is then applied to the image, except where noise was detected.

To use this tool, view the image and look at the Red channel. Then increase the Red Softness until the grain appears to be gone. Next, increase the sharpness until the detail reappears, but stop before the grain reappears. Repeat for the Green and Blue channels.

Controls / Color
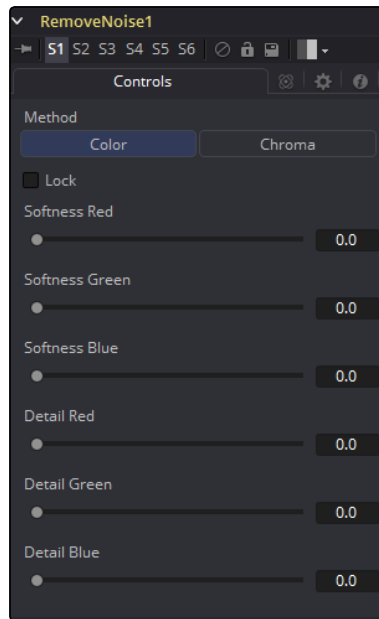
Method

Use these buttons to choose whether the tool processes color using Color or Chroma methods. This will also give you a different set of control sliders.

Lock

This checkbox will link the Softness and Detail sliders of each channel together.

Softness Red, Green and Blue

The Softness sliders determine the amount of blur applied to each channel of the image. In Chroma mode you have sliders for the softness in the Luminance and Chrominance channels respectively.

Detail Red, Green and Blue

The Sharpness sliders determine how much detail is reintroduced into each channel after each channel is softened. In Chroma mode you have sliders for Luminance and Chrominance channels respectively.

Controls / Chroma
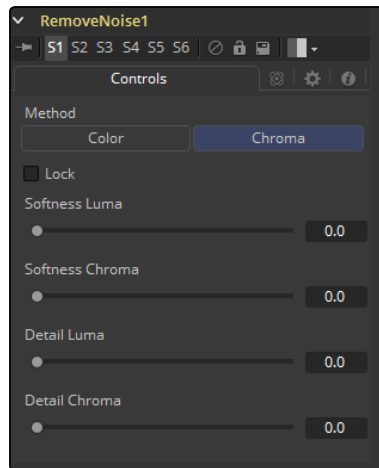
Method

The same principle applies as with the RGB Controls, but in this case the Luminance and Chrominance channels are influenced.

Filter Tools

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Filter Tools

Filter Tools

CreateBumpmap

Custom Filter Tool

ErodeDilate Tool

Filter Tool

Rank Filter Tool

3D
Blur
Color
Composite
Creator
Deep Pixel
Effect
Film
Filter
Flow
Fuses
I/O
LUT
Macro
Mask
Matte
Metadata
Miscellaneous
Optical Flow
Paint
Particles
Position
Primatte
Stereo
Tracking
Transform
Warp

Create Bump Map
Custom Filter
Erode / Dilate
Filter
Rank Filter
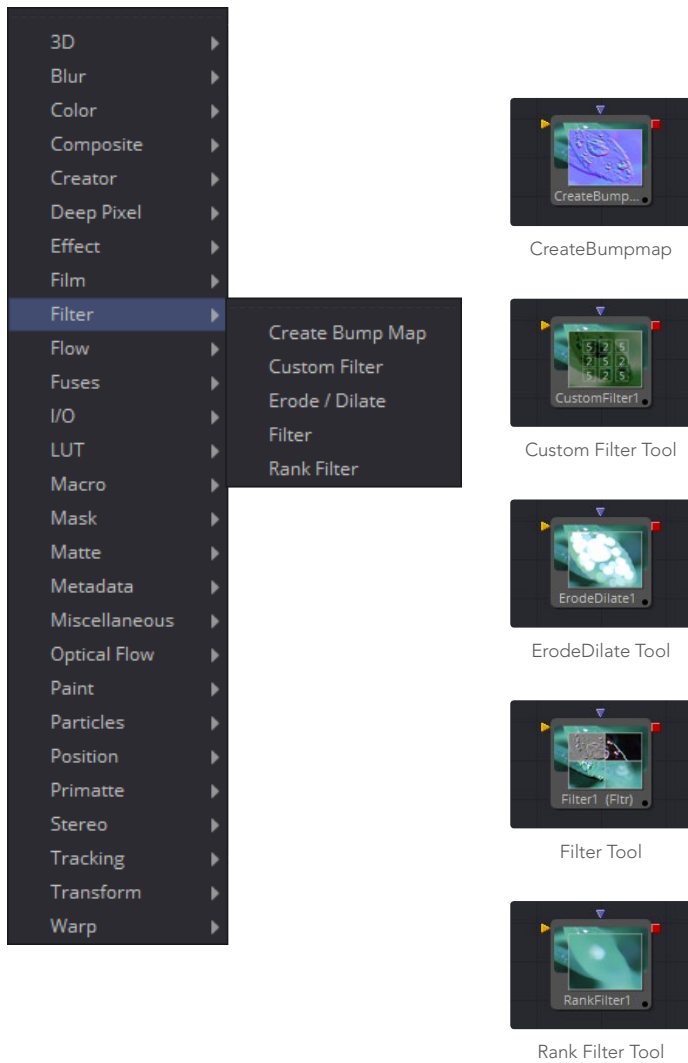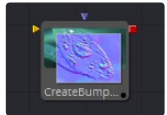
CreateBumpmap

The Create Bumpmap tool converts a grayscale (heightmap) image into a bump map. Check the notes for the naming conventions used in Fusion. Since the resulting bump vector information is represented as RGB, it´s possible to modify them using all the image processing tools in Fusion. Use the Create Bumpmap tool for applying to a material.
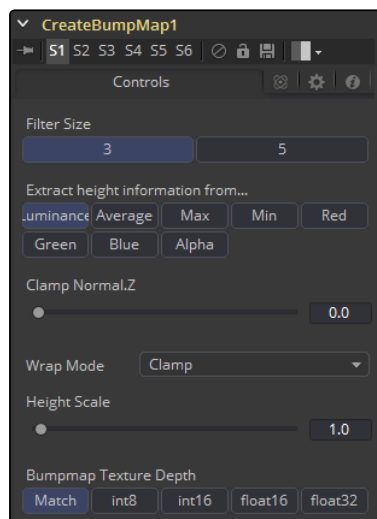
Input Port

CreateBumpmap.Input (white): Receives the RGBA channels from an image output for the bump calculation

Controls

This tab contains all parameters for the tool.

Filter Size

The process of generating the bump information is basically a Custom Filter. This multi-button control sets the filter size.

Extract height information from…

Set the channel from where to extract the grayscale information from.

Clamp Normal.Z

Clips the lower values of the Blue channel in the resulting bump texture.

Filter Wrap Mode

Basically wraps the image at the borders, so the filter produces correct result when using seamless tileable textures.

Height Scale

Changes the contrast of the resulting values in the bump map. Increasing this value yields in a more visible bump map.

Bumpmap Texture Depth

Optionally converts the resulting bump texture into the desired bit depth.

Notes on Bumpmaps

This tab contains all parameters for the tool.

Heightmap:

A grayscale image containing a height value per pixel.

Bumpmap:

An image containing normals stored in the RGB channels used for modifying the existing normals (usually given in tangent space)

Normalmap:

An image containing normals stored in the RGB channels used for replacing the existing normals (usually given in tangent or object space)
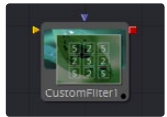
Custom Filter Tool

The Custom Tool is used to apply custom convolution filters to images. A custom convolution filter can give a wide variety of image effects. For example, emboss, relief, sharpen, blurring and edge detection are all convolution filters. There are many supplied custom filters in the Filters directory that can be loaded by right-clicking on the control header and selecting Settings > Load from the context menu.
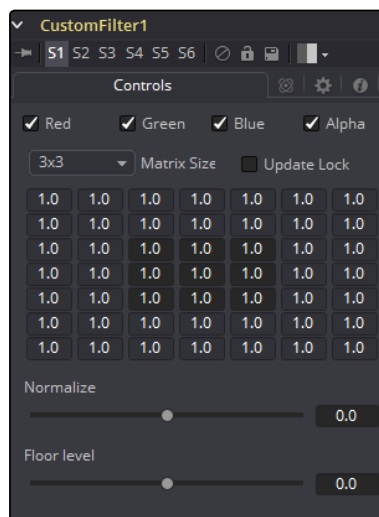
A Kernel filter is an array (or grid) of either 3 x 3, 5 x 5 or 7 x 7 values. The center of the array represents the current pixel, and entries nearby represent adjacent pixels. A value of 1 applies the full value of the pixel to the filter. A value of 0 ignores the pixel's value. A value greater than one multiplies the pixel's effect on the result. Negative values can also be entered, where the value of the pixel will be subtracted from the average. Only integer values can be entered; 0.5 is not valid.

For example, a filter with the values...

```
0  0  0

0  1  0

0  0  0
```

...will have zero effect from its neighboring pixels and the resulting image would be unchanged. A blurring effect would be...

```
1  1  1

1  1  1

1  1  1
```

...where the neighboring pixels are averaged with the center, resulting in a softening effect.

```
−5  0  0

0  1  0

0  0  5
```

This example will subtract five times the value from the top left and add five times the value from the lower right. If parts of the image that is processed are very smooth in color, the neighboring values will be very similar. In parts of the image where the pixels are different (i.e., an edge), the results will be different and tend to highlight or emboss edges in the image.

Using the values...

```
1  1  1

1  1  1

1  1  1
```

...in a filter and sliding Normalize to Positive will make the image go brighter or glow, simulating film over-exposure.

Using the values...

```
−1  0  0

0  0  0

0  0  1
```

...in a filter and sliding Floor Level to Positive will look like a Relief filter.

Custom Filter Controls Tab
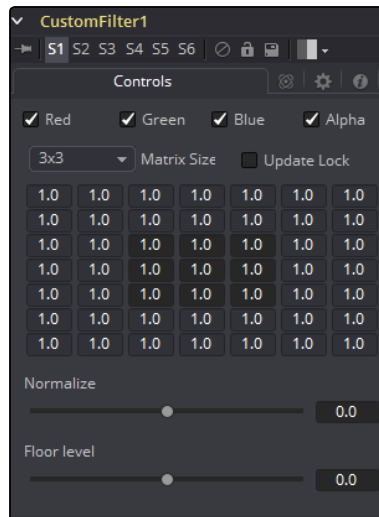
Color Channels (RGBA)

The color corrector defaults to operating on R, G, B and A channels. Selective channel editing is possible by clicking the checkboxes beside each channel, making selected channels active or inactive.

This is not the same as the RGBA checkboxes found under the common controls. The tool takes these controls into account before it processes. Deselecting a channel will cause the tool to skip that channel when processing, speeding up the rendering of the effect. In contrast, these controls under the Common Controls tab are applied after the tool has processed.

Matrix Size

Use this drop-down to set the size of the filter at 3 x 3 pixels, 5 x 5 pixels or 7 x 7 pixels, thus setting the radius of the pixels sampled. The larger the size, the more time it takes to render.

Update Lock

When this control is selected, Fusion will not render the filter. This is useful for setting up each value of the filter, then turning Update Lock off and rendering the filter.

Filter Matrix

The Filter Matrix control is a 7 x 7 grid of text boxes where a number is entered to represent how much influence each pixel has on the overall convolution filter. The text box in the center represents the pixel that is processed by the filter. The text box to the left of the center represents the pixel to the immediate left, and so forth.

The default Matrix size is 3 x 3. Only the pixels immediately adjacent to the current pixel will be analyzed. If a larger Matrix size is set, more of the text boxes in the grid will be enabled for input.

Normalize

This controls the amount of filter normalization that is applied to the result. Zero will give a normalized image. Positive values will brighten or raise the level of the filter result. Negative values will darken or lower the level.

Floor Level

This will add or subtract a minimum, or Floor Level, to the result of the filtered image. Zero will not add anything to the image. Positive values will add to the filtered image and Negative values will subtract from the image.
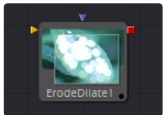
ErodeDilate Tool

This simple tool erodes or dilates the image, depending on whether the Amount slider is set to a negative or positive value.

ErodeDilate Controls Tab
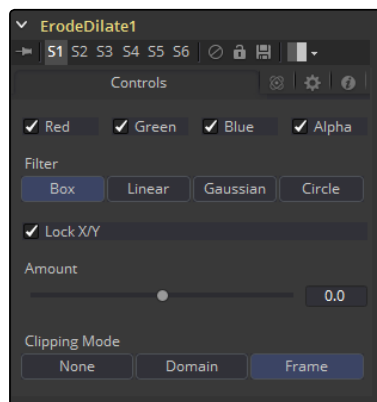
Color Channels (RGBA)

The filter defaults to operating on R, G, B and A channels. Selective channel filtering is possible by clicking the checkboxes beside each channel to make them active or inactive. This is not the same as the RGBA checkboxes found under the common controls. The tool takes these controls into account before it processes. Deselecting a channel will cause the tool to skip that channel when processing, speeding up the rendering of the effect. In contrast, the channel controls under the Common Controls tab are applied after the tool has processed.

Lock X/Y

The Lock X/Y checkbox is used to separate the Amount slider into amount X and amount Y, allowing a different value for the effect on each axis.

Amount

A negative value for Amount causes the image to erode. Eroding simulates the effect of an underexposed frame, shrinking the image by growing darker areas of the image so that they eat away at brighter regions.

A positive value for Amount causes the image to dilate, similar to the effect of overexposing a camera. Regions of high luminance and brightness grow, eating away at the darker regions of the image. Both techniques will eradicate fine detail in the image and tend to posterize fine gradients.
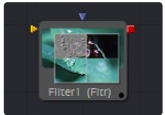
Filter Tool

The Filter Tool contains several pre-set filters, enabling a variety of effects, from radically changing the look of an image to adding subtle randomly-generated film grain.

Filter Controls Tab
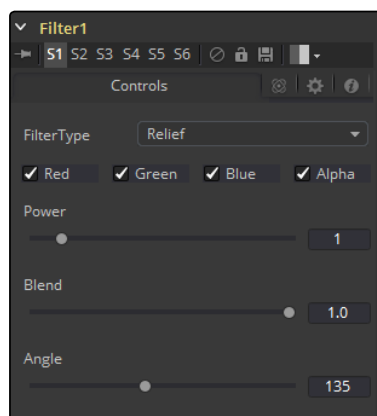
Filter Type

This drop-down control provides a selection of filter types. The options are displayed below.

Relief

This appears to press the image into metal, such as an image on a coin. The image will appear to be bumped and overlaid on gray.

Emboss Over

Embosses the image over top of itself, with adjustable highlight and shadow height and direction.

Noise

Uniformly adds noise to images. This is often useful for 3D computer-generated images that need to be composited with live action as it reduces the squeaky clean look that is inherent in rendered images. The frame number acts as the random generator seed. Therefore, the effect is different on each frame and is repeatable.

Defocus

This filter type blurs the image.

Sobel

Sobel is an advanced edge detection filter. Used in conjunction with a Glow filter, it creates amazing neon light effects from live action or 3D rendered images.

Laplacian

Laplacian is a very sensitive edge detection filter that produces a finer edge than the Sobel filter.

Grain

Adds noise to images similar to the grain of film (mostly in the mid-range). This is useful for 3D computer-generated images that need to be composited with live action as it reduces the squeaky clean look that is inherent in rendered images. The frame number acts as the random generator seed. Therefore, the effect is different on each frame and is repeatable.

Color Channels (RGBA)

The filter defaults to operating on R, G, B and A channels. Selective channel filtering is possible by clicking the checkboxes beside each channel to make them active or inactive.

Power

Values range from 1 to 10. It proportionately increases the amount by which the selected filter affects the image. This does not apply to Laplacian filter type.

Angle

This control has a range from 0 to 315 degrees and changes the effect in increments of 45 degrees. This only applies to the Relief and Emboss filters.

Median

Depending on which Filter Type is selected, the control may appear. It varies the Median filter's effect. A value of 0.5 will produce the true median result, as it will find the middle values. A value of 0.0 will find the minimums and 1.0 will find the maximums. Applies to the Median filter only.

Seed

This control is only visible when applying the Grain or Noise filter types. The Seed slider can be used to ensure that the random elements of the effect are seeded with a consistent value. The randomizer will always produce the same result given the same seed value.

Animated

This control is only visible when applying the Grain or Noise filter types. Select the checkbox to cause the noise or grain to change from frame to frame. To produce static noise, remove the selection from this checkbox.
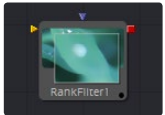
Rank Filter Tool

The Rank Filter is a very simple tool. This filter examines nearby pixels, sorts the pixels by value, and then replaces the color of all the pixels examined by the color of the pixel with the specified rank.

For example, a Rank filter with a size of 1 will sample 9 adjacent pixels for their values. The following shows some example values, sorted by value.

```
0.0
0.4
0.4
0.5
0.5
0.7
0.7
0.7
```

A Blur filter with the same size would average these values together to produce a value of 3.9. A Rank filter lets you choose a value from the list to select. For example, a rank of four would select the fourth item in the list, producing a value of.5

A Median filter is simply a linear Rank filter that selects the median, or middle value from the list of sorted values.

Rank Filter Controls Tab
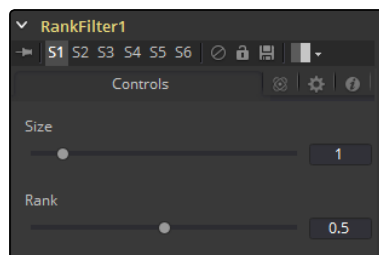
Size

This control determines the Size in pixels of the area sampled by the filter. A value of 1 will sample only the pixels immediately adjacent to the center pixel, while larger values sample from a larger area.

Small values are excellent for removing salt and pepper style noise, while larger values produce an effect similar to water color paintings.

Rank

The Rank determines which value from the sampled values will be chosen, where 0 is the lowest value and 1 is the brightest.

Flow Tools

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Flow Tools

Flow Tools

3D	▶
Blur	▶
Color	▶
Composite	▶
Creator	▶
Deep Pixel	▶
Effect	▶
Film	▶
Filter	▶
Flow	▶
Fuses	▶
I/O	▶
LUT	▶
Macro	▶
Mask	▶
Matte	▶
Metadata	▶
Miscellaneous	▶
Optical Flow	▶
Paint	▶
Particles	▶
Position	▶
Primatte	▶
Stereo	▶
Tracking	▶
Transform	▶
Warp	▶

Sticky Note
Underlay

Sticky Note

Underlay
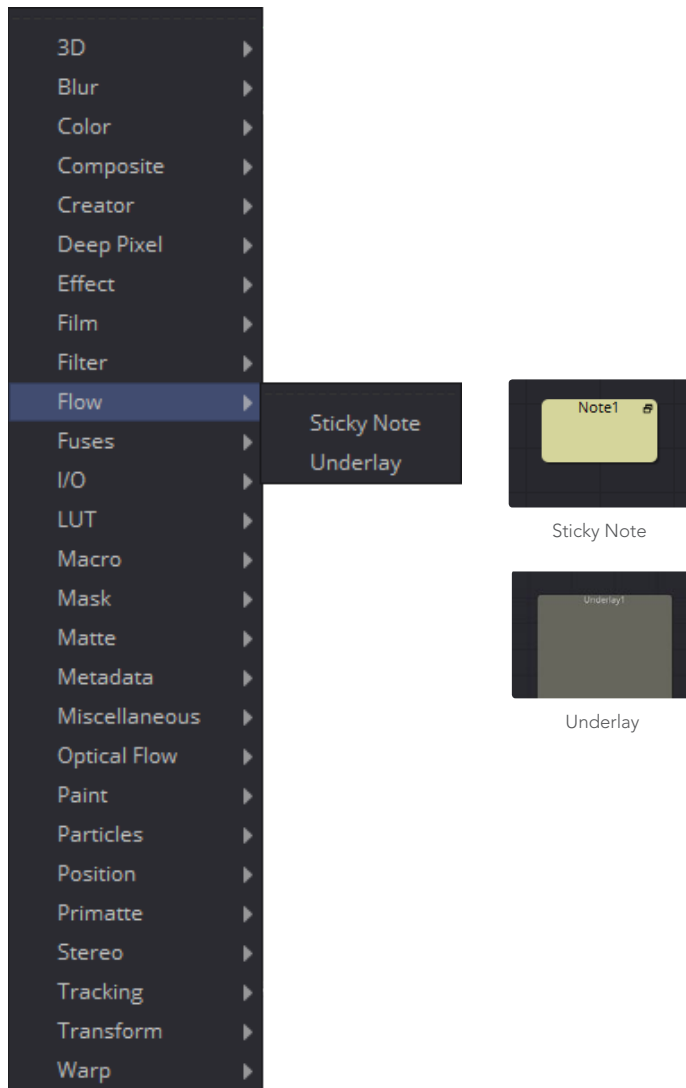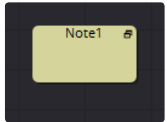
Sticky Note [NTE]

Sticky Notes are a useful way of providing notes, comments and history for a specific area of a comp. By changing their size and color, they can provide unobtrusive comments or crucial notices, as required. Sticky Notes make a good complement to the Comments tab.

Usage
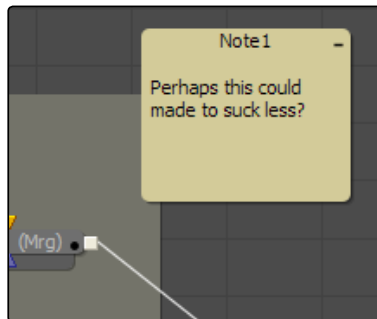
As with conventional tools, a Sticky Note can be added to a comp by selecting it from the Tools menu, in the Flow category, or from the Flow Editor's Add Tool contextual menu. The new Sticky Note will be created with its title bar centered on the last click position.

Like Groups, Sticky Notes are created in a smaller, collapsed form. They can be expanded by double-clicking anywhere on them, or by clicking the icon in the top right corner. Once expanded, they can be resized by dragging on any side or corner. To collapse them again, click the icon in the top right corner once more.

Sticky Notes can be renamed, deleted, copied and pasted and have their tile color and text color changed, using the Flow Editor's contextual menu like any other tool. It is also possible to lock them to prevent editing.
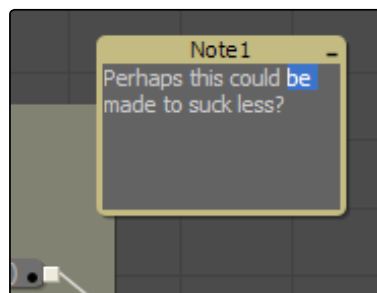
To edit the text in a Sticky Note, first expand it by double-clicking anywhere on the note, then click below its title bar. If the note is not locked, the text will become editable.

Underlay [UND]

Underlays are a convenient method of visually organizing areas of a composition. As with Groups, Underlays can improve the readability of a comp by separating it into labeled functional blocks. While Groups are designed to streamline the look of a comp by collapsing complex layers down to single tools, Underlays highlight, rather than hide, and do not restrict outside connections.

Usage
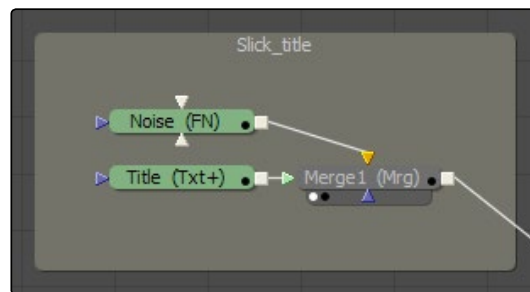
As with conventional tools, an Underlay can be added to a comp by selecting it from the Tools menu, in the Flow category, or from the Flow Editor's Add Tool contextual menu. The new Underlay will be created with its title bar centered on the last click position.

Underlays can be resized by dragging on any side or corner. This will not affect any tools.

Underlays can also be used as simple selection groups. Activating an Underlay, by clicking on its title, will select all the tools contained wholly within it as well, allowing the entire set to be moved, duplicated, passed-through, etc.

FlowOrg Tools

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FlowOrg Tools

FlowOrg Tools

Groups [Nᴛᴇ]

Groups can be used to neatly organize your comps, especially by putting together multiple tools.

Usage

→ To group tools, select them and either press Command-G or Ctrl-G or right-click and select Group from the contextual menu. Press Command-E or Ctrl-E to either Expand or Collapse a selected Group.
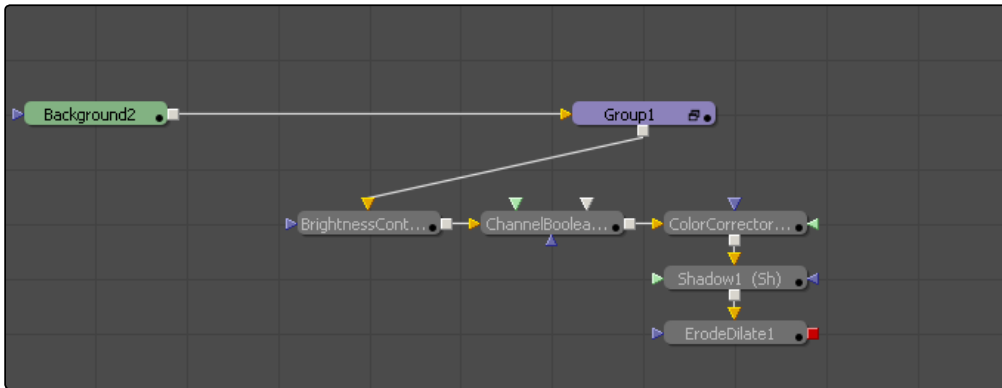
→ Right-click and select Ungroup from the contextual menu to ungroup all tools.
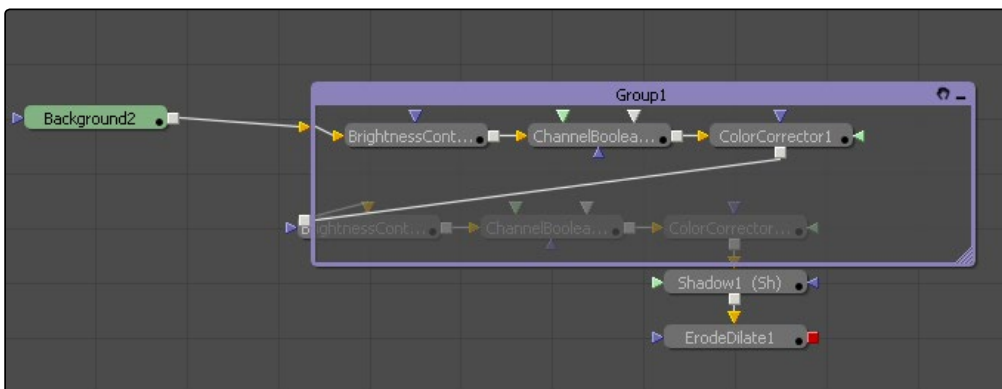
→ When opened, Groups will hover over existing elements, allowing editing of the enclosed tools.

Macro [-/-]

Macros can be used to combine multiple tools and expose a user-definable set of controls. They are meant as a fast and convenient way for building your own customized tools.

Usage
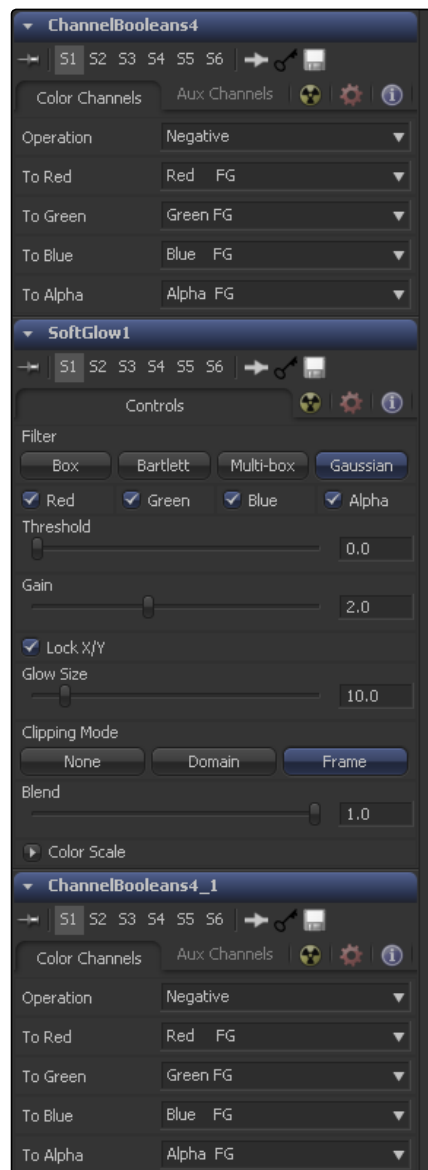
Creating a Macro

To create a Macro, select the tools intended for the macro, right-click on any of them and select Macro > Create Macro from the contextual menu.

Macro Editor

The Macro Editor then allows you to specify and rename the controls that shall be exposed in the final macro.

In this example we only expose the Threshold and Gain sliders of a Softglow tool, which is sandwiched between two ChannelBooleans.

After setting up the Macro to your liking, type in a name in the Macro Name field and select File > Save.
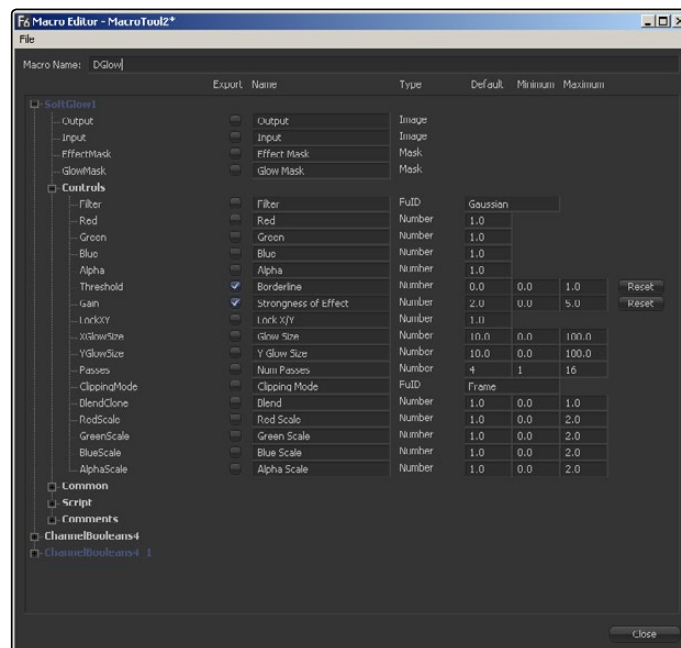
To add the Macro to your flow, right-click anywhere on the flow and select Macro > [NameOfYourMacro] from the contextual menu.

The Final Macro
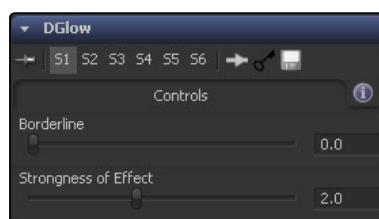
The final Macro looks and behaves just like any other tool in Fusion.

As another example, you could take a single ChannelBoolean, set it to Add mode, and make it into a macro exposing no controls at all, thus creating the equivalent of a Add Node like the one that can be found in programs like Shake.

Pipe Router [-/-]

Pipe Routers can be used to neatly organize your comps by creating diversions in your pipes to make them better visible and help you understand the flow more easily. Pipe Routers do not have any influence on render times.

Usage
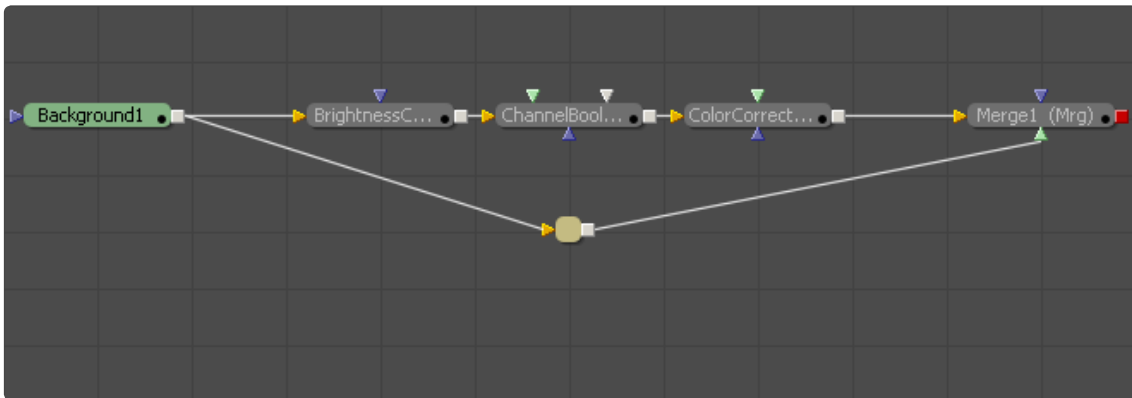
Pipe Router
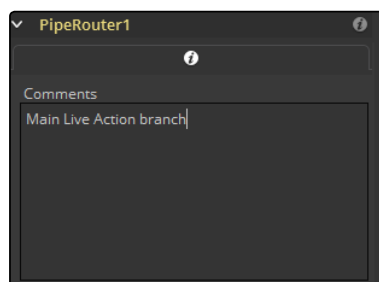
To insert a Router in your pipe, Option or Alt left-click on the pipe and place the Router anywhere on the flow.

Though Routers have no actual controls, they still can be used to add comments to your comp.

Fuses

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Fuses
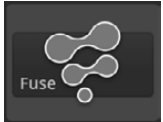
Fuses [Fus]

Fuses are scriptable plug-ins. They can be edited within Fusion by pressing the Edit button, and will compile on-the-fly when clicking on Reload.

Fuses are a great way to prototype plug-ins or to deal with experimental code.

Please refer to the SDK for further information.
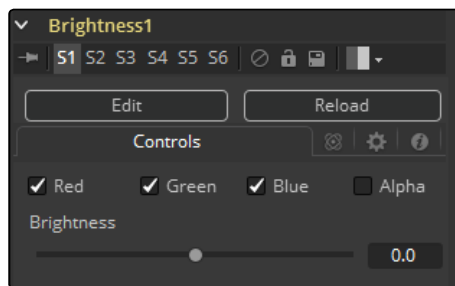
I/O Tools

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I/O Tools

I/O Tools

Loader

Saver
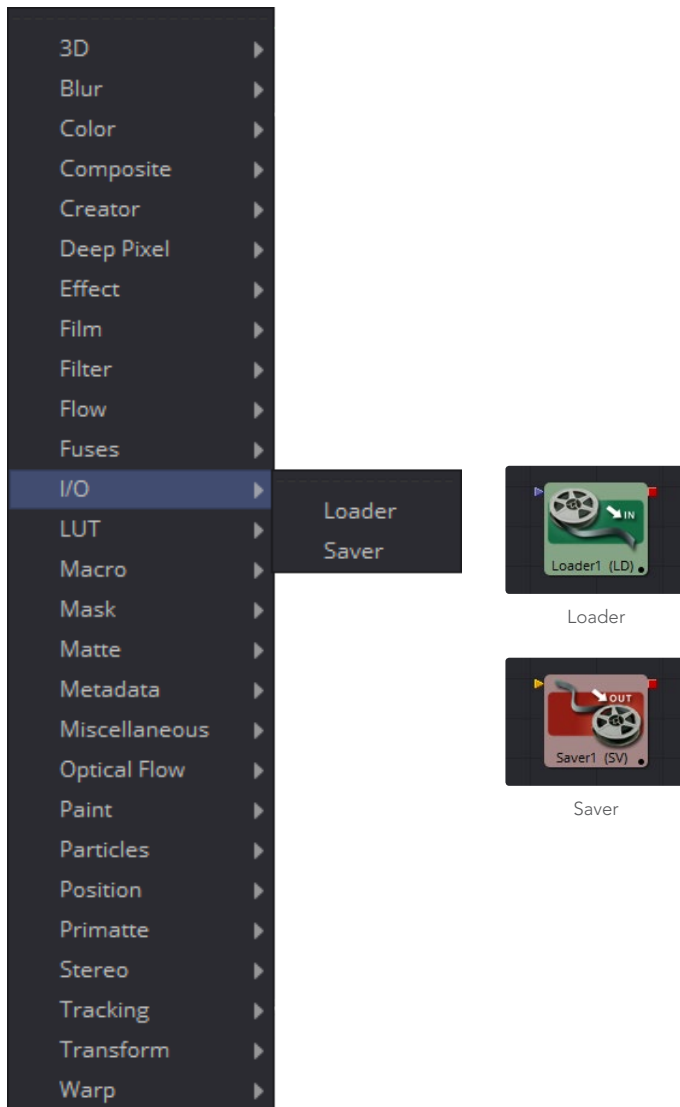
Loader [LD]

The Loader tool is used to select and load footage from the hard drive or network storage. The Loader is responsible for trimming, looping, and extending the footage, as well as setting the field order, pixel aspect and color depth. Loader is arguably the most important tool in Fusion.

File Tab
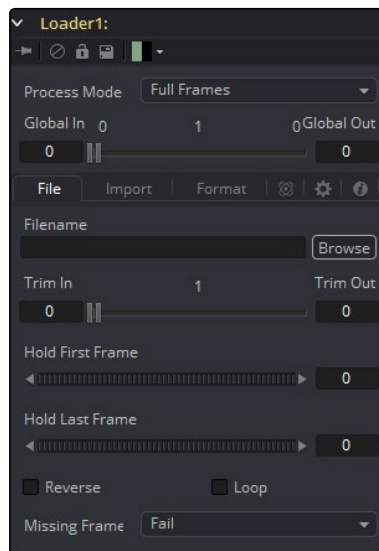
Filename

Clicking on the yellow Folder button will display a standard Fusion file browser. The path to the footage can also be typed directly using the text box provided.

The text box supports filename completion. As the name of a directory or file is typed in the text box, Fusion will display a popup that lists possible matches. Use the arrow keys to select the correct match and complete the path.

When a Loader is added to the flow, a file dialog will appear automatically to allow selection of a clip from the hard drives. To select footage later, select Cancel. The Loader will still be added to the flow. Disable the automatic display of the file browser by disabling Auto Clip Browse in the Global > General Preferences.

File Sequences

It is common practice to use file sequences to identify an image that is part of a series. If the last part of a file's name is a number (not counting file extension), Fusion will automatically scan the directory looking for files that match the sequence.

For example, the following filenames would be valid sequences.

image.0001.tga
image.0002.tga
image.0003.tga

image151.exr
image152.exr
image153.exr

image1.tif
image2.tif
image3.tif

The following would not be considered a sequence, since the last characters are not numeric.

shot.1.fg.tga
shot.2.fg.tga
shot.3.fg.tga

It is not necessary to select the first file in the sequence; Fusion will search the entire folder for files matching the sequence in the selected filename. Also, Fusion will determine the length of the sequence based on the first and last numeric value in the filenames. Missing frames are ignored.

For example, if the folder contains two files with the following names:

image.0001.tga
image.0100.tga

Fusion will see this as a file sequence with 100 frames, not a file sequence containing two frames. The Missing Frames drop-down menu is used to choose how Fusion handles missing frames. The Trim In/Trim Out control's contextual menu can also be used to force a specific clip length, or to rescan the folder. Both controls are described in greater detail below.

Occasionally, you only want to load a single frame out of a sequence, like, for example, a photograph out of a folder containing many other files as well. By default, Fusion will detect those as a sequence, but if you hold Shift while dragging the file from Explorer to the Flow Editor, Fusion will only take that specific file and disregard any sequencing.

Also, if you use the Preview controls on the bottom right of the screen, you can Command-click or Ctrl-click on the slider once you reached the frame you want to use as a still, and Fusion will set up the loader accordingly.

Proxy Filename

The Proxy Filename control only appears once the filename control points to a valid clip. This can specify a clip that will be loaded when the Proxy mode is enabled. This allows smaller versions of the image to be loaded to speed up file I/O from disk and processing.

For example, create a 1/4 scale version of a Cineon film sequence to use as a file proxy. Whenever the proxy mode of the flow is enabled, the smaller resolution proxy clip will be loaded from disk and all processing will be performed at the lower resolution, significantly improving render times.

This is particularly useful when working with large film plates stored on a remote fileserver. Lower resolution versions of the plates can be stored locally, reducing network bandwidth, interactive render times and memory usage.

The proxy clip must have the same number of frames as the source clip, and the sequence numbers for the clip must start and end on the same frame numbers.

It is strongly suggested that the proxies are exactly the same format as the main files. In the case of formats with options, such as Cineon, DPX and OpenEXR, the proxies will use the same format options as the primary.

Trim In and Out

The Trim range control is used to trim frames from the start or end of a clip. Adjust the Trim In to remove frames from the start and Trim Out to specify the last frame of the clip. The values used here are offsets. A value of 5 in Trim In would use the 5th frame in the sequence as the start, ignoring the first four frames. A value of 95 would stop loading frames after the 95th.

Right-click on the range control to see three options appear in a submenu

Autodetect Clip Length

This rescans the clip to see if frames have been added or removed since the last time the clip was scanned (when it was loaded).

Set Clip Start Frame

Selecting this will display a dialog box to set the number of the actual start frame of the clip on disk. Use this when the first frames of the file sequence are not yet available to set the clip's properties manually.

Set Clip Length

This sets the actual clip length, overriding the scanned length. This is useful if the entire clip has not yet been rendered or captured. Used in combination with Set Clip Start Frame, it can be used to define a clip before the clip is available.

For example, imagine there is only a single animatic frame available for a scene that is being precomped. The animation department has yet to render the entire layer. Use the Set Clip Start and Set Clip Length to define the clip anyway, and the composition will load the correct frames when they become available. If the Missing Frames control is set to Wait, then rendering will pause until the frame is available, instead of failing.

Hold First and Last Frame

The Hold First Frame and Hold Last Frame controls will hold the first or last frame of the clip for the specified amount of frames. Held frames are included in a loop if the footage is looped.

Reverse

Select this checkbox to reverse the footage so that the last frame is played first and the first frame played last.

Loop

Select this checkbox to loop the footage until the end of the project. Any lengthening of the clip using Hold First/Last Frame or shortening using Trim In/Out is included in the looped clip.

Missing Frames

The Missing Frames drop-down menu provides options for selecting how the Loader will behave when an expected frame is missing from the footage, or is unable to load for any reason.

→ Fail: The Loader will not output any image unless a frame becomes available. Rendering will abort.

→ Hold Previous: Output the last valid frame until a frame becomes available again. This fails if no valid frame has been seen, for example if the first frame is missing.

→ Output Black: Output a black frame until a valid frame becomes available again.

→ Wait: Fusion will wait for the frame to become available, checking every few seconds. Useful for rendering a flow simultaneously with a 3D render. All rendering will cease until the frame appears.

Import Tab
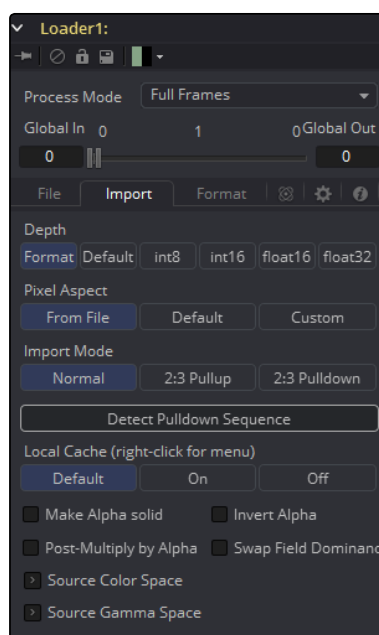
Depth

The buttons in this array are used to select the Color Depth used by Fusion to process footage from this loader. The default option is Format.

Format

The color depth is determined by the color depth supported in the file format loaded. For example, TGA files will automatically process at 8-bit because the TGA file format does not store color depths greater than 8. Cineon files will load at Float, etc. If the color depth of the format is undetermined, the default depth defined in the flow's Frame Format preferences is used.

Formats that support multiple color depths will be set to the appropriate color depth automatically.

→ Default: The color depth is determined by the settings in the composition's Frame Format Preferences panel.

→ Int 8-bit/Int 16-bit/Float 16/Float 32: These options set the color depth in which the image will be processed. For a more complete discussion of color depth and how it affects composites, consult the Frame Formats chapter of this manual.

Pixel Aspect

This button array is used to determine the image's pixel aspect ratio.

From File

The loader will conform to the image aspect detected in the saved file. There are a few formats that can store aspect information. TIFF, JPEG and OpenEXR are examples of image formats that may have the pixel aspect embedded in the file's header. When no aspect ratio information is stored in the file, the default frame format method is used.

→ Default: Any pixel aspect ratio information stored in the header of the image file will be ignored. The pixel aspect set in the composition's Frame Format preferences will be used instead.

→ Custom: Select this option to override the preferences and set a pixel aspect for the clip manually. Selecting this button will cause the X/Y Pixel Aspect control to appear. For a more complete discussion of pixel aspect and how it affects composites, consult the Frame Formats chapter of this manual.

Custom Pixel Aspect

This control is only visible when the Custom Pixel Aspect method is used. Enter the desired aspect, or right-click on the control to display a menu of common frame formats and their aspects.

Import Mode

This menu provides options for removing pull-up from an image sequence. Pull-up is a reversible method of combining frames used to convert 24fps footage into 30fps. It is commonly used to broadcast NTSC versions of films.

→ Normal: This passes the image without applying pull-up or pull-down.

→ 2:3 Pull Up: This will remove existing 3:2 pull-down applied to the image sequence, converting from 30fps to 24fps.

→ 2:3 Pull Down: The footage will have pull-down applied, converting 24fps footage to 30fps by creating 5 frames out of every four. The Process mode of a loader set to Pull Down should always be Full Frames.

First Frame

This control is used to determine which frame of the 3:2 sequence is used as the first frame of the loaded clip. It only appears if the Pull-up or Pull-down options are selected from the Import Mode menu.

Detect Pulldown Sequence

Pressing this button will cause Fusion to attempt to automatically detect and set the Pull-up sequence of the footage. It only appears if Pull-up or Pull-down is selected from the Import Mode menu. If it succeeds in detecting the order, the First Frame control will automatically be set to the correct value.

Make Alpha Solid

When checked, the original alpha channel of the clip will be cleared and set to solid white (completely opaque).

Invert Alpha

When checked, the original alpha channel of the clip will be inverted. This may also be used in conjunction with Make Alpha Solid to set the alpha to pure black (completely transparent).

Post-multiply by Alpha

Selecting this option will cause the color value of each pixel to be multiplied by the alpha channel for that pixel. This option can be used to convert subtractive (non-premultiplied) images to additive (premultiplied) images.

Swap Field Dominance

When this control is selected, the field order (dominance) of the image will be swapped, so that the order in time that the fields appear in is reversed. Unlike the Process Mode control, this is done without spatially swapping the scanlines in the image.

Source Color Space
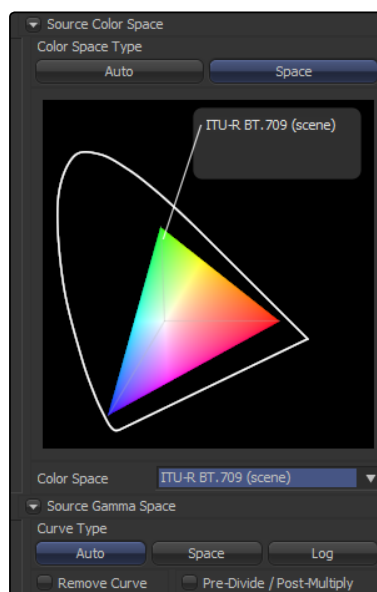
Sets the Color Space of the footage to help achieve a linear workflow.

Unlike the Gamut tool, this doesn't perform any actual color space conversion, but rather adds the source space data into the metadata, if that metadata doesn't already exist. The metadata can then be used downstream by a Gamut tool with the From Image option, or in a Saver, if explicit output spaces are defined there.

> → Auto: Passes along any metadata that might be in the incoming image.

> → Space: Allows the user to set the Color Space from a variety of options.

Source Gamma Space

Determines the Gamma Space of the footage and gives the option to remove the Gamma Curve to help achieve a linear workflow.
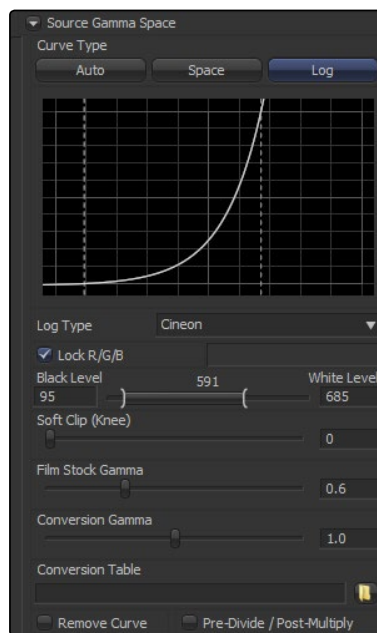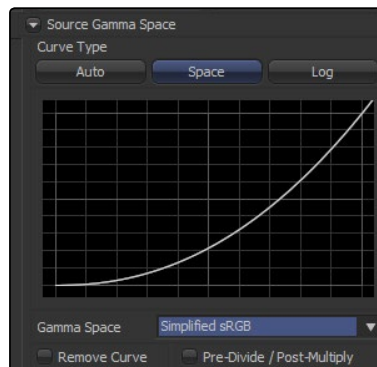
> → Auto: Passes along any metadata that might be in the incoming image.

> → Space: Allows the user to set the Gamma Space from a variety of options.

> → Log: Brings up the Log/Lin settings, similar to the Cineon Tool.

Remove Curve

Depending on the selected Gamma Space or on the Gamma Space found in Auto mode, the associated Gamma Curve is removed from, or a log-lin conversion is performed on, the material, effectively converting it to a linear output space.

Format Tab
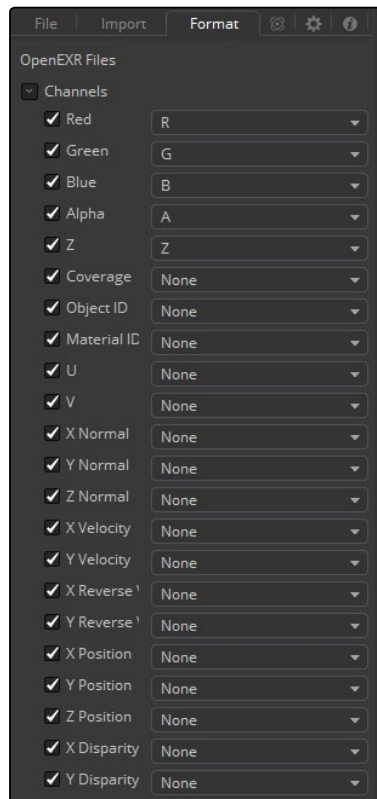
The Format tab contains information, options and settings relative to loading the image format. Not all file formats have options. Notably, the Cineon, DPX, PSD, OMF, OpenEXR and QuickTime formats all provide additional options when loaded. See Appendix A, File Formats, for a description of all supported formats.

Options for JPG and DPX are shown for reference on the right.

OMF Format

An OMF file is not just a media format; it can contain information about edits, multiple sequences, and even multiple versions of the same shot. If multiple clips exist within the OMF file, the format options may be used to select the desired clip. To import all clips from an OMF file, complete with edit and combine information, use the Import OMF option from Fusion's File menu to create a entire composition from the contents of the OMF.

Photoshop PSD Format

Fusion can load any one of the individual layers stored in the PSD file, or the completed image with all layers. Transformation and adjustment layers are not supported. To load all layers individually from a PSD file, with appropriate blend modes to combine them, use the Import PSD option from Fusion's File menu to create a entire composition from the contents of the PSD file.

Cineon and DPX Format

See the chapter Film in Fusion and the chapter for the Cineon Log tool for a detailed discussion of the options found in the Cineon and DPX file formats.

OpenEXR Format

Industrial Light and Magic developed the OpenEXR format. Its initial design was to provide a compact and flexible format to support storage of high dynamic range images (float). The format has been expanded to support a variety of extra channels and metadata.

The format options for OpenEXR files provide a mechanism for mapping any non-RGBA channels to the channels supported natively in Fusion. Enter the name of a channel in the OpenEXR file into any of the edit boxes next to the Fusion channel name. A command line utility for dumping the names of the channels can be found at http//www.openexr.com/.

QuickTime

QuickTime files can potentially contain multiple tracks. Use the format options to select one of the tracks.

Image File Lists

One of the more interesting formats supported by Fusion is the Image File List format. An IFL is actually a text file containing a list of files that should be loaded. Use IFL files to specify a sequence of arbitrarily named files, or files from different directories.

Common Controls
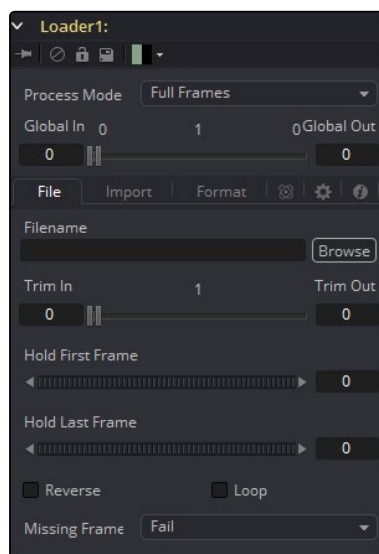
Process Mode

Use this menu to select the Fields Processing mode used by Fusion when loading the image. The default option is determined by the Has Fields checkbox control in the Frame Format preferences, and the default height as well. Available options are Full frames, NTSC fields, PAL/HD fields, PAL/HD fields (reversed) and NTSC fields (reversed). The two Reversed options load fields in the opposite order, and will thus result in the fields being swapped both in time order and in vertical order as well. Use the Reverse Dominance checkbox (described in the Import tab below) to swap fields in time only.

For more information on Fields Processing, consult the Frame Formats chapter.

Global In and Out

Use this control to specify the position of this tool within the project. Use Global In to specify the frame on which that the clip starts and Global Out to specify the frame on which this clip ends within the project's Global Range. The tool will not produce an image on frames outside of this range.

If the Global In and Out values are decreased to the point where the range between the In and Out values is smaller than the amount of available frames in the clip, Fusion will automatically trim the clip by adjusting the Clip Time range control. If the global in/out values are increased to the point where the range between the In and Out values is larger than the amount of available frames in the clip, Fusion will automatically lengthen the clip by adjusting the Hold First/Last Frame controls.

Extended frames are visually represented in the range control by changing the color of the held frames to purple in the control.

To slip the clip in time or move it through the project without changing its length, place the mouse pointer in the middle of the range control and drag it to the new location, or enter the value manually in the Global In value control.

The Magic Comp Variable

The pathnames in this example start with Comp:\.

The Comp-variable in Fusion works for Loaders and Savers and helps you to keep your work organized. Comp:\ stands for the folder your actual composition is stored in.

So as long as all your source footage is stored in subfolders of your Comp folder, Fusion will find that footage regardless of the actual hard drive or network share name.

You could, for example, copy an entire shot from the network to your local drive, set up your Loaders and Savers to use the Comp-variable, work all your magic locally (i.e., set up your composition) and then copy just the composition back to the server and issue a net-render.

All Render Slaves will automatically find the source footage.

Some examples:

Your Composition is stored in X:\Project\Shot0815\Fusion\Shot0815.comp

Your source footage sits in X:\Project\Shot0815\Fusion\Greenscreen\0815Green_0000.dpx

The relative path in the loader would then be: Comp:\Greenscreen\0815Green_0000.dpx

If your source footage is stored in X:\Project\Shot0815\Footage\
Greenscreen\0815Green_0000.dpx, the relative path in the loader would
then be: Comp:\..\Footage\Greenscreen\0815Green_0000.dpx

Observe how the two dots .. set the directory to go up one folder; pretty much the same as CD .. in a command shell window.
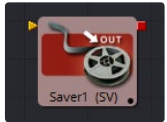
Saver [Sv]

The Saver is responsible for writing the results of a composition to disk. It can be inserted into a composition at any point. The Saver tool can also be used to add scratch track audio to your flow, which can be heard during interactive playback.

A composition can contain any number of Saver tools, and Savers can be placed at any point in the flow.

File Tab
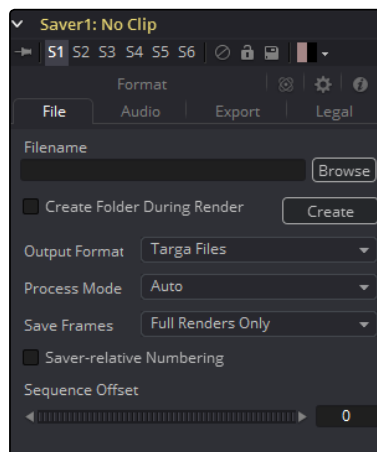
Filename

Use the Filename dialog to select the name and path of the rendered image output. Click on the yellow folder icon to display a file browser to select a folder and filename to be used for output.

Sequence numbering is automatically added to the filename when rendered. For example, if c\renders\image.tga is entered as the filename and 30 frames of output is rendered, the files will automatically be numbered as image0000.tga, image0001.tga, image0003.tga...and so on. Four digit padding is automatically used for numbers lower than 10000.

Specify the number of digits to use for padding the sequence number by explicitly entering the digits into the filename.

For example, image000000.tga would apply 6 digit padding to the numeric sequence, image.001.tga would use 3 digit padding and image1.tga would use none.

Saving to an Image File List

It is possible to save to an IFL file if more control is required over the filenames written to disk than specified here. To create an IFL, create a text file with the extension .ifl. Each line of the text file specifies the name for one frame of the output. For example, to render using roman numerals instead of decimals for the file sequence numbering would create the following files:

> image.i.tga
> image.ii.tga
> image.iii.tga
> image.iv.tga
> image.v.tga

The render will fail if there are not enough lines to match the number of frames rendered. In the above example, the render would fail after the fifth frame.

Format options cannot be specified when using image file lists to save to disk. The defaults will be used instead.

Output Format

Use this control to select the image format to be saved. Selecting a new format from this menu does not change the extension used in the filename to match. Modify the filename manually to match the expected extension for that format to avoid a mismatch between name and image format.

For a list of file formats supported for saving by Fusion, see Appendix A.

Process Mode

The Process Mode menu is used to set the method of field processing used by Fusion when the flow is rendered.

The default option is Auto. This will render the flow using the field ordering set in the Process mode of the most background Loader or Creator tool in the flow.

To force a flow to render individual fields or full frames regardless of the settings of other tools in the flow, change this menu's setting to one of the other listed options.

For example, if the Saver's process mode is set to NTSC fields, a Loader set to process full frames will still load a full frame from disk, but animation applied to that layer will be applied with field level accuracy. In all cases, footage will be re-interlaced, if necessary, and saved as frames on disk.

See the Frame Formats chapter for additional details on frame and fields processing in Fusion.

Save Frames

This control selects between two modes.

Full Renders Only

Images are only saved to disk when a final render is started using the Start Render button in the Time Ruler.

High Quality Interactive

This render mode is designed for real-time rendering when painting and rotoscoping. Fusion will save each frame to disk as it is processed interactively.

When used correctly, this feature can completely eliminate the need to perform a final render after rotoscoping. It can cause tremendous confusion when used in conjunction with a flow that contains spline-animated parameters.

If these splines are modified in such a way that frames already saved interactively are changed, the frames already on the disk will not automatically be re-rendered. Either step through each frame again or perform a final render to make certain that the result is correct.

Set Sequence Start

Normally, Fusion will use the render range of a composition to determine the numeric sequence used when rendering a file sequence to disk. Enable this checkbox to reveal the Sequence Start Frame control to adjust the starting number in the sequence to a custom value.

Sequence Start Frame

This thumbwheel control can be used to set an explicit start frame for the number sequence applied to the rendered filenames. For example, if Global Start is set to 1 and frames 1-30 are rendered, files will normally be numbered 0001-0030. If the Sequence Start Frame is set to 100, the rendered output would be numbered from 100-131.

Audio Tab

The Audio functionality is included in Fusion for scratch track (aligning effects to audio and clip timing) purposes only. Final renders should almost always be performed without audio. The smallest possible audio files should be used, as Fusion will load the entire audio file into memory for efficient display of the waveform in the Timeline.

The audio track will be included in the saved image if a QuickTime or AVI file format is selected. Fusion currently supports playback of WAV audio.
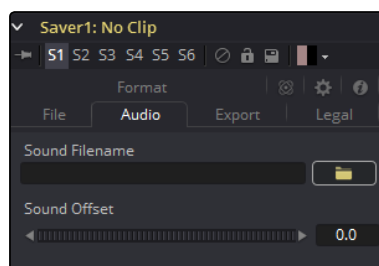
Audio Browse

Select the optional audio scratch track to be used. Select the *.WAV file of choice, then expand the Saver segment in the Timeline layout to view the audio waveform. Drag the pointer over the audio wave in the Timeline layout to hear the track.

Sound Offset

Drag the control left or right to create an offset in time between the audio and images of the flow.

Export Tab
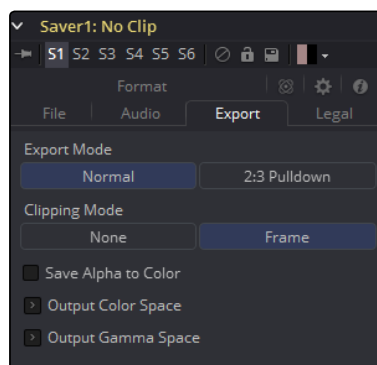
Export Mode

This menu is used to apply a SMPTE standard 3:2 pulldown to the footage as it is saved to disk, converting the footage from 24fps to 30 fps.

First Frame

First Frame determines the cadence of the 3:2 pulldown by choosing what frames are combined from the 24fps source to create the first frame in the 30fps pulldown result. Normally, this should be left to AA. When saving a clip that originally had pulldown that was removed to apply effects and it needs to be reinserted into an existing edit, the cadence of the original clip may need to be matched.

Clipping Mode

These radio buttons define how the edges of image should be treated. This can also be called source image clipping.

They default to Frame, which will provide the same behavior as previous versions of Fusion. Since this option will clip to the parts of the image visible within its visible dimensions, it will break any infinite-workspace behavior.

If the upstream DoD is smaller than the frame, the remaining area in the frame will be treated as black/transparent. None does not perform any source image clipping at all.

This means that any data that would normally be needed outside the upstream DoD will be treated as black/transparent. Be aware that this might create humongous images which can consume a huge amount of diskspace. So you should use this option only if really needed.

For more information about ROI, DoD and Infinite Workspace, please see the dedicated chapter.

Save Alpha to Color

When selected, this control will cause the alpha channel to be saved into the color channels as a grayscale image. This will completely overwrite any existing color information.

Legal Tab
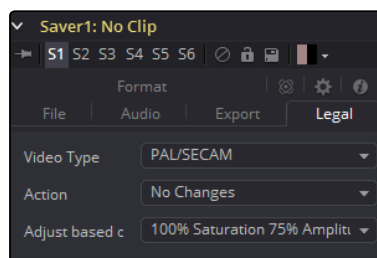
Video Type

Select the standard to be used for broadcast legal color correction. NTSC, NHK or PAL/SECAM can be chosen.

Action

Use this menu to choose how Fusion will treat illegal colors in the image.

Adjust to Legal

This will cause the images to be saved with legal colors relevant to the Video Type selected.

Indicate as Black

This causes the illegal colors to be displayed as black in the views.

Indicate as White

This causes the illegal colors to be displayed as white in the views.

No Changes

This causes the images to be saved unaffected.

Adjust Based On

This menu is used to choose whether Fusion will legalize the image to 75% or 100% amplitude. Very few broadcast markets permit 100% amplitude, but for the most part this should be left to 75%.

Format Tab
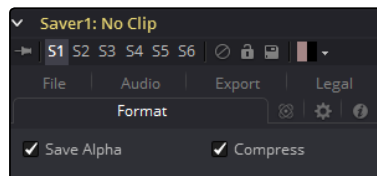
The Format tab contains information, options and settings specific to the image format being saved. The controls for a TGA sequence will be entirely different from the ones displayed when a DPX file is saved.

TGA and DPX are displayed on the right for reference.

When the Saver is set to DPX, it's important to understand the reason for the "Data is Linear" option. When saving log data into a DPX, and not using the Saver's own lin-log conversion (that is, Bypass Conversion is checked), the "Data is Linear" option should be off. This indicates whether the reason for checking Bypass Conversion is because the data is linear, or whether it's already log.

If "Data is Linear" is enabled, then the DPX is marked in its Header as containing linear data. In turn, that means that when the DPX is loaded back into Fusion, or into other apps that evaluate the Header, those apps will think the data is linear, and will not perform any log-lin conversion.

The Magic Comp Variable

As you can see in the screenshots, the pathnames in this example start with Comp:\.

The Comp-variable in Fusion works for Loaders and Savers and helps you to keep your work organized. Comp:\ stands for the folder your actual composition is stored in.

So as long as all your source footage is stored in subfolders of your comp-folder, Fusion will find that footage regardless of the actual hard-drive or network share name.

You could, for example, copy an entire shot from the network to your local drive, set up your Loaders and Savers to use the Comp:-variable, work all your magic locally (i.e., set up your composition) and then copy just the composition back to the server and issue a net-render. All render slaves will automatically find the source footage.

Some examples:

Your Composition is stored in X:\Project\Shot0815\Fusion\Shot0815.comp

Your source footage sits in X:\Project\Shot0815\Fusion\Greenscreen\0815Green_0000.dpx The relative path in the Loader would then be: Comp:\Greenscreen\0815Green_0000.dpx

If your source footage is stored in X:\Project\Shot0815\Footage\Greenscreen\0815Green_0000.dpx The relative path in the Loader would then be: Comp:\..\Footage\Greenscreen\0815Green_0000.dpx

Observe how the two dots .. set the directory to go up one folder. Pretty much the same like CD .. in a command shell window.

LUT Tools

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LUT Tools

LUT Tools

File LUT

LUT Cube Analyzer

LUT Cube Apply

LUT Cube Creator
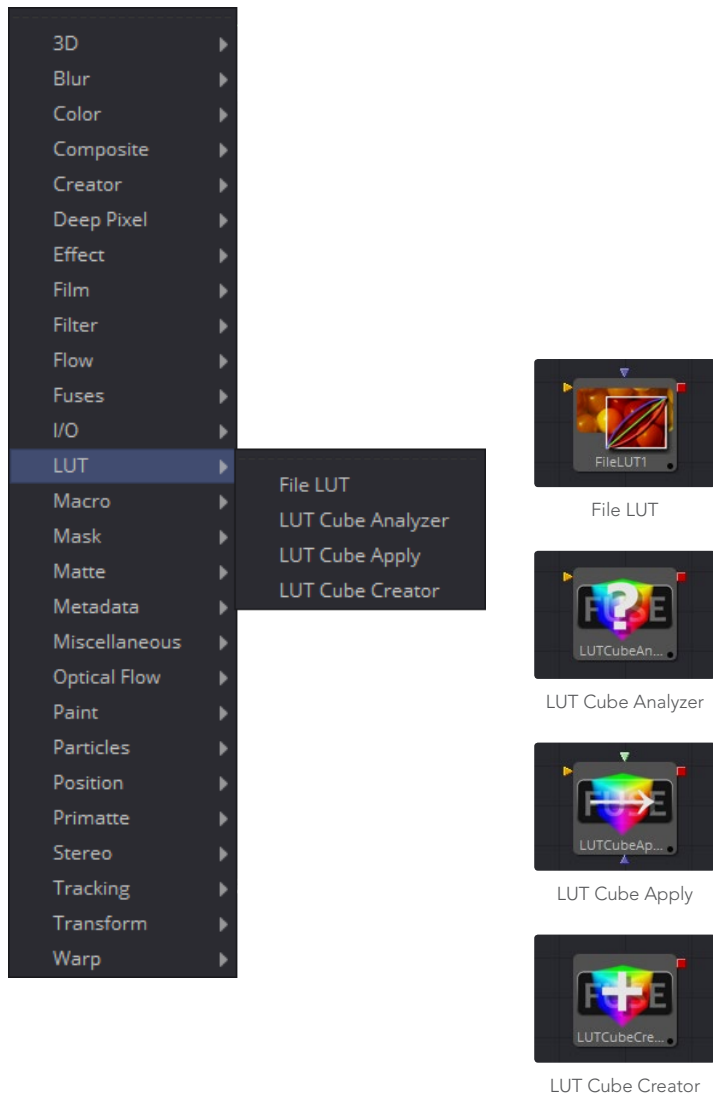
File LUT [FLU]

The File LUT tool applies a Look up Table (LUT) to the image, either a simple 1D LUT or a supported 3D LUT. Unlike the Color Curves tool, it does not use a spline-based LUT. Instead, it loads the LUT from a file stored on the system or network.

This approach has two advantages. The first is that the only part of the LUT stored in the composition is the path to the file. Since LUT files can be very large, this can dramatically reduce the file size of a composition when several LUTs are present. The second advantage is that it becomes possible to adjust all File LUT tools using the same file at the same time, simply by changing the contents of the LUT. This can be useful when the same LUT-based color correction is applied in many different compositions.

Controls
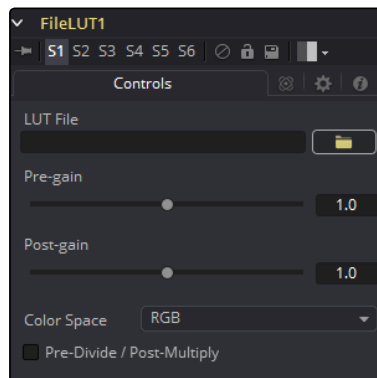
LUT File

Use this control to select the path to the file describing the LUT. Currently, this tool supports LUTs exported from Fusion in .LUT and .ALUT formats, Shake's LUT format, and a number of 3D LUT formats as well. The tool will fail with an error message on the Console if it is unable to find or load the specified file.

Color Space

Use this control to change the color space the LUT is applied in. The default is to apply the curves described in the LUT to the RGB color space, but options for YUV, HLS, HSV and others are also available.

Pre-Divide/Post-Multiply

Selecting the Pre-Divide/Post-Multiply checkbox will cause the image pixel values to be divided by the alpha values prior to applying the LUT, and then re-multiplied by the alpha value after the correction.

This helps to prevent the creation of illegally additive images, particularly around the edges of a blue/green key or when working with 3D rendered objects.
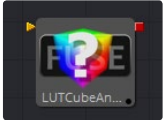
LUT Cube Analyzer [LCA]

The LUT Cube Analyzer takes an image created by the LUT Cube Creator as an input and allows the user to create a 3D LUT file in ALUT3, ITX or 3DL format.

Feeding the original image into the tool would result in an unaltered or 1:1 LUT file.

You can, however, modify, grade and color correct the original cube image with as many tools as you like and feed the result into the LUT Cube Analyzer. This will create a LUT that exactly resembles your color pipeline.

Usage
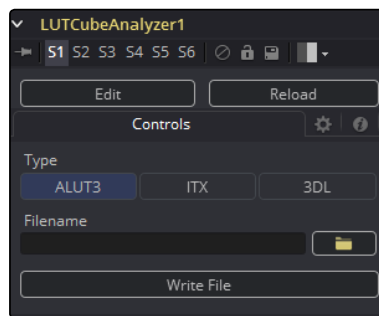
Connect the output of any tool modifying an image that was created with the LUT Cube Creator to the input of the Analyzer, view the Analyzer, select the desired output format, specify a filename and press Write File to create the 3D LUT.

Controls

Type

Select the desired output format of the 3D LUT.

Filename

Specify a path and name the LUT file is written to.

Write File

Press this button to generate the 3D LUT file based on the settings above.

LUT Cube Apply [LCP]

The LUT Cube Apply takes an image created by the LUT Cube Creator as the Foreground input and applies that LUT to the image connected to the Background input.

Feeding the original image into the tool would result in an unaltered or 1:1 output.

You can, however, modify, grade and color correct the original cube image with as many tools as you like and feed the result into the LUT Cube Apply. Or, take a LUT image that has been graded beforehand to apply the LUT without having to write an actual 3D LUT using the LUT Cube Analyzer.

Usage
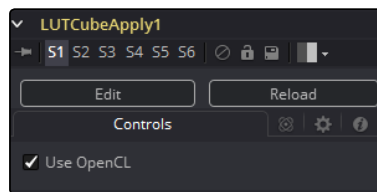
Connect any image that is meant to be modified according to the LUT to the Background input of the tool. Connect a LUT Cube image to the Foreground input of the tool.

Use OpenCL

If your graphics card supports OpenCL, enabling this option will tremendously speed up the processing on this tool.

LUT Cube Creator [LCC]

The LUT Cube Creator creates an image for further use with the LUT Cube Analyzer or LUT Cube Apply. The output can be graded, color corrected or modified with any tool inside and outside of Fusion. If working outside Fusion, make sure to keep the image in 32-bit floating point to preserve color accuracy.

Controls
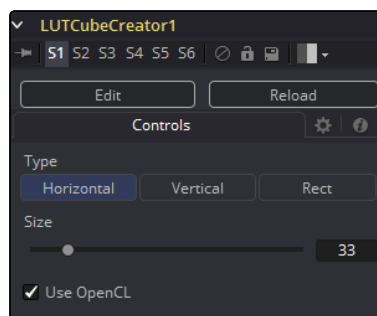
Type

> → Horizontal: Creates a long, horizontal strip representing a color cube.

> → Vertical: Creates a long, vertical strip representing a color cube.

> → Rect: Creates a rectangular image, as depicted below, representing a color cube.

Size

Determines the resolution of the color cube.

Note: Higher resolutions yield more accurate results but are also more memory and computational extensive.

Common values for color cubes are 17x17x17 or 33x33x33, or in a mathematical fashion n^2+1.

Use OpenCL

If your graphics card supports OpenCL, enabling this option will speed up the processing on this tool.
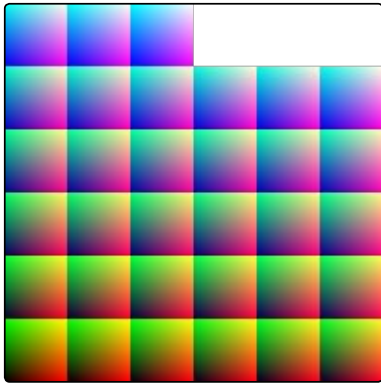
A Cube Image created with the "Rect" type
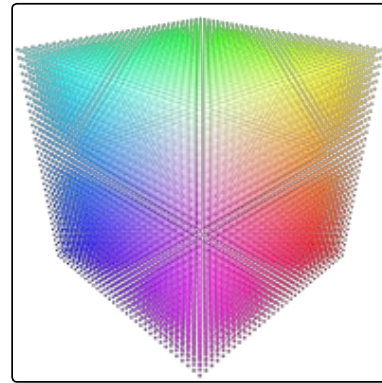
The resulting Color Cube

Mask Tools

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Mask Tools

Mask Tools

3D	▶
Blur	▶
Color	▶
Composite	▶
Creator	▶
Deep Pixel	▶
Effect	▶
Film	▶
Filter	▶
Flow	▶
Fuses	▶
I/O	▶
LUT	▶
Macro	▶
Mask	▶
Matte	▶
Metadata	▶
Miscellaneous	▶
Optical Flow	▶
Paint	▶
Particles	▶
Position	▶
Primatte	▶
Stereo	▶
Tracking	▶
Transform	▶
Warp	▶

Bitmap
BSpline
Ellipse
Mask Paint
Polygon
Ranges
Rectangle
Triangle
Wand

Bitmap Mask

Ranges Mask

B-Spline Mask

Rectangle Mask

Ellipse Mask

Triangle Mask

Mask Paint

Wand Mask

Polygon Mask
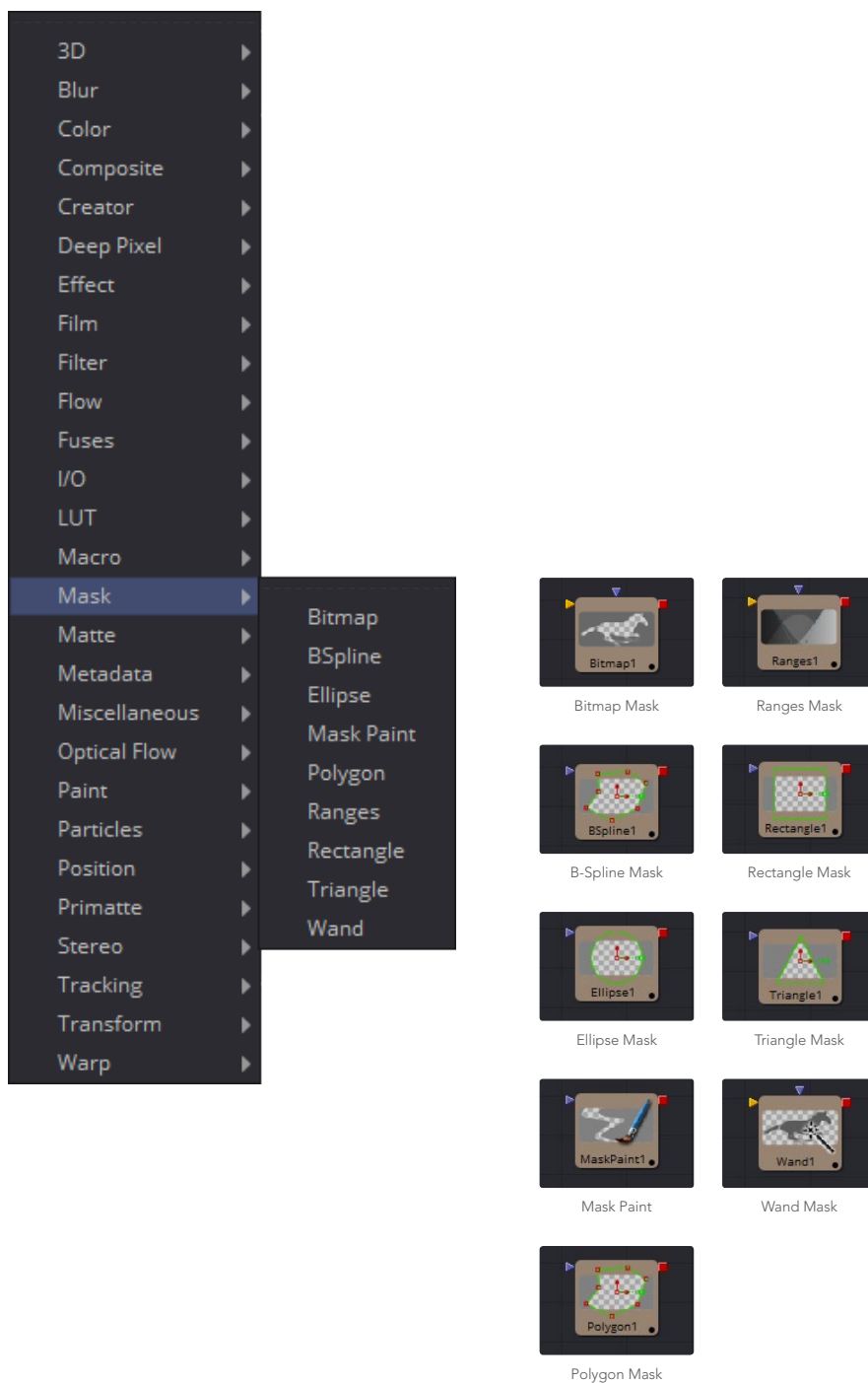
Common Mask Controls [CMC]

Common Controls can be found in every Mask tool. This chapter is therefore valid for all Mask tools.

Common Mask Controls

Although each mask has its own set of controls unique to that mask type, several of the controls shown are common for all types of masks. The controls listed here are generally found on all masks.
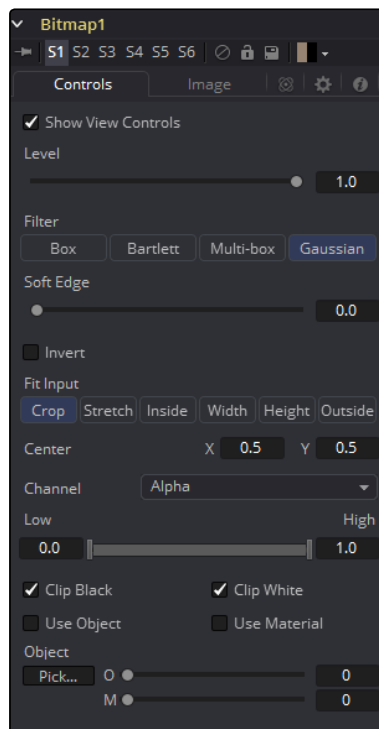
Show View Controls

Use the Show View Controls checkbox to disable the display of the Mask controls in the Viewer. Polylines, centers, angles and other controls will not be displayed, even when the tool is selected.

Level

The Level control designates the transparency level of the pixels in the Mask channel. When the value is 1.0, the effect mask is completely opaque (unless it has a soft edge). Lower values will cause the mask to be partially transparent. The result is identical to lowering the blend control of an effect.

Note: Lowering the level of a mask will lower the values of all pixels covered by the mask in the Mask channel. For example, if a Circle mask is placed over a Rectangle mask, lowering the level of the circle mask will lower the values of all of the pixels in the Mask channel, regardless of the fact that the rectangle mask beneath it is still opaque.

Filter

This control selects the filtering algorithm to be used when applying Soft Edge to the mask.

Box

This is the fastest method, but at reduced quality. This is best suited for very small amounts of blur.

Bartlett

Otherwise known as a Pyramid filter, Bartlett makes a good compromise between speed and quality.

Multi-box

When selecting this filter, the Num Passes slider appears to let you control the quality. At 1 and 2 passes, results are identical to Box and Bartlett, respectively. At 4 and above, results are usually as good as Gaussian, in less time and with no edge 'ringing.'

Gaussian

The default filter, this uses a true Gaussian approximation and gives excellent results, but it is a little slower than the other filters. In some cases, it can produce extremely slight edge 'ringing' on floating-point pixels.

Soft Edge

Use the Soft Edge slider to blur (feather) the edges of the mask, using the selected Filter. Higher values will cause the edge to fade off well beyond the boundaries of the mask. A value of 0.0 will create a crisp, well-defined edge.

Border Width

The Border Width control adjusts the thickness of the mask's edge. When the Solid checkbox is toggled on, the border thickens or narrows the mask. When the mask is not solid, an outline of the mask shape is drawn and the thickness of the outline is handled with this control.

Paint Mode

Although each mask has its own set of controls unique to that mask type, several of the controls shown are common for all types of masks. The controls listed here are generally found on all masks.
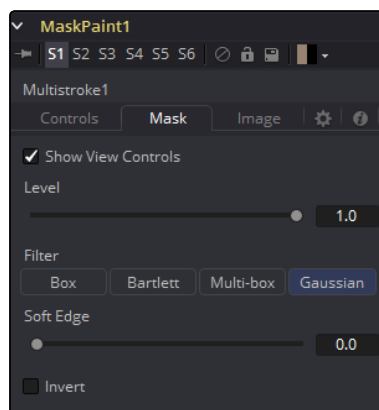
Merge

Merge is the default for all masks. The new mask is merged together with the input mask.

Add

The mask's values are added to the input mask's values.

Subtract

In the intersecting areas, the new mask values are subtracted from the input mask's values.

Minimum

The input mask's values are compared to the new mask, and the lowest (minimum) value is taken.

Maximum

The input mask's values are compared to the new mask, and the highest (maximum) value is taken.

Average

This calculates the average (half the sum) of the new mask and the input mask.

Multiply

This multiplies the values of the input mask by the new mask's values.

Replace

The new mask completely replaces the input mask wherever they intersect. Areas that are zero (completely black) in the new mask do not affect the input mask.

Invert

Areas of the input mask that are covered by the new mask are inverted; white becomes black and vice versa. Gray areas in the new mask are partially inverted.

Copy

This mode completely discards the input mask and uses the new mask for all values.

Ignore

This mode completely discards the new mask and uses the input mask for all values.

Invert

Selecting this checkbox inverts the entire mask. This differs from the Invert Paint mode in that it affects all pixels, regardless of whether they are covered by the new mask or not.

Solid

When the Solid checkbox is enabled, all areas completely enclosed by the mask will be filled solid white. Turning off the checkbox will treat the mask as an outline, with the width of the outline determined by the Border Width control. This checkbox is enabled by default.

Center

All masks have a Center, with the exception of the common controls found on Creator tools, such as Background and Fast Noise.

Process Mode

Use this menu control to select the Fields Processing mode used by Fusion to render changes to the mask. The default option is determined by the Has Fields checkbox control in the Frame Format preferences. For more information on fields processing, consult the Frame Formats section.
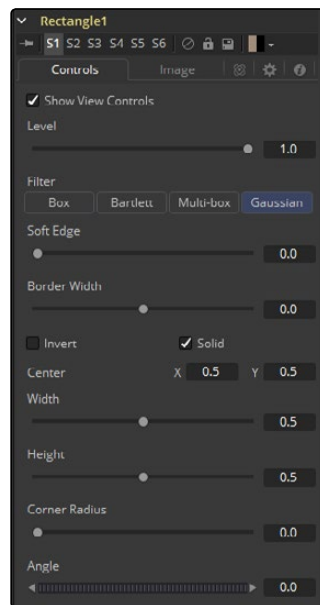
Use Frame Format Settings

When this checkbox is selected, the width, height and pixel aspect of the mask created will be locked to values defined in the composition's Frame Format preferences. If the Frame Format preferences change, the resolution of the mask produced will change to match. Disabling this option can be useful to build a composition at a different resolution than the eventual target resolution for the final render.

Width and Height

This pair of controls is used to set the Width and Height dimensions of the mask to be created.

Pixel Aspect

This control is used to specify the Pixel Aspect ratio of the created mask. An aspect ratio of 1:1 would generate a square pixel with the same dimensions on either side (like a computer display monitor) and an aspect of 0.91 would create a slightly rectangular pixel (like an NTSC monitor).

Depth

The Depth button array is used to set the pixel color depth of the image created by the mask. 32-bit pixels require four times the memory of 8-bit pixels, but have far greater accuracy. Float pixels allow high dynamic range values outside the normal 0..1 range, for representing colors that are brighter than white or darker than black. See the Frame Format chapter for more details.

Note: Right-click on the Width, Height or Pixel Aspect controls to display a menu listing the file formats defined in the preferences Frame Format tab. Selecting any of the listed options will set the width, height and pixel aspect to the values for that format.
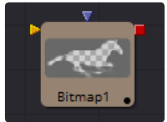
Bitmap Mask [Bᴍᴘ]

The Bitmap Mask allows images from the flow to act as masks for tools and effects. Bitmap masks can be based on values from any of the color, alpha, hue, saturation, luminance and auxiliary coverage channels of the image. Tools can also be masked based on the Object or Material ID of a 3D rendered image (provided those channels were included when the file was rendered).

The output of any tool can be connected directly to another tool's Effect Mask input. The Bitmap Mask tool is not required for many common tasks. If the output is connected directly, the Common Controls tab for the masked tool will display a control to select which channel of the mask image is used to create the mask.

However, Bitmap Mask tools may still be required to connect to other mask inputs on some tools, such as Garbage Mattes and Pre-Masks. Also, using a Bitmap Mask tool between the mask source and the target tool provides additional options that would not be available when connecting directly, such as combining masks, blurring the mask or clipping its threshold.

Many of the controls found in this mask tool are common to all mask tools. These controls are documented at Common Mask Controls.
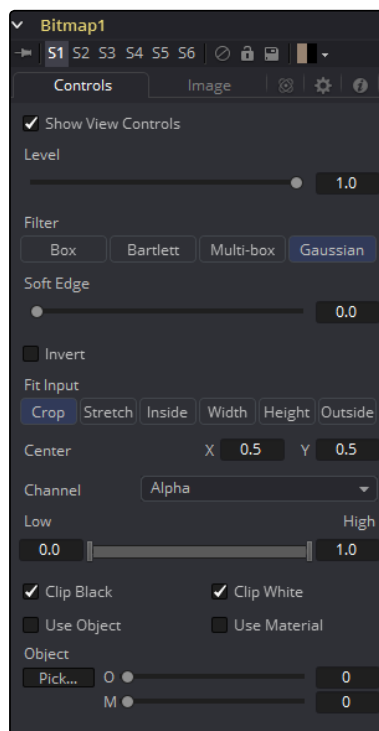
Controls Tab

Level, Filter, Soft Edge and Border Width

Please refer to the Common Mask controls.

Fit Input

This control defines how the image source is treated if it does not fit the dimensions of the generated mask.

Imagine a 720*576 image source being used to generate a 1920x1080 mask.

In the following section we refer to image source as being the 720x576 image (yellow) and mask as being the mask that is actually generated (gray).

Crop
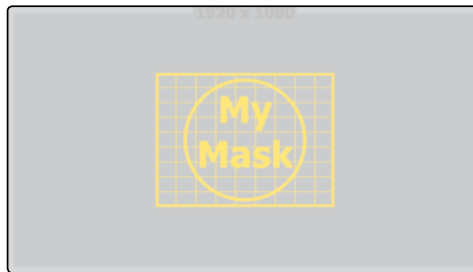
If the image source is smaller than the generated mask it will be placed according to the X/Y controls, masking off only a portion of the mask. If the image source is bigger than the generated mask it will be placed according to the X/Y controls and cropped off at the borders of the mask.

Stretch

The image source will be stretched in X and Y to accommodate the full dimensions of the generated mask. This might lead to visible distortions of the image source.

Inside

The image source will be scaled uniformly until one of its dimensions (X or Y) fits the inside dimensions of the mask. Depending on the relative dimensions of the image source and mask background, either the image source's width or height may be cropped to fit the respective dimension of the mask.

Width

The image source will be scaled uniformly until its width (X) fits the width of the mask. Depending on the relative dimensions of the image source and mask, the image source's Y-dimension might not fit the mask's Y-dimension, resulting in either cropping of the image source in Y or the image source not covering the mask's height entirely.

Height

The image source will be scaled uniformly until its height (Y) fits the height of the mask. Depending on the relative dimensions of the image source and mask, the image source's X-dimension might not fit the mask's X-dimension, resulting in either cropping of the image source in X or the image source not covering the mask's width entirely.

Outside

The image source will be scaled uniformly until one of its dimensions (X or Y) fits the outside dimensions of the mask. Depending on the relative dimensions of the image source and mask, either the image source's width or height may be cropped or not fit the respective dimension of the mask.

Other Controls

Channel

Use this control to select the Channel of the input image used to create the mask. Choices include the red, green, blue and alpha channels, the hue, luminance or saturation values, or the auxiliary coverage channel of the input image (if one is provided).

Threshold Low/High

The Threshold range control can be used to clip the bitmap image. Increasing the value of the low control will clip pixels below the specified value to black (0.0). Decreasing the high value will force pixels higher than the specified value to white (1.0).

Use Object/Use Material

This control has no affect unless the input image contains a Material or Object ID channel. When toggled on, the selected Object ID and/or Material ID is used to create a mask based on the selected object or material. When toggled off, the regular color channels will generate the mask.

Image Tab

Please refer to the Common Mask Controls.

B-Spline Mask [BSp]

A B-spline Mask is identical to a Polygon Mask in all respects except one. Where Polygon masks use Bezier splines, this Mask tool uses B-splines. Where Bezier splines employ a main point and two handles to manage the smoothing of the spline segment, a B-spline requires only a single point. This means that a B-spline shape requires far fewer control points to create a nicely smoothed shape.

The smoothness of a B-spline is determined by the tension of the control points. To adjust the tension of a B-spline's control points, select the point, hold down the W key and drag the mouse pointer to the left and right to increase or decrease the tension of the curve through that point.

Many of the controls found in this Mask tool are common to all Mask tools. These controls are documented at Common Mask Controls.
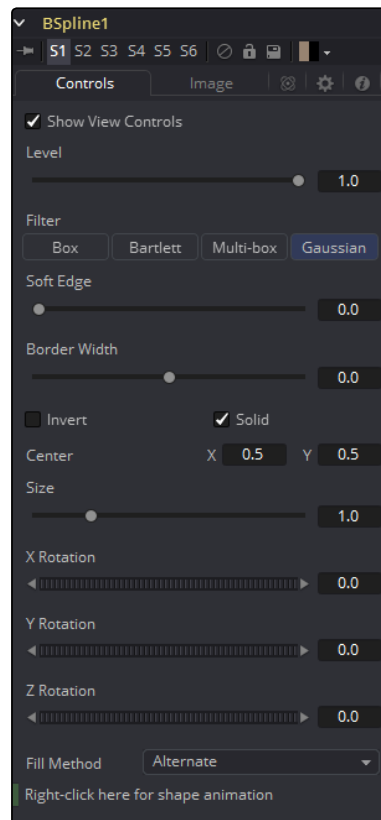
Controls Tab

Level, Filter, Soft Edge and Border Width

Please refer to the Common Mask Controls.

Size

Use the Size control to adjust the scale of the B-spline effect mask, without affecting the relative behavior of the points that compose the mask or setting a keyframe in the mask animation.

X, Y and Z Rotation

Use these three controls to adjust the rotation angle of the effect mask along any axis.

Fill Method

The Fill Method drop-down menu offers two different techniques for dealing with overlapping regions of a polyline. If overlapping segments in a mask are causing undesirable holes to appear, try switching the setting of this control from Alternate to Non Zero Winding.

Right Click Here for Shape Animation

By default, all B-spline masks are animated when they are created. The initial keyframe is set to the current time and any changes to the shape at different times will create new keys.

Right-clicking on this label will display a contextual menu that offers options for removing or re-adding animation to the mask, or publishing and connecting the masks together.

Adding Points

Adding Points to a B-spline effect mask is relatively simple. Immediately after creating the mask there are no points, but the mask will be in Click Append mode. Simply click once in the Viewer wherever a point is required for the mask. Continue clicking to draw the shape of the mask. When the shape is complete, click on the initial point again to close the mask.

When the shape is closed, the mode of the polyline will change to Insert and Modify. This allows for the adjusting and adding of additional points to the mask by clicking on segments of the polyline. To lock down the mask's shape and prevent accidental changes, switch the Polyline mode to Done using the Polyline toolbar or contextual menu.

When a B-spline mask is added to a tool, a toolbar will appear in the view with buttons that offer easy access to the modes and tools. Hold the mouse pointer over any button in the toolbar to display a tooltip that describes that button's function.

Change the way the toolbar is displayed by right-clicking on the toolbar and selecting from the options displayed in the toolbar's contextual menu.

The functions of the buttons in this toolbar are explained in depth in the Polylines chapter.

Image Tab

Please refer to the Common Mask Controls.
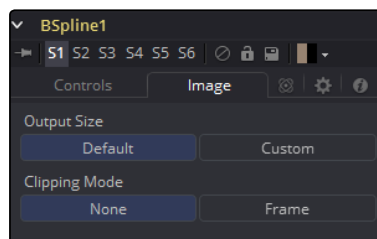
Ellipse Mask [Elp]

The Ellipse Mask is most useful for masking round objects. It is a circle by default, but independent control is offered over the width, height and angle, providing for a wide variety of ellipsoidal shapes.

Many of the controls found in this Mask tool are common to all Mask tools. These controls are documented at Common Mask Controls.
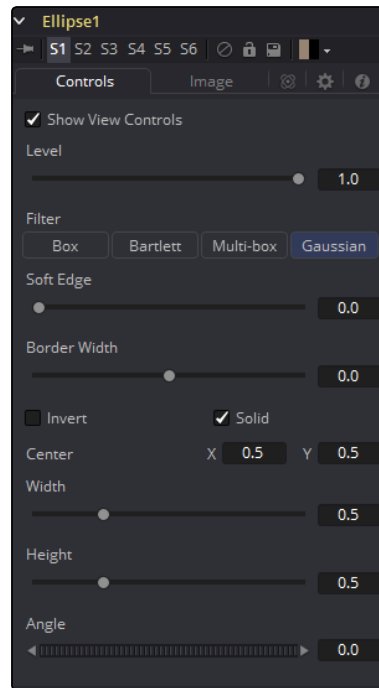
Controls Tab

Level, Filter, Soft Edge and Border Width

Please refer to the Common Mask Controls.

Width

This control allows independent control of the ellipse mask's Width. In addition to the slider in the mask's controls, interactively drag the width (left or right edge) of the mask on the view using the pointer. Any changes will be reflected on this control.

Height

Height allows independent control of the ellipse mask's Height. In addition to the slider in the mask's controls, interactively drag the height (top or bottom edge) of the mask on the view using the pointer. Any changes will be reflected on this control.

To change the mask's size without affecting the aspect ratio, drag the on screen control between the edges (diagonal). This will modify both the width and height proportionately.

Angle

Change the rotational angle of the mask by moving the Angle control left or right. Values can be entered in the input boxes provided. Alternately, use the onscreen controls by dragging the little circle at the end of the dashed angle line to interactively adjust the rotation of the ellipse.

Image Tab

Please refer to the Common Mask Controls.
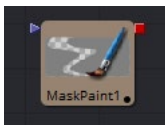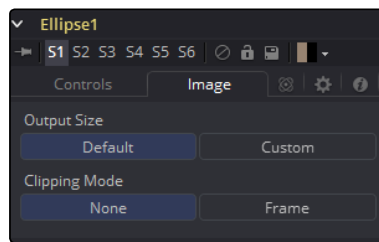
Mask Paint [PNM]

The Mask Paint tool allows direct painting on mask images, using the mouse pointer as if it was a paintbrush. In addition to regular paint strokes, it is possible to apply basic primitive shapes and polyline style strokes.

Each stroke can have a duration that lasts for the entire project, a single frame or field, or an arbitrary number of fields. The strokes can have independent durations in the Timeline for easy manipulation of time. Alternatively, Multistrokes is a faster but non-editable way for doing many mask cleanup paint tasks.

Controls Tab

As the Paint Mask tool is fundamentally identical to the Paint tool, see the Paint tool and the Paint and Rotoscoping chapter for more details on the many options and capabilities available. The only difference is that, as Paint Mask operates on single-channel mask images, there is no Channel Selector control and all color controls have only a single Alpha value.
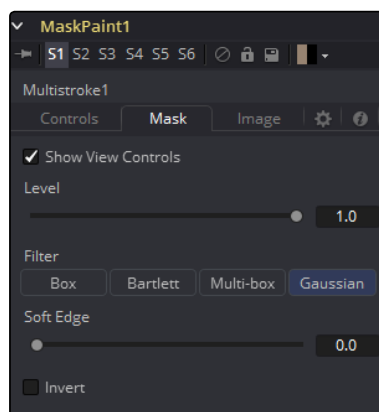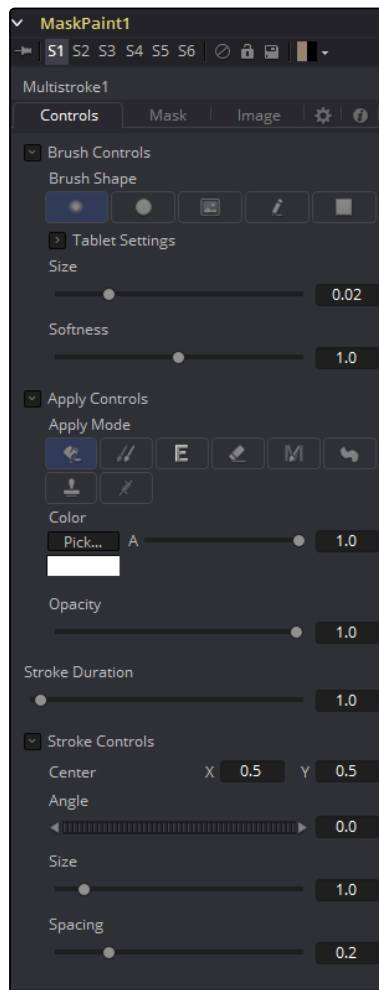
Image Tab

Please refer to the Common Mask Controls.
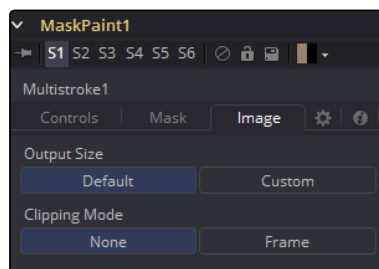
Polygon Mask [Ply]

The Polygon Mask is most useful for masking objects that do not have a regular shape. When first added to a tool, the Polygon mask consists of only Center and Angle controls, which are visible onscreen. Points are added to the polyline by clicking in the Viewer. Each new point is connected to the last one created.

Controls Tab
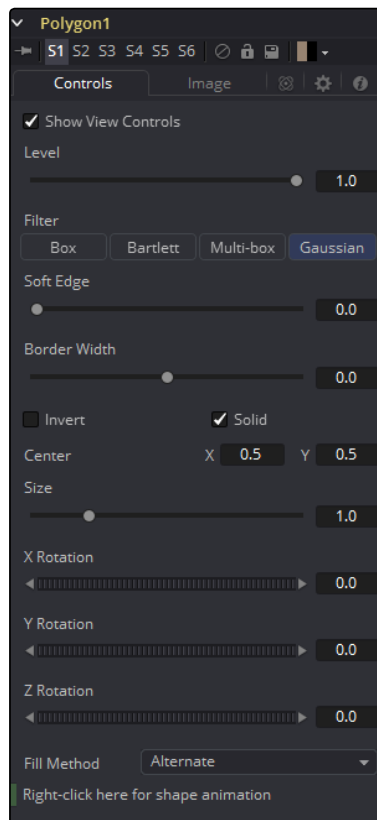
Level, Filter, Soft Edge and Border Width
Please refer to the Common Mask Controls.

Size
Use the Size control to adjust the scale of the Polygon effect mask, without affecting the relative behavior of the points that compose the mask or setting a keyframe in the mask animation.

X, Y and Z Rotation
Use these three controls to adjust the rotation angle of the effect mask along any axis.

Fill Method

The Fill Method drop-down menu offers two different techniques for dealing with overlapping regions of a polyline. If overlapping polyline segments in a mask are causing undesirable holes in the mask, try switching the setting of this control from Alternate to Non Zero Winding.

Right Click Here for Shape Animation

By default, all polyline masks are animated when they are created. The initial keyframe is set to the current time and any changes to the shape at different times will create new keys.

Right-clicking on this label will display a contextual menu that offers options for removing or re-adding animation to the mask, or publishing and connecting masks together.

Adding Points

Adding Points to a polygonal effect mask is relatively simple. Immediately after creating the mask there are no points, but the mask will be in Click Append mode. Simply click once in the Viewer wherever a point is required for the mask. Continue clicking to draw the shape of the mask. When the shape is complete, click on the initial point again to close the mask.

When the shape is closed, the mode of the polyline will change to Insert and Modify. This allows for the adjusting and adding of additional points to the mask by clicking on segments of the polyline. To lock down the mask's shape and prevent accidental changes, switch the Polyline mode to Done using the Polyline toolbar or contextual menu.

When a Polygon mask is added to a tool, a toolbar will appear in the view with buttons that offer easy access to modes and tools. Hold the mouse pointer over any button in the toolbar to display a tooltip that describes that button's function.

Change the way the toolbar is displayed by right-clicking on the toolbar and selecting from the options displayed in the toolbar's contextual menu. The functions of the buttons in this toolbar are explained in depth in the Polylines chapter.
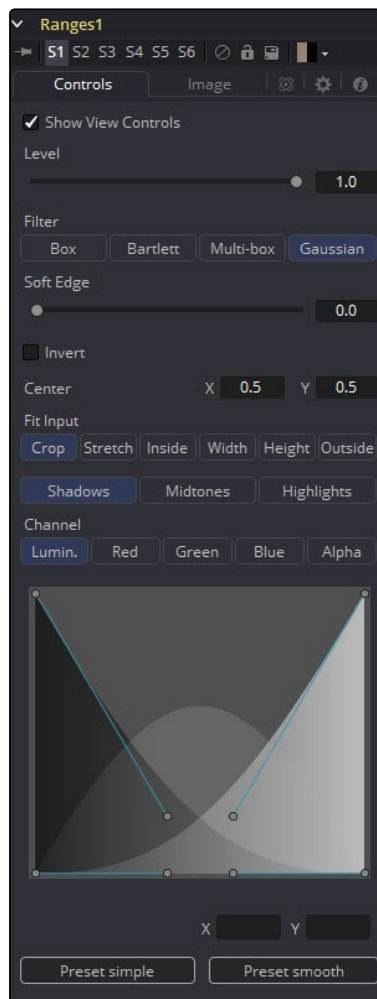
Image Tab

Please refer to the Common Mask Controls.
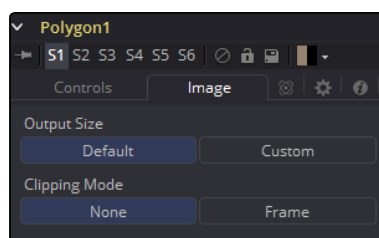
Ranges Mask [RNG]

Similar to Bitmap Mask, the Range Mask allows images from the flow to act as masks for tools and effects. Instead of creating a simple luminance-based mask from a given channel, Range allows spline-based selection of low, mid and high ranges, akin to Color Corrector.

Controls Tab

Level, Filter, Soft Edge and Border Width
Please refer to the Common Mask Controls.

Shadows/Midtones/Highlights
These buttons are used to select which range will be output by the tool as a mask. White pixels represent pixels that are considered to be part of the range and black pixels are not included in the range. For example, choosing Shadows would show pixels considered to be shadows as white and pixels that are not shadows as black. Mid gray pixels are only partly in the range and will not receive the full effect of any color adjustments to that range.

Channel

The Channel selection buttons shown in this tab can be used to extract a mask from the range of a specific color channel. By default, Fusion uses the luminance channel when the color ranges are examined.

Spline Display

The extent of the ranges is selected by manipulating the spline handles. There are four spline points, each with one Bezier handle. The two handles at the top represent the start of the shadow and highlight ranges, whereas the two at the bottom represent the end of the range. The Bezier handles are used to control the falloff.

The midtones range has no specific controls since its range is understood to be the space between the shadow and the highlight ranges. In other words, after low and high masks have been applied, midtones is everything else.

The X and Y text controls below the Spline Display can be used to enter precise positions for the selected Bezier point or handle.

Presets

This sets the splines to two commonly-used configurations. Simple gives a straightforward linear-weighted selection, while Smooth uses a more natural falloff.

Image Tab

Please refer to the Common Mask Controls.
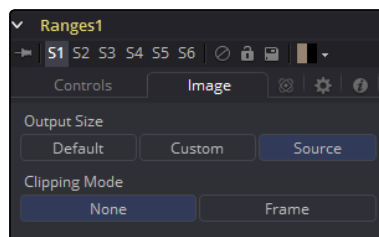
Rectangle Mask [REC]

The Rectangle Mask creates a simple square or rectangular effect mask. Many of the controls found in this mask tool are common to all mask tools. These controls are documented at Common Mask Controls.
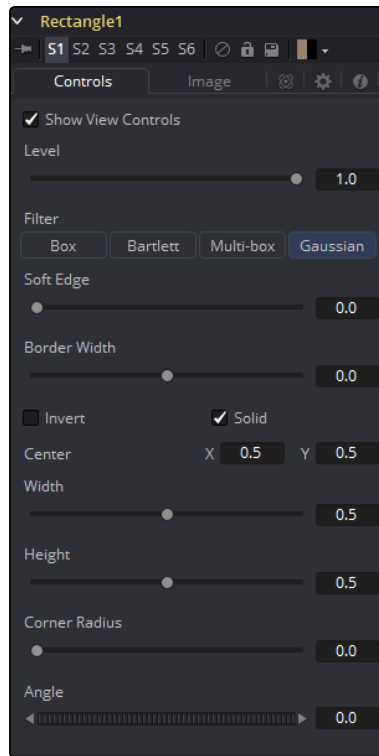
## Controls Tab

Level, Filter, Soft Edge and Border Width
Please refer to the Common Mask Controls.

Width and Height
Use these controls to change the X or Y scale of the rectangular effect mask independently of each other. Alternatively, drag the edges of the rectangle in the Viewer to interactively adjust its size.

Corner Radius
Corner Radius allows the corners of the rectangle mask to be rounded. A value of 0.0 is not rounding at all, which means that the rectangle has sharp corners. A value of 1.0 will apply the maximum amount of rounding to the corners.

Angle

Change the rotation angle of an effect mask by moving the Angle control left or right. Values can be entered in the provided input boxes. Alternately, use the onscreen controls by dragging the little circle at the end of the dashed angle line to interactively adjust the rotation of the ellipse.

Image Tab

Please refer to the Common Mask Controls.
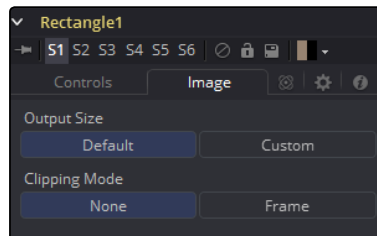
Triangle Mask [Tri]

The Triangle Mask is unique in that it has no Center, Size or Angle control. Unlike most other types of masks, all three points of the triangle may be attached to a tracker or motion path. Complex effect masking is possible using trackers and other tools' paths to manipulate the triangle shape.

Many of the controls found in this mask tool are common to all mask tools. These controls are documented at Common Mask Controls.
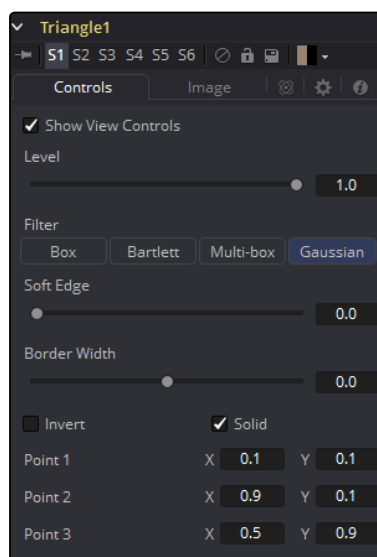
Controls Tab

Level, Filter, Soft Edge and Border Width

Please refer to the Common Mask Controls.

Point 1, Point 2, Point 3

These controls indicate the position of the three corners of the triangle. Each point can be published, connected to other controls, animated with a path, or attached to trackers. To perform any of these tasks, right-click on the Position control in the mask controls, or directly on the point in the Viewer, and select the appropriate option from the contextual menu.

Image Tab

Please refer to the Common Mask Controls.
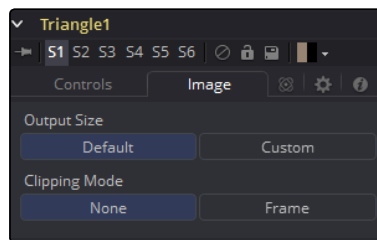
Wand Mask [Wnd]

The Wand Mask provides the ability to mask an image based on a magic wand-style selection, similar to the magic wand tools found in traditional 2D paint applications. As with a Bitmap mask, any image in the composition can be used as a source for the mask. Generally, the default is most useful, where the source image is the input of the tool to which the mask is applied.

Note: When adding a Wand mask to a tool, a crosshair will appear in the Viewers. This crosshair should be positioned in the image to select the color used to create the Wand mask. The mask itself is created by examining the color of the pixel beneath the selection point and adding that color to the mask. The mask then expands to examine the pixels surrounding the selection point. If the surrounding pixels are the same color, they are also added to the mask. The mask stops expanding when no connecting pixels fall within the color range of the mask. The tool to be used as the image source for the mask should be connected to the Source (orange) input on the flow. As with other masks, the Effect Mask (blue) input is used to combine the wand's result with other Mask tools. Many of the controls found in this Mask tool are common to all Mask tools. These controls are documented at Common Mask Controls.
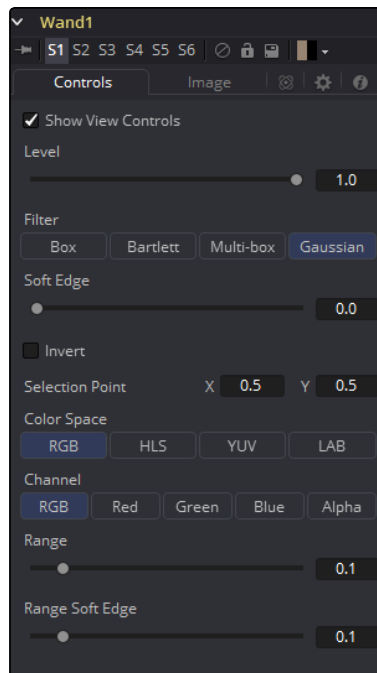
Controls Tab

Level, Filter, Soft Edge and Border Width
Please refer to the Common Mask Controls.

Selection Point
The Selection Point is a pair of X and Y coordinates that determine from where in the source image the Wand mask derives its initial color sample. This control is also seen as a crosshair in the Viewers. The selection point can be positioned manually, connected to a tracker, path or other expressions.

Color Space
The Color Space button group determines the color space used when selecting the source color for the mask. The Wand mask can operate in RGB, YUV, HLS or LAB color spaces.

Channel
The Channel button group is used to select whether the color that is masked comes from all three color channels of the image, the alpha channel, or from an individual channel only.

The exact labels of the buttons will depend on the color space selected for the Wand Mask operation. If the color space is RGB, the options will be R, G or B. If YUV is the color space, the options will be Y, U or V.

Range

The Range slider controls the range of colors around the source color that will be included in the mask. If the value is left at 0.0, only pixels of exactly the same color as the source will be considered part of the mask. The higher the value, the more that similar colors in the source will be considered to be wholly part of the mask.

Range Soft Edge

The Range Soft Edge determines the falloff range of the colors selected. Any pixel within the range defined above will be treated as 100% within the mask. If the soft range is set to 0.0, no other pixels will be considered for the mask. Increasing the soft range will increase the number of colors close to, but not quite within, the range that will be included in the mask. These pixels will be semi-transparent in the mask.

Image Tab

Please refer to the Common Mask Controls.
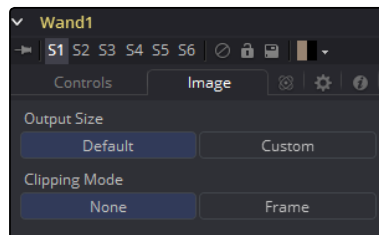
Matte Tools

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Matte Tools

Matte Tools

3D
Blur
Color
Composite
Creator
Deep Pixel
Effect
Film
Filter
Flow
Fuses
I/O
LUT
Macro
Mask
Matte
Metadata
Miscellaneous
Optical Flow
Paint
Particles
Position
Primatte
Stereo
Tracking
Transform
Warp

Alpha Divide
Alpha Multiply
Chroma Keyer
Difference Keyer
Luma Keyer
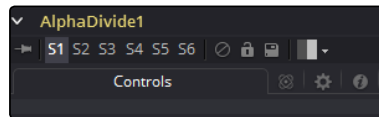Matte Control
Ultra Keyer

Alpha Divide

Alpha Multiply

Chroma Keyer

Difference Keyer

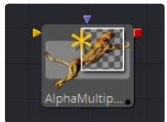Luma Keyer

Matte Control

Ultra Keyer

Alpha Divide [ADv]

As the name gives away, the Alpha Divide's sole purpose is to divide an incoming image by its Alpha Channel.

Controls Tab

This tool has no controls.

Alpha Multiply [AMl]

As the name gives away, the AlphaMultiply's sole purpose is to multiply an incoming image with its Alpha Channel.
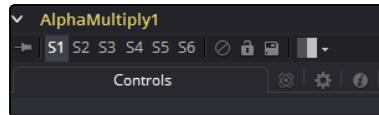
Controls Tab

This tool has no controls.
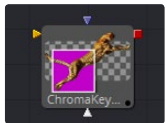
Chroma Keyer [CKy]

The Chroma Keyer Tool creates an alpha channel (matte) for an image by removing selected colors from the scene. Unlike the Ultrakeyer, which has specific optimizations for keying from blue and green colors, the chroma keyer works equally well with any color.

Chroma Key Tab

Key Type

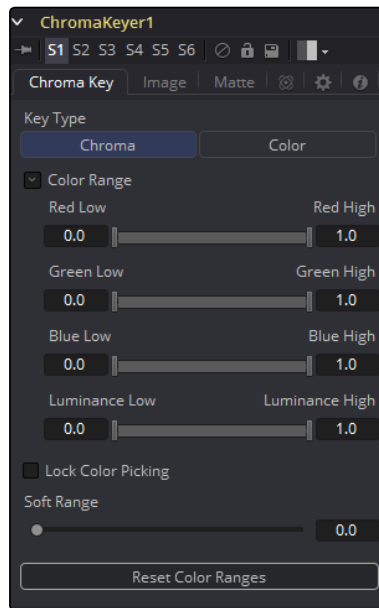This determines the type of selection to be used for the matte creation.

Chroma

Chroma causes a matte to be created based on the RGB values of the selected color range.

Color

This causes a matte to be created based on the hue of the selected color range.

Color Range

These range controls update automatically to represent the current color selection. Colors are selected by selecting the Chroma Keyer tool's tile in the flow, then dragging in the Viewer to select the colors to be used to create the matte. These range controls can be used to tweak the selection slightly, although generally selecting colors in the displays is all that is required.

Lock Color Picking

When this checkbox is selected, Fusion will prevent accidental growing of the selected range by selecting more colors from the view. It is a good idea to select this checkbox once the color selection has been made for the matte. All other controls in the tool remain editable.
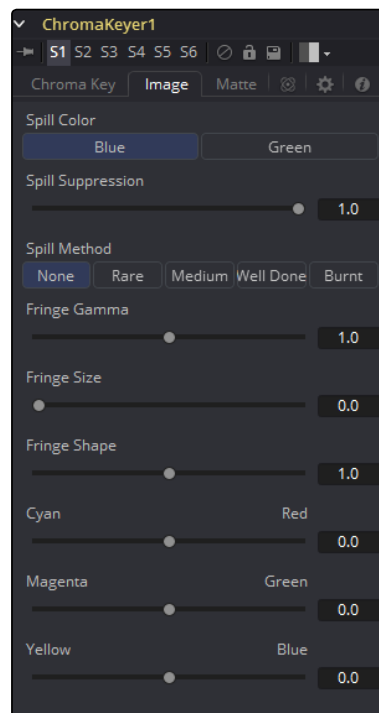
Soft Range

This control softens the selected color range to include additional colors into the matte.

Reset Color Ranges

Clicking on this button resets the Chroma Keyer's range controls, discarding all color selections. All other sliders and controls maintain their values.

Image Tab

Spill Color

Use these buttons to select the color used as the base for all spill suppression techniques.

Spill Suppression

Spill is generally caused by the transmission of the color of the background through the semitransparent areas of the alpha channel. In the case of blue or green screen keying, this usually causes the color of the background to become apparent in the fringe of the foreground element.

Spill suppression attempts to remove color from the fringe. The process used is optimized for either blue or green screens; you select which color is used as the base from the control above.

When this slider is set to 0 no spill suppression is applied to the image.

Spill Method

This selects the strength of the algorithm used to apply spill suppression to the image.

None

None is selected when no spill suppression is required.

Rare

This removes very little of the spill color, the lightest of all methods.

Medium

This works best for green screens.

Well Done

This works best for blue screens.

Burnt

This works best for blue. Use this mode only for very troublesome shots. Most likely you will have to add strong color correction after the key to get, for example, your skin tones back.

Fringe Gamma

This control can be used to adjust the brightness of the fringe or halo that surrounds the keyed image.

Fringe Size

This expands and contracts the size of the fringe or halo surrounding the keyed image.

Fringe Shape

Fringe Shape forces the fringe to be pressed toward the external edge of the image or pulled toward the inner edge of the fringe. Its effect is most noticeable while the Fringe Size sliders value is large.

Cyan/Red, Magenta/Green and Yellow/Blue

Use these three controls to color correct the fringe of the image. This is useful for correcting semi-transparent pixels that still contain color from the original background to match the new background.

Chroma Keyer Matte Tab

Matte Blur

Matte Blur blurs the edge of the matte using a standard constant speed Gaussian blur. A value of zero results in a sharp, cutout-like hard edge. The higher the value, the more blur applied to the matte.

Matte Contract/Expand

This slider shrinks or grows the semi-transparent areas of the matte. Values above 0.0 expand the matte while values below 0.0 contract it.

This control is usually used in conjunction with the Matte Blur to take the hard edge of a matte and reduce fringing. Since this control only affects semi-transparent areas, it will have no effect on a hard edge's matte.

Matte Gamma

Matte Gamma raises or lowers the values of the matte in the semi-transparent areas. Higher values cause the gray areas to become more opaque and lower values cause the gray areas to become more transparent. Completely black or white regions of the matte remain unaffected.

Since this control only affects semi-transparent areas, it will have no effect on a hard edge's matte.

Matte Threshold

Any value below the lower threshold becomes black or transparent in the matte. Any value above the upper threshold becomes white or opaque in the matte. All values within the range maintain their relative transparency values.

This control is often used to reject salt and pepper noise in the matte.

Invert Matte

When this checkbox is selected, the alpha channel created by the keyer is inverted, causing all transparent areas to be opaque and all opaque areas to be transparent.

Garbage Matte Mode

Garbage Mattes are Mask tools or images connected to the Garbage Matte input on the tool's tile. The Garbage matte is applied directly to the alpha channel of the image. Generally, Garbage mattes are used to remove unwanted elements that cannot be keyed, such as microphones and booms. They are also used to fill in areas that contain the color being keyed but that you wish to maintain.

Garbage mattes of different modes cannot be mixed within a single tool. A Matte Control tool is often used after a Keyer tool to add a Garbage matte with the opposite effect of the matte applied to the keyer.

Make Transparent

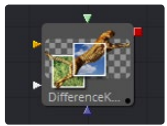Select this button to make the Garbage matte transparent.

Make Solid

Select this button to make the Garbage matte solid.

Post Multiply Image

Select this option to cause the keyer to multiply the color channels of the image against the alpha channel it creates for the image. This option is usually enabled and is on by default.

Deselect this checkbox and the image can no longer be considered pre-multiplied for purposes of merging it with other images. Use the Subtractive option of the Merge tool instead of the Additive option.

For more information, see the Merge tools documentation.

Difference Keyer [DK$_Y$]

Difference keying is a process that produces a matte based on the differences between two images. A Difference key uses two input images, one containing the subject with the background and another containing the background without the subject.

The Difference Keyer tool is very sensitive and, although the process sounds reasonable at first glance, subtle variations in the position of the camera from shot to shot usually make it difficult to pull a highly-detailed alpha channel using this method. Think of the futile attempt of trying to key smoke in front of a brick wall and using a clean plate of the brick wall as your difference input. Part of the wall's structure will always be visible in this keying method. Instead, a Difference keyer is often used to produce a rough matte that is combined with other tools to produce a more detailed matte.

Controls Tab
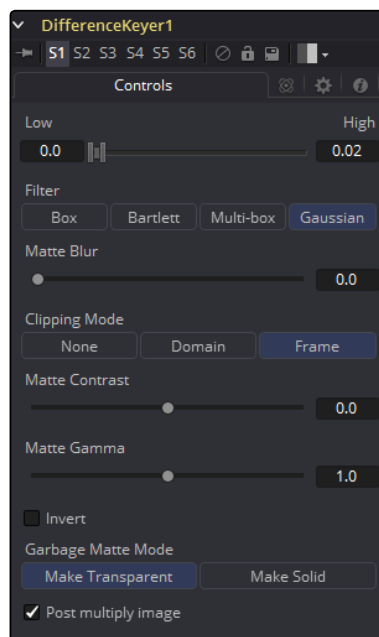
Threshold High and Low

This slider works by defining a range of difference values between the images to create a matte. A difference below the lower threshold becomes black in the matte. Any difference above the upper threshold becomes white (solid) in the matte. The difference values in the range in between create a gray scale matte.

Matte Blur

This blurs the edge of the matte using a standard constant speed Gaussian blur. A value of zero results in a sharp, cutout-like hard edge. The higher the value, the more blur.

Matte Contrast

The Matte Contrast slider changes the Look up Table curve of the matte's luminance values. This creates a soft cropping of the matte at the low end of the slider and a hard edge expansion of the matte at higher slider values.

Matte Gamma

Matte Gamma raises or lowers the values of the matte in the semi-transparent areas. Higher values cause the gray areas to be more opaque and lower values cause the gray areas to be more transparent. Completely black or white regions of the matte remain unaffected.

Invert

Selecting this checkbox inverts the matte, causing all transparent areas to be opaque and all opaque areas to be transparent.

Garbage Matte Mode

Garbage Mattes are Mask tools or images connected to the Garbage Matte input on the tool's tile. The Garbage matte is applied directly to the alpha channel of the image. Generally, Garbage mattes are used to remove unwanted elements that cannot be keyed, such as microphones and booms. They are also used to fill in areas that contain the color being keyed but that you wish to maintain.

Garbage mattes of different modes cannot be mixed within a single tool. A Matte Control tool is often used after a Keyer tool to add a Garbage matte with the opposite effect of the matte applied to the keyer.

Make Transparent

Select this button to make the Garbage matte transparent.
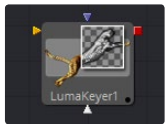
Make Solid

Select this button to make the Garbage matte solid.

Post Multiply Image

Select this option to cause the keyer to multiply the color channels of the image against the alpha channel it creates for the image. This option is usually enabled and is on by default.

Deselect this checkbox and the image can no longer be considered pre-multiplied for purposes of merging it with other images. Use the Subtractive option of the Merge tool instead of the Additive option.

For more information, see the Merge Tools documentation.

Luma Keyer [LK$_Y$]

The Luma Keyer tool uses the overall luminance of an image to create an alpha channel. When this tool was first created it was used exclusively on the luminance channel of the image, but it has since grown to allow pulling mattes from virtually any channel Fusion understands. In some respects, it would now be more accurate to call this tool a Channel Keyer.

Controls Tab
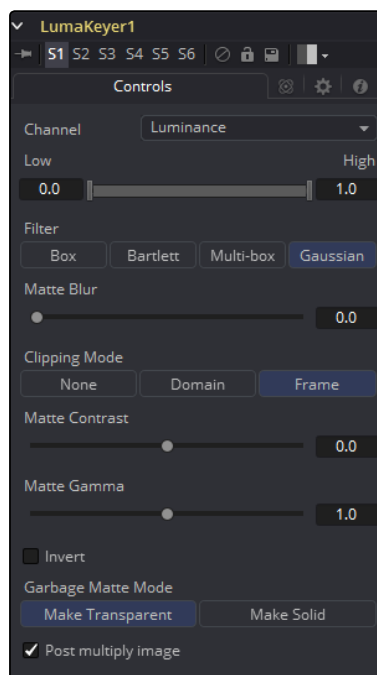
Channel

Use this drop-down list to select the color channel used for creating the matte. Select from the Red, Green, Blue, Alpha, Hue, Luminance, Saturation and Depth (Z-buffer) channels.

Threshold High and Low

This slider works by defining a range of luminance values in the image to create a matte. Any value below the lower threshold becomes black in the matte. Any value above the upper threshold becomes white (solid) in the matte. All values within the range create the gray scale matte.

Matte Blur

Matte Blur blurs the edge of the matte using a standard constant speed Gaussian blur. A value of zero results in a sharp, cutout-like hard edge. The higher the value, the more blur applied to the matte.

Matte Contrast

The Contrast slider changes the Look up Table curve of the matte's luminance values. This creates a soft cropping of the matte at the low end of the slider and a hard edge expansion of the matte at higher slider values.

Matte Gamma

Matte Gamma raises or lowers the values of the matte in the semi-transparent areas. Higher values cause the gray areas to be more opaque and lower values cause the gray areas to be more transparent. Completely black or white regions of the matte remain unaffected.

Invert

When toggled on, the matte is inverted, causing all transparent areas to be opaque and all opaque areas to be transparent.

Garbage Matte Mode

Garbage Mattes are Mask tools or images connected to the Garbage Matte input on the tool's tile. The Garbage matte is applied directly to the alpha channel of the image. Generally, Garbage mattes are used to remove unwanted elements that cannot be keyed, such as microphones and booms. They are also used to fill in areas that contain the color being keyed but that you wish to maintain.

Garbage mattes of different modes cannot be mixed within a single tool. A Matte Control tool is often used after a Keyer tool to add a Garbage matte with the opposite effect of the matte applied to the keyer.

Make Transparent

Select this button to make the Garbage matte transparent.

Make Solid

Select this button to make the Garbage matte solid.

Post Multiply Image

Select this option to cause the keyer to multiply the color channels of the image against the alpha channel it creates for the image. This option is usually enabled and is on by default.

Deselect this checkbox and the image can no longer be considered pre-multiplied for purposes of merging it with other images. Use the Subtractive option of the Merge tool instead of the Additive option.

For more information, see the Merge Tools documentation.

Matte Control [MAT]

Keyer tools are generally used to create an alpha channel on an image that does not already have one. The Matte Control tool is used to manipulate an existing alpha channel or to create one by hand via rotoscoping.

The Matte Control tool also has a Foreground Image input. Use this tool to copy a color channel or alpha channel from the foreground to the background, or to combine alpha channels from the two images.

Controls Tab
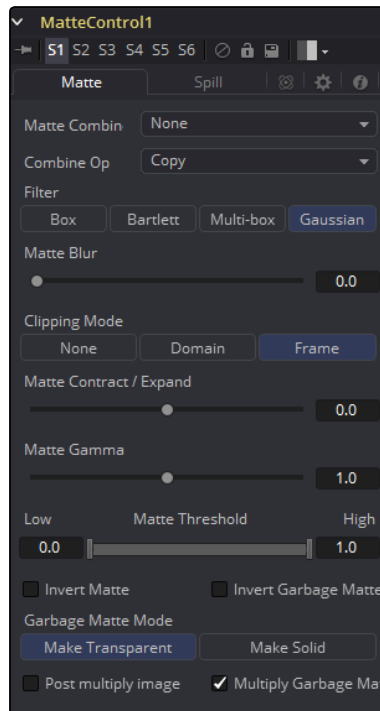
Matte Combine

The Matte Control tool can combine alpha or color channels from an image in the foreground input with the background image. Use this menu to select which operation is applied. The default is set to None for no operation.

None

This causes the foreground image to be ignored.

Combine Red

This combines the FG red channel to the BG alpha channel.

Combine Green

This combines the FG green channel to the BG alpha channel.

Combine Blue

This combines the FG blue channel with the BG alpha channel.

Combine Alpha

This combines the FG alpha channel with the BG alpha channel.

Solid

This causes the BG alpha channel to become completely opaque.

Clear

This causes the BG alpha channel to become completely transparent.

Combine Operation

Use this menu to select the method used to combine the foreground channel with the background.

Copy

This copies the foreground source over the background alpha, overwriting any existing alpha in the background.

Add

This adds the foreground source to the background alpha.

Subtract

This subtracts foreground source from the background alpha.

Inverse Subtract

This subtracts the background alpha from the foreground source.

Maximum

This compares the foreground source and the background alpha and takes the value from the pixel with the highest value.

Minimum

This compares the foreground source and the background alpha and takes the value from the pixel with the lowest value.

And

This performs a logical AND on the two values.

Or

This performs a logical OR on the values.

Merge Over

This merges the foreground source channel over the background alpha channel.

Merge Under

This merges the foreground source channel under the background alpha channel.

Filter

Selection of the Filter that is used when blurring the matte.

→ Box Blur: This option applies a Box Blur effect to the whole image. This method is faster than the Gaussian blur but produces a lower quality result.

→ Bartlett: Bartlett applies a more subtle, anti-aliased blur filter.

→ Multi-box: Multi-Box uses a box filter layered in multiple passes to approximate a Gaussian shape. With a moderate number of passes (e.g., 4), a high quality blur can be obtained, often faster than the Gaussian filter and without any ringing.

→ Gaussian: Gaussian applies a smooth, symmetrical blur filter, using a sophisticated constant-time Gaussian approximation algorithm. In extreme cases, this algorithm may exhibit ringing; see below for a discussion of this. This mode is the default filter method.

Matte Blur

This blurs the edge of the matte using a standard constant speed Gaussian blur. A value of zero results in a sharp, cutout-like hard edge. The higher the value, the more blur applied to the matte.

Matte Contract/Expand

This shrinks or grows the matte to exclude some of the keyed image or include some of its surrounding area. Values above 0.0 expand the matte and values below 0.0 contract it.

Matte Gamma

This raises or lowers the values of the matte in the semi-transparent areas. Higher values cause the gray areas to become more opaque and lower values cause the gray areas to become more transparent. Completely black or white regions of the matte remain unaffected.

Matte Threshold

Any value below the lower threshold becomes black or transparent in the matte. Any value above the upper threshold becomes white or opaque in the matte. All values within the range maintain their relative transparency values.

Invert Matte

When this checkbox is selected, the alpha channel of the image is inverted, causing all transparent areas to be opaque and all opaque areas to be transparent.

Garbage Matte

Garbage Mattes are Mask tools or images connected to the Garbage Matte input on the tools tile. The Garbage matte is applied directly to the alpha channel of the image. Generally, Garbage mattes are used to remove unwanted elements that cannot be keyed, such as microphones and booms. They are also used to fill in areas that contain the color being keyed but that you wish to maintain.

Garbage mattes of different modes cannot be mixed within a single tool. A Matte Control tool is often used after a Keyer tool to add a Garbage matte with the opposite effect of the matte applied to the keyer.

Make Transparent

Select this button to make the Garbage matte transparent.

Make Solid

Select this button to make the Garbage matte solid.

Post Multiply Image

Select this option to cause the keyer to multiply the color channels of the image against the alpha channel it creates for the image. This option is usually enabled and is on by default.
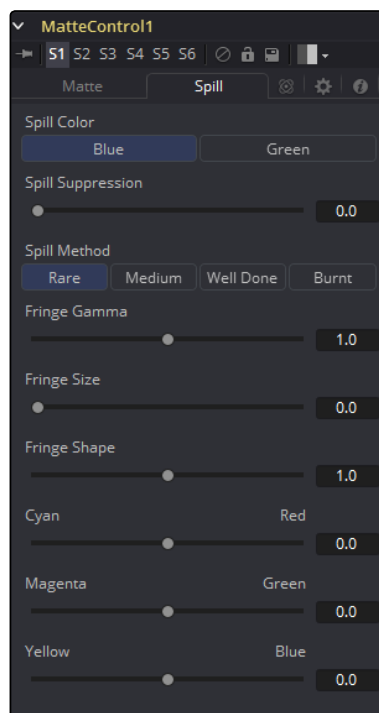
Deselect this checkbox and the image can no longer be considered pre-multiplied for purposes of merging it with other images. Use the Subtractive option of the Merge tool instead of the Additive option.

For more information, see the Merge Tools documentation.

Multiply Garbage Matte

When selected, the values of the image's Red, Green and Blue channels will be multiplied against the Garbage Matte input.

Spill Tab

Spill Color

Use these buttons to select the color used as the base for all spill suppression techniques.

Spill Suppression

Spill is generally caused by the transmission of the color of the background through the semitransparent areas of the alpha channel. In the case of blue or green screen keying, this usually causes the color of the background to become apparent in the fringe of the foreground element.

Spill suppression attempts to remove color from the fringe. The process used is optimized for either blue or green screens; you select which color is used as the base from the control above.

When this slider is set to 0, no spill suppression is applied to the image.

Spill Method

This selects the strength of the algorithm used to apply spill suppression to the image.

None

None is selected when no spill suppression is required.

Rare

This removes very little of the spill color, the lightest of all methods.

Medium

This works best for green screens.

Well Done

This works best for blue screens.

Burnt

This works best for blue. Use this mode only for very troublesome shots.

Fringe Gamma

This control can be used to adjust the brightness of the fringe or halo that surrounds the keyed image.

Cyan/Red, Magenta/Green and Yellow/Blue

Use these three controls to color correct the fringe of the image. This is useful for correcting semi-transparent pixels that still contain color from the original background to match the new background.

Fringe Size

This expands and contracts the size of the fringe or halo surrounding the keyed image.

Fringe Shape

Fringe Shape forces the fringe to be pressed toward the external edge of the image or pulled toward the inner edge of the fringe. Its effect is most noticeable while the Fringe Size sliders value is large.

Ultra Keyer [UKy]

The Ultra Keyer tool is very similar to the Chroma Key tool, except that it has been specifically optimized to extract mattes from images using blue screen or green screen backgrounds.

Pre Matte Tab
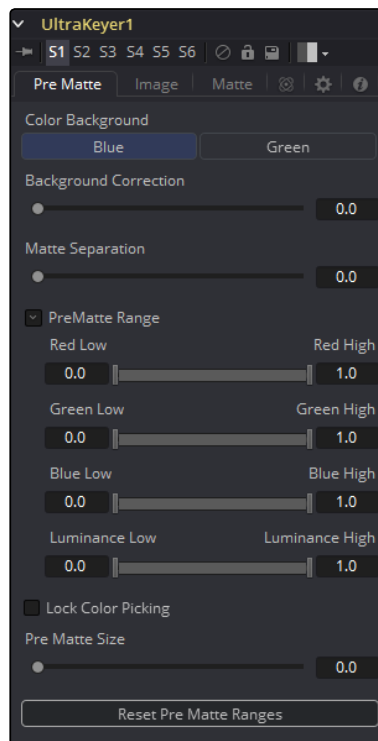
Color Background
The Ultra Keyer is optimized for the removal of blue or green backgrounds. Select the color that matches the image's background using these buttons.

Background Correction
Depending on the background color selected above, the keyer will iteratively merge the pre-keyed image over either a blue or green background before processing it further.

In certain cases this leads to better, more subtle edges.

Matte Separation
Matte Separation performs a pre-process on the image to help separate the foreground from the background before color selection. Generally, increase this control while viewing the alpha to eliminate the bulk of the background, but stop just before it starts cutting holes in the subject or eroding fine detail on the edges of the matte.

PreMatte Range

These range controls update automatically to represent the current color selection. Generally, the Reveal control does not have to be opened to display these controls.

Colors are selected by selecting the Ultra Keyer tool's tile in the flow and dragging in the Viewer to select the colors to be used to create the matte. These range controls can be used to tweak the selection slightly, although generally selecting colors in the displays is all that is required.

Lock Color Picking

When this checkbox is selected, Fusion will prevent accidental growing of the selected range by selecting more colors from the view. It is a good idea to select this checkbox once the color selection is made for the matte. All other controls in the tool remain editable.
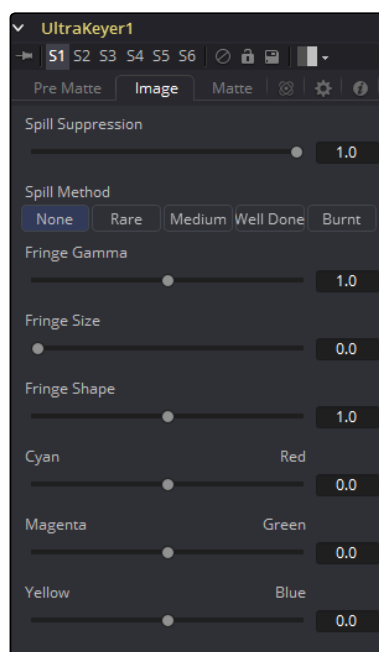
Pre Matte Size

The Pre Matte Size control can be used to soften the general area around the keyed image. This is used to close holes in the matte often caused by spill in semi-transparent areas of the subject. This generally will also cause a small halo around the subject, which can be removed using the Matte Contract tools found later in the tool.

Reset Pre Matte Ranges

This discards all color selection by resetting the ranges but maintains all other slider and control values.

Image Tab

Spill Suppression

Spill is generally caused by the transmission of the color of the background through the semitransparent areas of the alpha channel. In the case of blue or green screen keying, this usually causes the color of the background to become apparent in the fringe of the foreground element.

Spill suppression attempts to remove color from the fringe. The process used is optimized for either blue or green screens; you select which color is used as the base from the control above.

When this slider is set to 0, no spill suppression is applied to the image.

Spill Method

This selects the strength of the algorithm used to apply spill suppression to the image.

None

None is selected when no spill suppression is required.

Rare

This removes very little of the spill color, the lightest of all methods.

Medium

This works best for green screens.

Well Done

This works best for blue screens.

Burnt

This works best for blue. Use this mode only for very troublesome shots.

Fringe Gamma

This control can be used to adjust the brightness of the fringe or halo that surrounds the keyed image.

Fringe Size

This expands and contracts the size of the fringe or halo surrounding the keyed image.

Fringe Shape

Fringe Shape forces the fringe to be pressed toward the external edge of the image or pulled toward the inner edge of the fringe. Its effect is most noticeable while the Fringe Size sliders value is large.

Cyan/Red, Magenta/Green and Yellow/Blue

Use these three controls to color correct the fringe of the image. This is useful for correcting semi-transparent pixels that still contain color from the original background to match the new background.

Matte Tab

Matte Blur

Matte Blur blurs the edge of the matte using a standard constant speed Gaussian blur. A value of zero results in a sharp, cutout-like hard edge. The higher the value, the more blur applied to the matte.

Matte Contract/Expand

This slider shrinks or grows the semi-transparent areas of the matte. Values above 0.0 expand the matte while values below 0.0 contract it.

This control is usually used in conjunction with the Matte Blur to take the hard edge of a matte and reduce fringing. Since this control only affects semi-transparent areas, it will have no effect on a hard edge's matte.

Matte Gamma

Matte Gamma raises or lowers the values of the matte in the semi-transparent areas. Higher values cause the gray areas to become more opaque and lower values cause the gray areas to become more transparent. Completely black or white regions of the matte remain unaffected.

Since this control only affects semi-transparent areas, it will have no effect on a hard edge's matte.

Matte Threshold

Any value below the lower threshold becomes black or transparent in the matte. Any value above the upper threshold becomes white or opaque in the matte. All values within the range maintain their relative transparency values.

This control is often used to reject salt and pepper noise in the matte.

Invert Matte

When this checkbox is selected, the alpha channel created by the keyer is inverted, causing all transparent areas to be opaque and all opaque areas to be transparent.

Garbage Matte Mode

Garbage Mattes are Mask tools or images connected to the Garbage Matte input on the tool's tile. The Garbage matte is applied directly to the alpha channel of the image. Generally, Garbage mattes are used to remove unwanted elements that cannot be keyed, such as microphones and booms. They are also used to fill in areas that contain the color being keyed but that you wish to maintain.

Garbage mattes of different modes cannot be mixed within a single tool. A Matte Control tool is often used after a Keyer tool to add a Garbage matte with the opposite effect of the matte applied to the keyer.

Make Transparent

Select this button to make the Garbage matte transparent.

Make Solid

Select this button to make the Garbage matte solid.

Post Multiply Image

Select this option to cause the keyer to multiply the color channels of the image against the alpha channel it creates for the image. This option is usually enabled and is on by default.

Deselect this checkbox and the image can no longer be considered pre-multiplied for purposes of merging it with other images. Use the Subtractive option of the Merge tool instead of the Additive option.

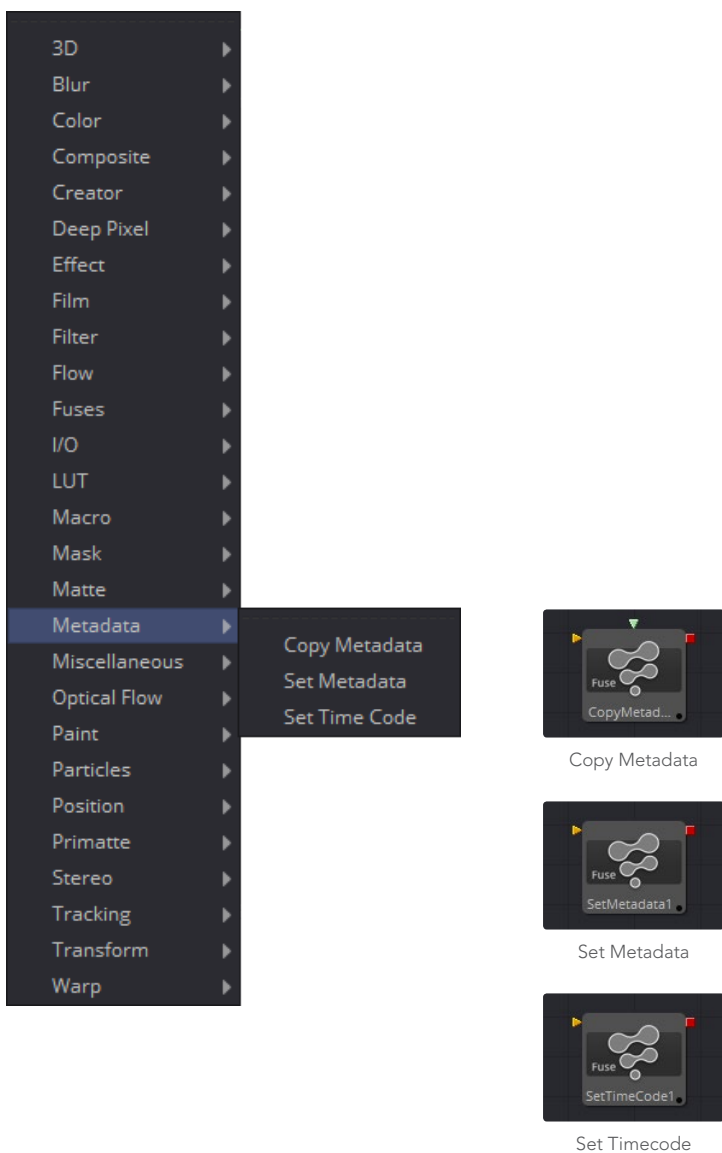For more information, see the Merge Tools documentation.

Metadata Tools

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Metadata Tools

Metadata Tools
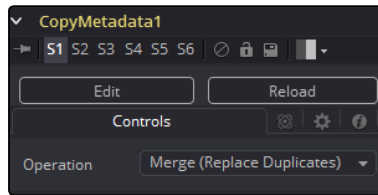

Copy Metadata

Set Metadata

Set Timecode

Copy Metadata [META]

Copy Metadata combines, replaces or clears the metadata in your image.

Controls Tab

Operation

The dropdown defines how the metadata of foreground and background input are treated.

Imagine having metadata in the background image looking like this:

```
FrameRate = 24
Record = Scratched
TimeCode = 00:00:08:15
Hovercraft_Filling = Eels
```

and the foreground's metadata looking like this:

```
Hovercraft_Filling = Oysters
```

Merge (Replace Duplicates)

All values will be merged, but values with duplicate names will be taken from the foreground input.

The output looks like this:

```
FrameRate = 24
Record = Scratched
TimeCode = 00:00:08:15
Hovercraft_Filling = Oysters
```

Merge (Preserve Duplicates)

All values will be merged, but values with duplicate names will be taken from the background input.

The output looks like this:

```
FrameRate = 24
Record = Scratched
TimeCode = 00:00:08:15
Hovercraft_Filling = Eels
```
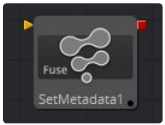
Replace

The entire metadata in the background will be replaced by the ones in the foreground.

The output looks like this:
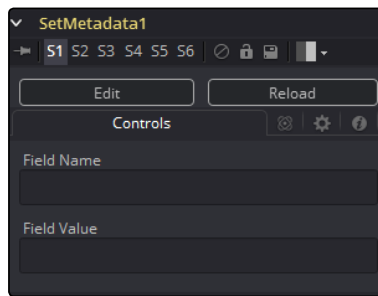
```
Hovercraft_Filling = Oysters
```

Clear

All metadata will be discarded.

Set Metadata [SMETA]

Set Metadata allows the user to create new Name = Value pairs in the metadata.

Controls Tab

Field Name

The name of the Metadata Value. Do not use spaces in here.

Field Value

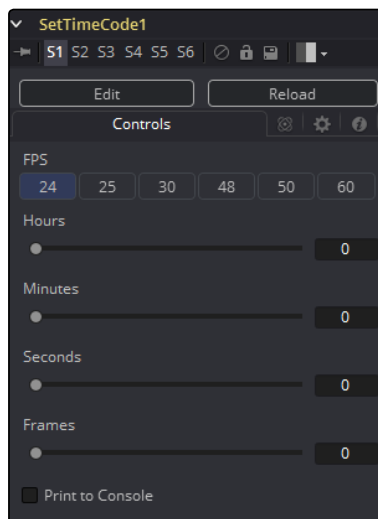The value assigned to the name above.

Set Timecode [TCMETA]

Set Timecode inserts dynamic timecode values into the metadata table based on the FPS settings.

Controls Tab

FPS

You can choose from a variety of Frame Per Second settings here. Since this is a Fuse you can easily adapt the settings to your needs by editing the appropriate piece of code for the buttons:

MBTNC_StretchToFit = true,

```
{ MBTNC_AddButton = "24" },
{ MBTNC_AddButton = "25" },
{ MBTNC_AddButton = "30" },
{ MBTNC_AddButton = "48" },
{ MBTNC_AddButton = "50" },
{ MBTNC_AddButton = "60" },
})
```

as well as for the actual values:

```
local rates = { 24, 25, 30, 48, 50, 60 }
```

Hours/Minutes/Seconds/Frames sliders

Define an offset from the starting frame of the current comp.

Print to Console

Verbose output of the Timecode/Frame value in the Console.

The Timecode/Frames conversion is done according to the FPS settings.

The result can look like this:

```
TimeCode:  00:00:08:15
Frames:    207
```
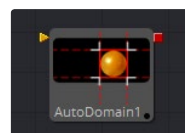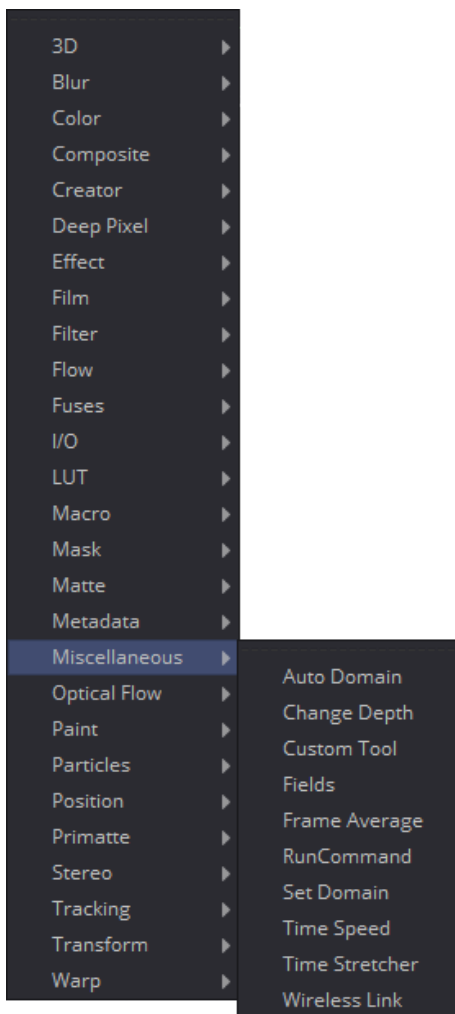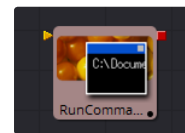
Miscellaneous Tools

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Miscellaneous Tools

Miscellaneous Tools

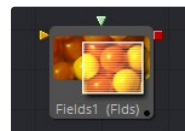|	
Auto Domain	Run Command
Change Depth	Set Domain
Custom	Time Speed
Fields	Time Stretcher
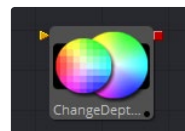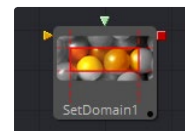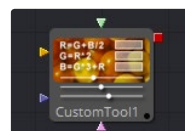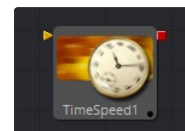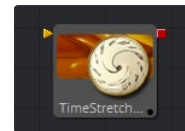
Auto Domain [ADоD]

The Auto Domain tool automatically sets the image's domain of definition based on bounds of the input image's background Canvas color. It does not change the image's physical dimensions. This tool can be used to speed up compositions by optimizing the DoD of images based on their content rather than their dimensions.

For example, a CG character rarely takes up the entire frame of an image. The Auto Domain tool would set the DoD to a rectangular region encompassing the portion of the scene actually containing the character. The DoD is updated on each frame to accommodate changes, such as a character walking closer to the camera.

See the Set Canvas Color tool for more information about the Canvas color.

Controls Tab
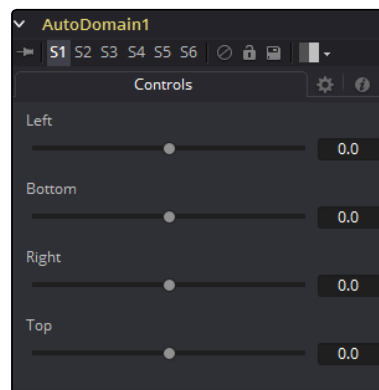
Left

Defines the left border of the search area of the ADoD. Higher values on this slider move the left border toward the right, excluding more data from the left margin.

1 represents the right border of the image, 0 represents the left border. The slider defaults to 0 (Left Border).

Bottom

Defines the bottom border of the search area of the ADoD. Higher values on this slider move the bottom border toward the top, excluding more data from the bottom margin.

1 represents the Top border of the image, 0 represents the bottom border. The slider defaults to 0 (Bottom Border).

Right

Defines the right border of the search area of the ADoD. Higher values on this slider move the right border toward the left, excluding more data from the right margin.

1 represents the right border of the image, 0 represents the left border. The slider defaults to 1 (Right Border).

Top

Defines the top border of the search area of the ADoD. Higher values on this slider move the top border toward the bottom, excluding more data from the top margin.

1 represents the top border of the image, 0 represents the bottom border. The slider defaults to 1 (Top Border).
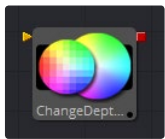
Change Depth [CD]

The Change Depth tool has one simple use, to change the bits per color channel used to process a tool. The single control for this tool is Depth, which contains five buttons. Select Keep to leave the color depth as is, or either 8-bit, 16-bit or Float to change to the selected color depth.

This tool is often used after color correcting Cineon files, converting from Float processing to 16-bit per channel to preserve memory and performance.

It can also be useful if, from a certain point in your flow, you feel the need to process your images in a higher bit depth than their original one or to reduce the bit depth to save memory.

Controls Tab
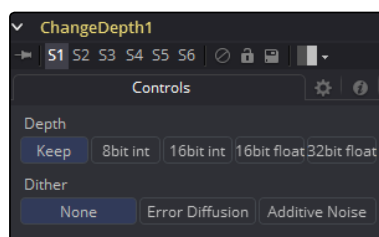
Depth

Keep doesn't do anything to the image but rather keeps the input depth. The other options change the bit depth of the image to the respective value.

Dither

When down converting from higher bit depth it might be useful to add Error Diffusion or Additive Noise to camouflage artifacts that result from problematic (high contrast) areas.
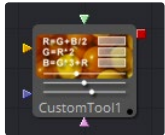
Custom [Cu]

The Custom tool is quite likely the most complex, and the most powerful, tool in Fusion. Any user moderately experienced with scripting, or C++ programming, should find the structure and terminology used by the Custom tool to be familiar.

The Custom tool is used to create custom expressions and filters to modify an image. In addition to providing three image inputs, the Custom tool will allow for the connection of up to eight numeric inputs and as many as four XY position values from other controls and parameters in the flow.

Per-pixel calculations can be performed on the Red, Green, Blue, Alpha, Z, Z Coverage, UV texture coords, XYZ Normals, RGBA background color and XY motion vector channels of the images.

Custom Controls Tab

Point in 1-4, X and Y

These four controls are 2D X and Y center controls that are available to expressions entered in the Setup, Intermediate and Channels tabs as variables p1x, p1y, ..., p4x, p4y. They are normal positional controls and can be animated or connected to modifiers as any other tool might.

Number in 1-8

The values of these controls are available to expressions entered in the Setup, Intermediate and Channels tabs as variables n1, n2, n3, ..., n8. They are normal slider controls, and can be animated or connected to modifiers exactly as any other tool might.

LUT in 1-4

The Custom tool provides 4 LUT splines. The values of these controls are available to expressions entered in the Setup, Intermediate and Channels tabs using the getlut# function. For example, setting the R, G, B and A expressions to getlut1(r1), getlut2(g1), getlut3(b1), and getlut4(a1) respectively would cause the Custom tool to mimic the Color Curves tool.

These controls can be renamed using the options in the Config tab to make their meanings more apparent, but expressions will still see the values as n1, n2, ..., n8.

Custom Setup Tab
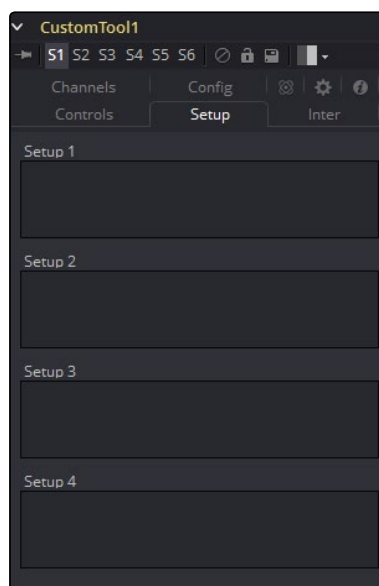
Setup 1-4

Up to four separate expressions can be calculated in the Setup tab of the Custom tool. The Setup expressions are evaluated once per frame, before any other calculations are performed. The results are then made available to the other expressions in the Custom tool as variables s1, s2, s3 and s4.

Note: Because these expressions are evaluated once per frame only and not for each pixel, it makes no sense to use per-pixel variables like X and Y or channel variables like r1,g1,b1, etc. Allowable values include constants, variables like n1..n8, time, W and H, etc., and functions like sin() or getr1d().

Custom Inter Tab
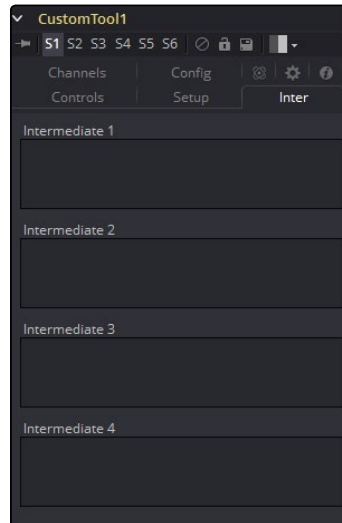
Intermediate 1-4

An additional four expressions can be calculated in the Inter tab. The Inter expressions are evaluated once per pixel, after the Setup expressions are evaluated but before the Channel expressions are evaluated. Per-pixel channel variables like r1,g1,b1 and a1 are allowable. Results are available as variables i1, i2, i3 and i4.

Custom Config Tab
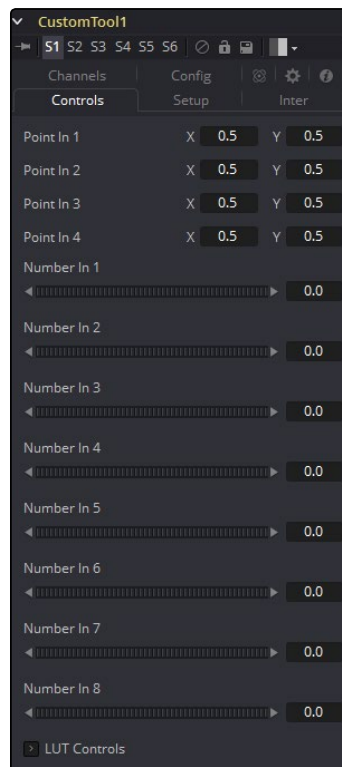
Random Seed

Use this to set the seed for the rand() and rands() functions. Click the Randomize button to set the seed to a random value. This control may be needed if multiple Custom tools are required with different random results for each.

Number Controls

There are eight sets of Number controls, corresponding to the eight Number In sliders in the Controls tab. Untick the Show Number checkbox to hide the corresponding Number In slider, or edit the Name for Number text field to change its name.

Point Controls

There are four sets of Point controls, corresponding to the four Point In controls in the Controls tab. Untick the Show Point checkbox to hide the corresponding Point In control and its crosshair in the Viewer. Similarly, edit the Name for Point text field to change the control's name.

Channels Tab
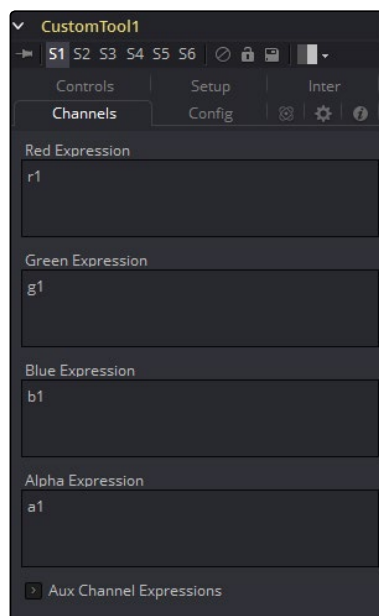
RGBA, Z, UV Expressions and XYZ Normal Expressions

The Channel tab is used to set up one expression per each available channel of the image. Each expression is evaluated once per pixel, and the result is used to create the value for that pixel in the output of the image.

Color Channel expressions (RGBA) should generally return floating-point values between 0.0 and 1.0. Values beyond this will be clipped if the destination image is an integer. Other expression fields should produce values appropriate to their channel (e.g., between -1.0 and 1.0 for Vector and Normal

fields, 0.0 to 1.0 for Coverage, or any value for Depth). The Channel expressions may use the results from both the Setup expressions (as variables s1-s4) and Inter expressions (as variables i1-i4).

Custom Tool Syntax
Value Variables

n1..n8	Numeric Inputs
p1x..p4x	Position Values (X-axis)
p1y..p4y	Position Values (Y-axis)
s1..s4	Setup Expression Results
i1..i4	Inter Expression Results
time	Current Frame
x	Horizontal co-ordinate of the current pixel, between 0.0 and 1.0
y	Vertical co-ordinate of the current pixel, between 0.0 and 1.0
w (or w1..w3)	Width of Image (for image1..image3)
h (or h1..h3)	Height of Image (for image1..image3)
ax (or ax1..ax3)	Image Aspect X (for image1..image3)
ay (or ay1..ay3)	Image Aspect Y (for image1..image3)

Note: Use w and h and ax and ay without a following number to get the dimensions and aspect of the primary image.

Channel (Pixel) Variables

c1..c3	Current Channel (for image1..image3)
r1..r3	Red (for image1..image3)
g1..g3	Green (for image1..image3)
b1..b3	Blue (for image1..image3)
a1..a3	Alpha (for image1..image3)
z1..z3	Z-Buffer (for image1..image3)
cv1..cv3	Z Coverage (for image1..image3)
u1..u3	U Coordinate (for image1..image3)
v1..v3	V Coordinate (for image1..image3)
nx1..nx3	X Normal (for image1..image3)
ny1..ny3	Y Normal (for image1..image3)
nz1..nz3	Z Normal (for image1..image3)
bgr1..bgr3	Background Red (for image1..image3)
bgg1..bgg3	Background Green (for image1..image3)
bgb1..bgb3	Background Blue (for image1..image3)
bga1..bga3	Background Alpha (for image1..image3)
vx1..vx3	X Vector (for image1..image3)
vy1..vy3	Y Vector (for image1..image3)

Note: Use c1, c2, c3 to refer to the value of a pixel in the current channel. This makes copy/pasting expressions easier. For example, if c1/2 is typed as the red expression, the result would be half the value of the red pixel from image 1, but if the expression is copied to the blue channel, now it would have the value of the pixel from the blue channel.

To refer to the red value of the current pixel in input 1, type r1. For the image in input 2, it would be r2.

→ get[ch][#]b(x, y) Read pixel at x,y, or 0 if out of bounds, e.g., getr1b(0,0)

→ get[ch][#]d(x, y) Read pixel at x,y or edge pixel if out of bounds, e.g., getr1d(0,0)

→ get[ch][#]w(x, y) Read pixel at x,y or wrap if out of bounds, e.g., getr1w(0,0)

Note: There are a variety of methods used to refer to pixels from other locations than the current one in an image.

In the above description, [ch] is a letter representing the channel to access, and [#] is a number representing the input image. So to get the red component of the current pixel (equivalent to 'r'), you would use getr1b(x,y). To get the alpha component of the pixel at the center of image 2 you would use geta2b(0.5, 0.5).

→ getr1b(x,y) Output the red value of the pixel at position x, y, if there were a valid pixel present. It would output 0.0, if the position were beyond the boundaries of the image (all channels).

→ getr1d(x,y) Output the red value of the pixel at position x, y. If the position specified were outside of the boundaries of the image, the result would be from the outer edge of the image (RGBA only).

→ getr1w(x,y) Output the red value of the pixel at position x, y. If the position specified were outside of the boundaries of the image, the x and y coordinates would wrap around to the other side of the image and continue from there (RGBA only).

To access other channel values with these functions, substitute the r in the above examples with the correct channel variable (r, g, b, a and, for the getr1b() functions only, z, etc...), as shown above. Substitute the 1 with either 2 or 3 in the above examples to access the images from the other image inputs.

Mathematical Expressions

pi	The value of pi
e	The value of e
log(x)	The base-10 log of x
ln(x)	The natural (base-e) log of x
sin(x)	The sine of x (x is degrees)
cos(x)	The cosine of x (x is degrees)
tan(x)	The tangent of x (x is degrees)
asin(x)	The arcsine of x, in degrees
acos(x)	The arccosine of x, in degrees
atan(x)	The arctangent of x, in degrees
atan2(x,y)	The arctangent of x,y, in degrees
abs(x)	The absolute (positive) value of x
int(x)	The integer (whole) value of x
frac(x)	The fractional value of x
sqrt(x)	The Square Root of x
rand(x,y)	A random value between x and y
rands(x,y,s)	A random value between x and y, based on seed s
min(x,y)	The minimum (lowest) of x and y
max(x,y)	The maximum (highest) of x and y
dist(x1,y1,x2,y2)	The distance between point x1,y2 and x2,y2
dist3d(x1,y1,z1,x2,y2,z2)	The distance between 3D points x1,y2,z1 and x2,y2,z2
noise(x)	A smoothly varying Perlin noise value based on x
noise2(x, y)	A smoothly varying Perlin noise value based on x and y
noise3(x, y, z)	A smoothly varying Perlin noise value based on x, y and z
if(c, x, y)	returns x if c not 0, otherwise y

Mathematical Operators

!x	1.0 if x = 0, otherwise 0.0
-x	(0.0 - x)
+x	(0.0 + x) i.e. effectively does nothing
x ^ y	x raised to the power of y
x * y	x multiplied by y
x / y	x divided by y
x % y	x modulo y, i.e. remainder of (x divided by y)
x + y	x plus y
x - y	x minus y
x < y	1.0 if x is less than y, otherwise 0.0
x > y	1.0 if x is greater than y, otherwise 0.0
x <= y	1.0 if x is less than or equal to y, otherwise 0.0
x >= y	1.0 if x is greater than or equal to y, otherwise 0.0
x = y	1.0 if x is exactly equal to y, otherwise 0.0
x == y	1.0 if x is exactly equal to y, otherwise 0.0, identical to above
x <> y	1.0 if x is not equal to y, otherwise 0.0
x != y	1.0 if x is not equal to y, otherwise 0.0, i.e. identical to above
x & y	1.0 if both x and y are not 0.0, otherwise 0.0
x && y	1.0 if both x and y are not 0.0, otherwise 0.0, i.e. identical to above
x|y	1.0 if either x or y (or both) are not 0.0, otherwise 0.0
x||y	1.0 if either x or y (or both) are not 0.0, otherwise 0.0

Example

The following examples are intended to help you understand the various components of the Custom tool.

Rotation

To rotate an image, we need the standard equations for 2D rotation:

```
x' = x * cos(theta) - y * sin(theta)
y' = x * sin(theta) + y * cos(theta)
```

Using the n1 slider for the angle theta, and a sample function, we get (for the red channel):

```
getr1b(x * cos(n1) - y * sin(n1), x * sin(n1) + y * cos(n1))
```

This will calculate the current pixel's (x,y) position rotated around the origin at (0,0) (the bottom-left corner), and then fetch the red component from the source pixel at this rotated position. For centered rotation, we need to subtract 0.5 from our x and y coordinates before we rotate them, and add 0.5 back to them afterwards:

```
getr1b((x-.5) * cos(n1) - (y-.5) * sin(n1) + .5, (x-.5) * sin(n1) + (y-.5) * cos(n1) + .5)
```

Which brings us to the next lesson: Setup and Intermediate Expressions. These are useful for speeding things up by minimizing the work that gets done in the channel expressions. The Setup expressions are executed only once, and their results don't change for any pixel, so you can use these for s1 and s2 respectively

```
cos(n1)
sin(n1)
```

Intermediate expressions are executed once for each pixel, so you can use these for i1 and i2:

```
(x-.5) * s1 - (y-.5) * s2 + .5
(x-.5) * s2 + (y-.5) * s1 + .5
```

These are the x and y parameters for the getr1b() function, from above, but with the Setup results, s1 and s2, substituted so that the trig functions are executed only once per frame, not every pixel. Now you can use these intermediate results in your channel expressions:

```
getr1b(i1, i2)
getg1b(i1, i2)
getb1b(i1, i2)
geta1b(i1, i2)
```

With the Intermediate expressions substituted in, we only have to do all the adds, subtracts and multiplies once per pixel, instead of four times per pixel. As a rule of thumb, if it doesn't change, do it only once.

This is a simple rotation that doesn't take into account image aspect at all. It is left as an exercise to the reader to include this (sorry). Another improvement could be to allow rotation around different points than the center.

Filtering

Our second example duplicates the functionality of a 3x3 Custom Filter tool set to averages the current pixel together with the eight pixels surrounding it. To duplicate it with a Custom tool, add a Custom tool to the flow, and enter the following expressions into the Setup tab.

(Leave the tool disconnected to prevent it from updating until we are ready.)

```
S1
1.0/w1

S2
1.0/h1
```

These two expressions will be evaluated at the beginning of each frame. S1 divides 1.0 by the current width of the frame, and S2 divides 1.0 by the height. This provides a floating-point value between 0.0 and 1.0 that represents the distance from the current pixel to the next pixel along each axis.

Now enter the following expression into the first text control of the Channel tab (r).

```
(getr1w(x-s1, y-s2) + getr1w(x, y-s2) + getr1w(x+s1, y-s2) +
getr1w(x+s1, y) + getr1w(x-s1, y) + r1 +
getr1w(x-s1, y+s2) + getr1w(x, y+s2) + getr1w(x+s1, y+s2)) / 9
```

This expression adds the nine pixels above the current pixel together by calling the getr1w() function nine times and providing it with values relative to the current position. Note that we referred to the pixels by using x+s1, y+s2, rather than using x+1, y+1.

Fusion refers to pixels as floating-point values between 0.0 and 1.0, which is why we created the expressions we used in the Setup tab. If we had used x+1, y+1 instead, the expression would have sampled the exact same pixel over and over again. (The function we used wraps the pixel position around the image if the offset values are out of range.)

That took care of the red channel; now use the following expressions for the green, blue and alpha channels.

```
(getg1w(x-s1, y-s2) + getg1w(x, y-s2) + getg1w(x+s1, y-s2) +
getg1w(x+s1, y) + getg1w(x-s1, y) + g1 +
getg1w(x-s1, y+s2) + getg1w(x, y+s2) + getg1w(x+s1, y+s2)) / 9

(getb1w(x-s1, y-s2) + getb1w(x, y-s2) + getb1w(x+s1, y-s2) +
getb1w(x+s1, y) + getb1w(x-s1, y) + b1 +
getb1w(x-s1, y+s2) + getb1w(x, y+s2) + getb1w(x+s1, y+s2)) / 9

(geta1w(x-s1, y-s2) + geta1w(x, y-s2) + geta1w(x+s1, y-s2) +
geta1w(x+s1, y) + geta1w(x-s1, y) + a1 + geta1w(x-s1, y+s2) +
geta1w(x, y+s2) + geta1w(x+s1, y+s2)) / 9
```

It is time to view the results. Add a Background tool set to solid color and change the color to a pure red. Add a hard-edged Rectangular Effects mask and connect it to the expression just created.

For comparison, add a Custom Filter tool and duplicate the settings from the image above. Connect a pipe to this tool from the background to the tool and view the results. Alternate between viewing the Custom tool and the Custom Filter while zoomed in close to the top corners of the Effects mask.

Of course, the Custom Filter tool renders a lot faster than the Custom tool we created, but the flexibility of the Custom tool is its primary advantage. For example, you could use an image connected to input 2 to control the median applied to input one by changing all instances of getr1w, getg1w, and getb1w in the expression to getr2w, getg2w, and getb2w, but leaving the r1, g1, and b1s as they are.

This is just one example; the possibilities of the Custom tool are limitless.

Fields [FLD]

The Fields tool is a robust multi-purpose utility offering several functions related to interlaced video frames. It interpolates separate video fields into video frames, or separates video frames into individual fields. It can be used to assist in the standards conversion of PAL to NTSC and provides the ability to process fields and frames for specific portions of a flow.

For more information about how Fusion handles fields processing, consult the Frame Formats chapter in this manual.

Controls Tab
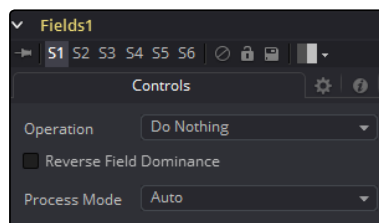
Operation

This control is used to select the type of operation the tool will perform. See below for a detailed explanation.

Process Mode

This control is used to select the field's format used for the output image. See below for a detailed explanation.

Operation

Do Nothing
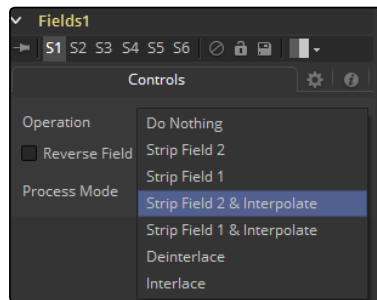
This causes the images to be affected by the Process Mode selection exclusively.

Strip Field 2

This removes field 2 from the input image stream, which shortens the image to half of the original height.

Strip Field 1

This removes field 1 from the input image stream, which shortens the image to half of the original height.

Strip Field 2 and Interpolate

This removes field 2 from the input image stream and inserts a field interpolated from field 1 so that image height is maintained. Should be supplied with frames, not fields.

Strip Field 1 and Interpolate

This removes field 1 from the input image stream and inserts a field interpolated from field 2 so that image height is maintained. Should be supplied with frames, not fields.

Interlace

This combines fields from the input image stream(s). If supplied with one image stream, each pair of frames will be combined to form half of the amount of double height frames. If supplied with two image streams, single frames from each stream will be combined to form double height images.
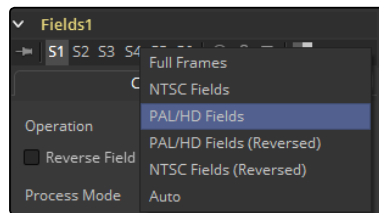
De-Interlace

This separates fields from one input image stream. This will produce double the amount of half height frames.

Reverse Field Dominance

When selected, the Field Order or Dominance of the image will be swapped.

Process

Full Frames

This forces Frame Processing. Useful for processing frames in a part of a flow that is otherwise field processing.

NTSC Fields

This forces NTSC Field Processing. Useful for processing fields in a part of a flow that is otherwise frame processing.

PAL Fields

This forces PAL Field Processing. Useful for processing fields in a part of a flow that is otherwise frame processing.
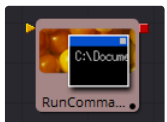
PAL Fields (Reversed)

This forces PAL swapped Field Processing.

NTSC Fields (Reversed)

This forces NTSC swapped Field Processing.

Auto

This attempts to match the mode of its input images. Fields is used if the input types are mixed.

Run Command [RUN]

The RunCommand tool is used to execute an external command or batch file at certain points during a render. Choose to run a command once at the start, or at the end of a render, or have the command execute once for each frame.

An image input is not required for this tool to operate. However, if RunCommand is connected to a tool's output, the command will only be launched after that tool has finished rendering. This is often useful when connected to a Saver, to ensure that the output frame has been fully saved to disk first. If the application launched returns a non-0 result, the tool will also fail.

RunCommand can be used to net render other command line applications using the Fusion render manager, as well as a host of other useful functions.

Controls Tab
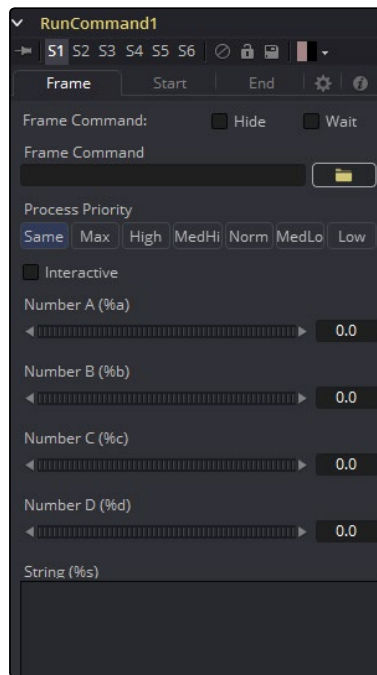
Frame Command

The first file browser in the tool is used to specify the path and parameters for the command to be run after each frame is rendered. Select the Hide checkbox to prevent the application or script from displaying a window when it is executed.

Hide

Select this checkbox to suppress the display of any window or dialog started by the command.

Wait

Enable this checkbox to cause the tool to Wait for the remote application or tool to exit before continuing. If this checkbox is cleared, the system will continue rendering without waiting for the external application.

Number A (%B) And Number B (%B)

Various wildcards can be used with the frame commands; these wildcards will be substituted at render time with the correct values.

> → %a: Outputs the number from the Number A thumbwheel control
>
> → %b: Outputs the number from the Number B thumbwheel control
>
> → %t: Outputs the current frame number (without zero padding)
>
> → %s: Substituted with the text from the large text entry field

If you want to add zero padding to the numbers generated by %t, refer to the wildcard with %0x where x is the number of characters with which to pad the value. This also works for %a and %b.

For example, test%04t.tga would return the following values at render time:

```
test0000.tga
test0001.tga
test0009.tga
test0010.tga
```

You may also pad a value with spaces by calling the wildcard as %x, where x is the number of spaces with which you would like to pad the value.

Process Priority

The Process Priority buttons provide options for selecting the priority at which the launched process runs. This determines how much processor time the launched process receives compared to other applications.

Interactive

This checkbox determines whether the launched application should run interactively, allowing user input.

RunCommand Start and End Tabs
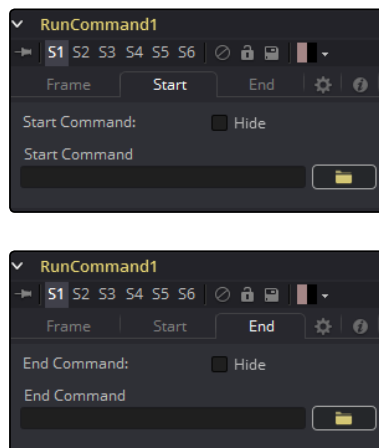
The Start and End tabs contain a file browser for a command to be run when the composition starts to render and when the composition is done rendering.

Example

To copy the saved files from a render to another directory as each frame is rendered, save the following text in a file called copyfile.bat to your C\ directory (the root folder).

```
@echo off
set parm=%1 %2
copy %1 %2
set parm=
```

Create or load any flow that contains a Saver. The following example assumes a Saver is set to output D\ test0000.tga, test0001.tga, etc. You may have to modify the example to match.

Add a RunCommand tool after the Saver, to ensure the Saver has finished saving first. Now enter the following text into the RunCommand tool's Frame Command text box:

```
C\copytest.bat D\test%04f.tga C\
```

Select the Hide Frame command checkbox to prevent the command prompt window from appearing briefly after every frame.

When this flow is rendered, each file will be immediately copied to the C\ directory as it is rendered.

The RunCommand tool could be used to FTP the files to a remote drive or Abekas device on the network, to print out each frame as it is rendered, or to execute a custom image-processing tool.

The RunCommand tool is not restricted to executing simple batch files. FusionScript, VBScript, Jscript, CGI, and Perl files could also be used, as just a few examples.

Set Domain [DOD]

Set Domain is used to adjust or set the active area of an image, or in other words the area of the image considered to have valid data.

It does not change the image's physical dimensions. Anything outside the DoD will not be processed by downstream tools, thus speeding up rendering of computational intensive tools.

This tool provides an absolute mode, for setting the Domain of Definition manually, and a relative mode for adjusting the existing Domain of Definition.

Controls Tab/Set Mode
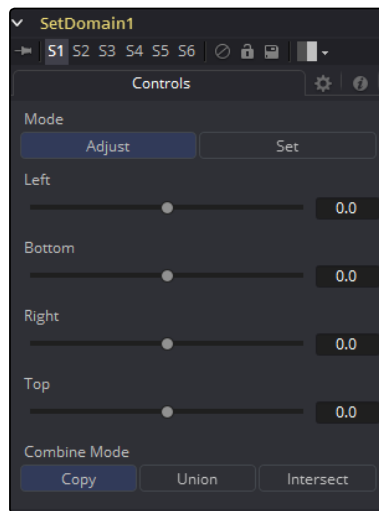
Left

Defines the left border of the DoD. Higher values on this slider move the left border toward the right, excluding more data from the left margin.

1 represents the right border of the image, 0 represents the left border. The slider defaults to 0 (Left Border).

Bottom

Defines the bottom border of the DoD. Higher values on this slider move the bottom border toward the top, excluding more data from the bottom margin.

1 represents the Top border of the image, 0 represents the bottom border. The slider defaults to 0 (Bottom Border).

Right

Defines the right border of the DoD. Higher values on this slider move the right border toward the left, excluding more data from the right margin.

1 represents the right border of the image, 0 represents the left border. The slider defaults to 1 (Right Border).

Top

Defines the top border of the DoD. Higher values on this slider move the top border toward the bottom, excluding more data from the top margin.

1 represents the top border of the image, 0 represents the bottom border. The slider defaults to 1 (Top Border).

External Inputs
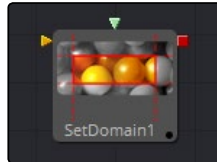
→ SetDomain.Input: [orange, required] This input must be connected to the output of a tool that produces a 2D image.

→ SetDomain.Foreground: [green, optional] This input expects a 2D image as its input. When the foreground input is connected, the Set Domain tool will replace the Background input's Domain of Definition with the foreground's DoD.

Set Mode defaults to the full extent of the visible image.

Controls Tab/Adjust Mode
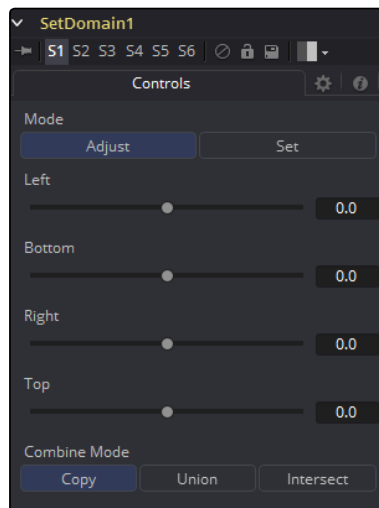
In Adjust mode, basically the same operations can be carried out like in Set Mode. All Sliders default to 0, though, marking their respective full extent of the image. Positive values shrink the DoD while negative values expand the DoD to include more data.
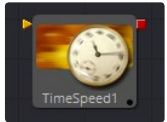
Time Speed [TSₚ]

Time Speed allows image sequences to be sped up, slowed down, reversed or delayed. Image Interpolation offers smooth, high quality results. Time Speed should be used for static speed changes or to introduce delays in the footage. To apply animated changes in time, such as accelerating or decelerating time, use a Time Stretcher instead.

When operating in Flow mode, Optical Flow data is required.

This tool does not generate optical flow directly. You have to create it manually upstream using an OpticalFlow tool or by loading the forward/reverse vector channels from disk.

TimeSpeed does not interpolate the aux channels, but rather destroys them. In particular, the Vector/BackVector channels are consumed and destroyed after computation.

Add an OpticalFlow after the FlowSpeed if you want to generate flow vectors for the retimed footage.
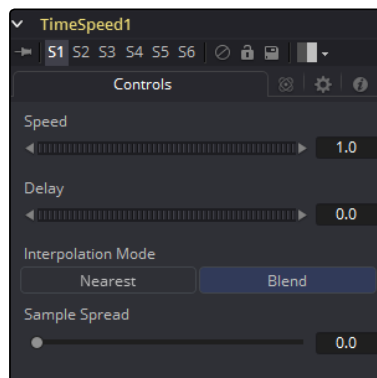
Controls

Speed

This control is used to adjust the Speed, in percentage values, of the outgoing image sequence. Negative values reverse the image sequence. 200% Speed is represented by a value of 2.0, 100% is 1.0, 50% is 0.5 and 10% is 0.1.

The Speed control cannot be animated.

Delay

Use this control to Delay the outgoing image sequence by the specified number of frames. Negative numbers will offset time back and positive numbers will advance.

Interpolate Between Frames

When checked, frames before and after the current frame will be interpolated to create new frames. This usually offers smoother and cleaner results. When cleared, no interpolation will take place.

Sample Spread

This slider controls the strength of the interpolated frames on the current frame. A value of 0.5 causes 50% of the frame before and 50% of the frame ahead of the current frame to be blended with 0% of the current frame.

Depth Ordering

The Depth Ordering is used to determine which parts of the image should be rendered on top. This is best explained by example.

In a locked off camera shot where a car is moving through the frame, the background does not move, so it will produce small or slow vectors. The car will produce larger or faster vectors.

The Depth Ordering in this case is Fastest Ontop, since the car will draw over the background.

In a shot where the camera pans to follow the car, the background will have faster vectors, and the car will have slower vectors, so the Depth ordering method would be Slowest Ontop.

Clamp Edges

Under certain circumstances, this option can remove the transparent gaps that may appear on the edges of interpolated frames. Clamp Edges will cause a stretching artifact near the edges of the frame that is especially visible with objects moving through it or when the camera is moving.

Because of these artifacts, it is a good idea to only use clamp edges to correct small gaps around the edges of an interpolated frame.

Softness

Helps to reduce the stretchy artifacts that might be introduced by Clamp Edges.

If you have more than one of the Source Frame and Warp Direction checkboxes turned on, this can lead to doubling up of the stretching effect near the edges. In this case, you'll want to keep the softness rather small at around 0.01. If you only have one checkbox enabled, you can use a larger softness at around 0.03)

Source Frame and Warp Direction

This control set allows for the choosing of which frames and which vectors are used to create the inbetween frames. Each method ticked on will be blended into the result.

→ **Prev Forward:** Will take the previous frame and use the Forward vector to interpolate the new frame.

→ **Next Forward:** Will take the next frame in the sequence and use the Forward vector to interpolate the new frame.

→ **Prev Backward**: Will take the previous frame and use the Back Forward vector to interpolate the new frame.

→ **Next Backward:** Will take the next frame in the sequence and use the Back vector to interpolate the new frame.
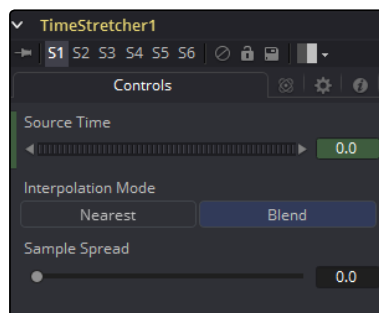
Time Stretcher [TST]

The Time Stretcher tool is similar to the Time Speed tool, but it permits the speed of the clip to be animated over the course of the effect. Full spline control of the effect is provided, including smoothing. As a result, the Time Stretcher can be used to animate a single clip to 200, back to normal speed, pause for a second, and then play backward (like a VCR rewinding).

Image interpolation offers smooth, high quality results, all using a spline curve to adjust time non-linearly. To apply steady time changes such as frame rate changes, use a TimeSpeed instead. When operating in Flow mode, Optical Flow data is required.

This tool does not generate optical flow directly, you have to create it manually upstream using an OpticalFlow tool or by loading the forward/reverse vector channels from disk.

FlowStretcher does not interpolate the aux channels but rather destroys them. In particular, the Vector/BackVector channels are consumed/destroyed. Add an OpticalFlow after the FlowStretcher if you want to generate flow vectors for the retimed footage.

Controls Tab

Source Time

This control designates from which frame in the original sequence to begin sampling.

When a Time Stretcher tool is added to the flow, the Source Time control already contains a Bezier spline with a single keyframe set to 0.0. The position of the keyframe is determined by the current time when the tool is added to the flow.

(The Source Time spline may not be immediately visible until Edit is selected from the Source Time's contextual menu, or Display all Splines from the Spline Window's contextual menu.)

Interpolate Between Frames

This toggles whether the Time Stretcher will interpolate between the next and previous frames.

Sample Spread

This determines the strength of the interpolated frames on the current frame. A value of 0.5 causes 50% of the frame before and 50% of the frame ahead of the current frame to be blended with 0% of the current frame. A value of 0.25 would blend 25% of the previous and next frames with 50% of the current frame. Set this control over 0.25 only in extreme cases.

Clamp Edges

Under certain circumstances this option can remove the transparent gaps that may appear on the edges of interpolated frames. Clamp Edges will cause a stretching artifact near the edges of the frame that is especially visible with objects moving through it or when the camera is moving.

Because of these artifacts, it is a good idea to only use clamp edges to correct small gaps around the edges of an interpolated frame.

Softness

Helps to reduce the stretchy artifacts that might be introduced by Clamp Edges.

If you have more than one of the Source Frame and Warp Direction checkboxes turned on, this can lead to doubling up of the stretching effect near the edges. In this case, you'll want to keep the softness rather small at around 0.01. If you only have one checkbox enabled, you can use a larger softness at around 0.03.

Source Frame and Warp Direction

This control set allows for the choosing of which frames and which vectors are used to create the in between frames. Each method ticked on will be blended into the result.

> → Prev Forward: Will take the previous frame and use the Forward vector to interpolate the new frame.

> → Next Forward: Will take the next frame in sequence and use the Forward vector to interpolate the new frame.

> → Prev Backward: Will take the previous frame and use the Back Forward vector to interpolate the new frame.

> → Next Backward: Will take the next frame in sequence and use the Back vector to interpolate the new frame.

Depth Ordering

The Depth ordering is used to determine which parts of the image should be rendered on top. This is best explained by example.

In a locked off camera shot where a car is moving through the frame, the background does not move, so it will produce small or slow vectors. The car will produce larger or faster vectors. The Depth ordering in this case is Fastest Ontop, since the car will draw over the background.

In a shot where the camera pans to follow the car, the background will have faster vectors, and the car will have slower vectors, so the Depth ordering method would be Slowest Ontop.

Example

Make certain that the current time is either the first or last frame of the clip to be affected in the project. Add the Time Stretcher tool to the flow. This will create a single point on the Source Time spline at the current frame. The value of the Source Time will be set to zero for the entire Global Range.

Set the value of the Source Time to the frame number to be displayed from the original source, at the frame in time it is to be displayed in during the project.

To shrink a 100-frame sequence to 25 frames, follow these steps:

> → Change the Current Time to frame 0.

> → Change the Source Time control to 0.0.

> → Advance to frame 24.

> → Change the Source Time to 99.

> → Check that the spline result is linear.

> → Fusion will render 25 frames by interpolating down the 100 frames to a length of 25.

> → Hold the last frame for 30 frames, then play the clip backward at regular speed. Continue the example from above and follow the steps below.

> → Advance to frame 129.

> → Right-click on the Source Time control and select Set Key from the menu.

> → Advance to frame 229 (129 + 100).

> → Set the Source time to 0.0.

Optical Flow

22

Optical Flow

Optical Flow

3D
Blur
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Primatte
Stereo
Tracking
Transform
Warp

Optical Flow
Repair Frame
Smooth Motion
Tween

Optical Flow

Repair Frame

Smooth Motion
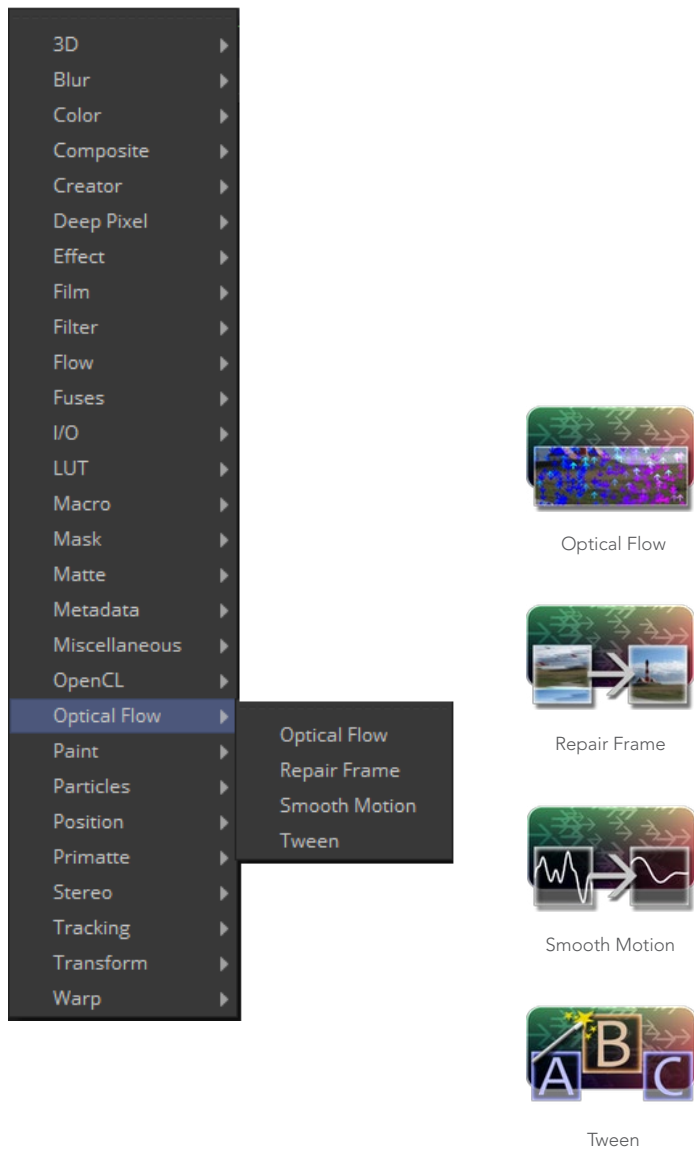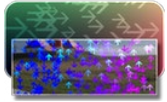
Tween

Optical Flow [OF]

This tool computes the Optical Flow between the frames of the input sequence. The optical flow can be thought of as a per pixel displacement vector which matches up features between two frames.

The computed optical flow is stored within the Vector and BackVector aux channels of the output image. At its highest quality settings, the Optical Flow tool can be slow to process. If you find optical flow is too slow, you should consider tweaking the quality settings, using a disk cache, or pre-rendering it out into OpenEXR files.

There are quite a few quality settings to tweak, many with small or diminishing returns; depending on the settings, there is easily a variation of 10x in rendering time. As a hint to those interested in reducing process time, try experimenting with the Proxy, Number of Iterations, and Number of Warps sliders and changing the filtering to Bilinear.

OpticalFlow can only work with the frames you allow. If you trim an upstream Loader to a sub frame range, OpticalFlow cannot see beyond the subframe range, even if there are additional frames on disk that it could use.

If the footage input flickers on a frame-by-frame basis, it is a good idea to deflicker the footage beforehand.

Currently, OpticalFlow will have to render twice for a downstream Time Stretcher or Time Speed to evaluate. This is because Time Speed needs A. FwdVec and B. BackVec to work but OpicalFlow generates A. BackVec and A. FwdVec when it processes.

When pre-generating Optical Flow vectors, consider adding a SmoothMotion tool afterward with smoothing for forward/ backward vectors enabled.
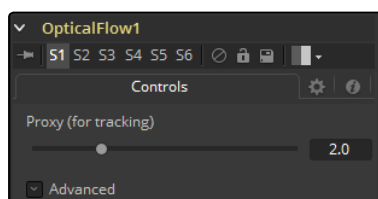
Inputs/Outputs

Input
This is the sequence of images for which you want to compute optical flow.

Output
This is the sequence of images with the optical flow stored in its Vector and BackVector channels.
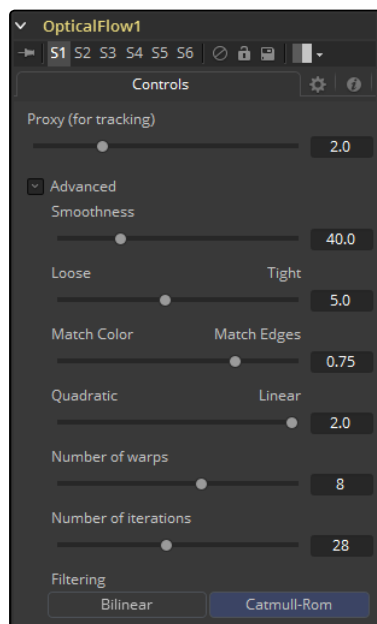
Controls

Proxy (for tracking)

The input images are re-sized down by the proxy scale, and tracked to produce the optical flow. This option is purely to speed up calculation of the optical flow. The computational time is roughly proportional to the number of pixels in the image. This means a proxy scale of 2 will give a 4x speedup and a proxy scale of 3 will give a 9x speedup.

Advanced

The Advanced Control section has parameter controls to tune the OpticalFlow vector calculations. The default settings have been chosen to be the best default values from experimentation with many different shots and should serve as a good standard. In most cases, tweaking of the advanced settings will not be needed.

Smoothness

This controls the Smoothness of the optical flow. Higher smoothness helps deal with noise, while lower smoothness brings out more detail.

Edges

This slider is another control for smoothness but applies smoothing based upon the color channel. It tends to have the effect of determining how edges in the flow follow edges in the color images. When it is set to Loose, the optical flow becomes smoother and tends to overshoot edges. When it is set Tight, details from the color images start to slip into the optical flow, which is not desirable, and edges in the flow more tightly align with the edges in the color images. As a rough guideline, if you are using the disparity to produce a Z-channel for post effects like DoF, then prefer it tight, and if you are using the disparity to do interpolation, you might want to be looser.

In general, if it is too tight, there can be problems with streaked out edges when the optical flow is used for interpolation.

Match Weight

This controls how the matching of neighborhoods in the subsequent image is done. When set to Match Color, large structural color features are matched. When set to Match Edges, small sharp variations in the color are matched. Typically, a good value for this slider is in the [0.7, 0.9] range although on some shots, values closer to 0.0 work well. Setting this option higher tends to improve the matching results in the presence of differences due to smoothly varying shadows or local lighting variations between the left and right images. The user should still do a color match or deflickering on the initial images, if necessary, so they are as similar as possible. This option also helps with local variations like lighting differences due to light passing through a mirror rig.

Mismatch Penalty

This option controls how the penalty for mismatched regions grows as they become more dissimilar. The slider gives the choice between a balance of Quadratic and Linear penalties. Quadratic strongly penalizes large dissimilarities while Linear is more robust to dissimilar matches. Moving this slider toward Quadratic tends to give a disparity with more small random variations in it, while Linear produces smoother more visually pleasing results.

Number of Warps

Turning this option down makes the optical flow computations faster. In particular, the computational time depends linearly upon this option. To understand what this option does, you need to understand that the optical flow algorithm progressively warps one image until it matches with the other image. After some point, convergence is reached and additional warps are just a waste of computational time. The default value in Fusion is set high enough that convergence should always be reached. You can tweak this value to speed up the computations, but it is good to watch what the optical flow is doing at the same time.

Number of Iterations

Turning this option down makes the computations faster. In particular, the computational time depends linearly upon this option. Just like adjusting Number of Warps, at some point adjusting this option higher will give diminishing returns and not produce significantly better results. By default, this value is set to something that should converge for all possible shots and can be tweaked lower fairly often without reducing the disparity's quality.

Filtering

This controls filtering operations used during flow generation. Catmull-Rom filtering will produce better results, but at the same time, turning on Catmull-Rom will increase the computation time steeply.

Repair Frame [REP]

RepairFrame is used for replacing damaged or missing frames or portions of frames with scratches or other temporally transient artifacts.

You can use the Mask input to limit the repairs to certain areas. If your footage varies in color from frame to frame, sometimes the repair can be noticeable because, to fill in the hole, RepairFrame needs to pull color values from adjacent frames. Consider some kind of deflickering, color correction, and/or using a soft edged mask to help reduce these kinds of artifacts.

RepairFrame replaces parts of a frame by examining its two neighboring frames and thus requires three sequential frames as opposed to TimeStretcher/TimeSpeed, which work between two sequential frames to create a new inbetween frame.

Unlike TimeStretcher and TimeSpeed, RepairFrame does not require, nor need, input Vector/BackVectors in order to work. An upstream OpticalFlow is not required.

RepairFrame internally will compute the optical flow it needs. This can make it slow to process. RepairFrame will not pass through, but rather destroy, any aux channels after the computation is done.

See the Optical Flow Tool for control and setting information:

Controls
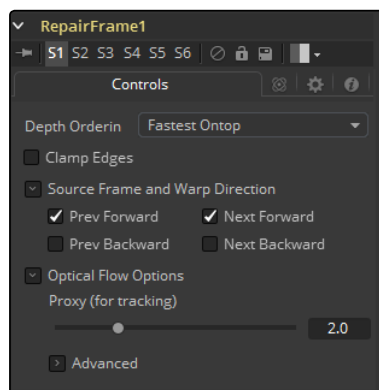
Depth Ordering

The Depth Ordering is used to determine which parts of the image should be rendered on top. This is best explained by an example.

In a locked off camera shot where a car is moving through the frame, the background does not move, so it will produce small or slow vectors, while the car will produce larger or faster vectors.

The depth ordering in this case is Fastest Ontop since the car will draw over the background.

In a shot where the camera pans to follow the car, the background will have faster vectors and the car will have slower vectors, so the Depth ordering method would be Slowest Ontop.

Clamp Edges

Under certain circumstances, this option can remove the transparent gaps that may appear on the edges of interpolated frames. Clamp Edges will cause a stretching artifact near the edges of the frame that is especially visible with objects moving through it or when the camera is moving.

Because of these artifacts, it is a good idea to only use clamp edges to correct small gaps around the edges of an interpolated frame.

Softness

Helps to reduce the stretchy artifacts that might be introduced by Clamp Edges.

If you have more than one of the Source Frame and Warp Direction checkboxes turned on, this can lead to doubling up of the stretching effect near the edges. In this case you'll want to keep the softness rather small at around 0.01. If you only have one checkbox enabled you can use a larger softness at around 0.03).

Source Frame and Warp Direction

This control set allows for the choosing of which frames and which vectors are used to create the inbetween frames. Each method ticked on will be blended into the result.

- → **Prev Forward:** Will take the previous frame and use the Forward vector to interpolate the new frame.

- → **Next Forward:** Will take the next frame in the sequence and use the Forward vector to interpolate the new frame.

- → **Prev Backward:** Will take the previous frame and use the Back Forward vector to interpolate the new frame.

- → **Next Backward:** Will take the next frame in the sequence and use the Back vector to interpolate the new frame.

- → **Advanced:** Please see the Advanced Controls chapter of Optical flow.

Smooth Motion [SM]

This tool takes an image sequence and smooths it using optical flow to look at neighboring frames.

It is important that the input sequence has pre-computed Vector and BackVector channels contained in it, otherwise this tool will print error messages.

Check on the channels you want to temporally smooth. If a channel selected for smoothing is not present, SmoothMotion will not fail nor will it print any error messages.

SmoothMotion was initially designed for smoothing of the Disparity channel, where it helps reduce temporal edge/fringing artifacts.

It can also be used to smooth the Vector and BackVector channels, however do be aware that in various situations this can make the interpolated results worse, especially if there are conflicting motions or objects in the shot that move around erratically, jitter or bounce rapidly.

One thing you can try is using two or more SmoothMotion tools in sequence to get additional smoothing. With one SmoothMotion tool, the previous, current and next frames are examined for a total of 3; with 2 SmoothMotion tools, 5 frames are examined, and with 3 SmoothMotion tools, 7 frames are examined.

Another thing you can try is using 2 SmoothMotion tools, but in the first tool enable the smoothing of the Vector and BackVector channels, and in the second SmoothMotion enable the channels you want to smooth (e.g., Disparity). This way you use the smoothed vector channels to smooth Disparity.

You can also try using the smoothed motion channels to smooth the motion channels.

Controls
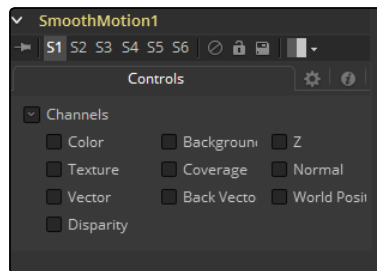
Channel

SmoothMotion can be applied to more than just the RGBA channels. It can also do all of the other aux channel groups in Fusion.

Tween [Tw]

Tween constructs an in between frame by interpolating between two frames using the optical flow. Tween is nearly identical in functionality to TimeSpeed and TimeStretcher. The major difference is that it works on two images that are not serial members of a sequence. As a consequence, it cannot use the Vector or BackVector aux channels stored in the images and it must manually generate the optical flow. There is no need to add an upstream OpticalFlow tool. The generated optical flow is thrown away and not stored back into the output frames.

Since optical flow is based upon color matching, it is a good idea to color correct your images to match ahead of time. Also, if you are having trouble with noisy images, it may also help to remove some of the noise ahead of time.

Tween will destroy any input aux channels. See the Optical Flow Tool for control and setting information.

Inputs/Outputs

InputA

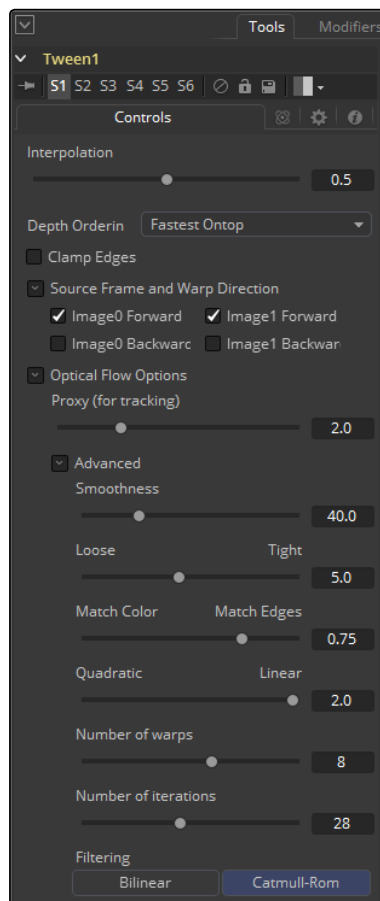This is an image to interpolate from.

InputB

This is an image to interpolate to.

Output

This is the interpolated image.

Controls

Interpolation Parameter

This option determines where the frame we are interpolating is, relative to the two source frames A and B. An Interpolation Parameter of 0.0 will give frame A back, a parameter of 1.0 will give frame B back, and a parameter of 0.5 will give a result that is halfway between A and B.

Depth Ordering

The Depth ordering is used to determine which parts of the image should be rendered on top. This is best explained by an example.

In a locked off camera shot where a car is moving through the frame, the background does not move, so will produce small or slow vectors. The car will produce larger or faster vectors.

The Depth Ordering in this case is Fastest Ontop since the car will draw over the background.

In a shot where the camera pans to follow the car, the background will have faster vectors and the car will have slower vectors, so the Depth Ordering method would be Slowest Ontop.

Clamp Edges

Under certain circumstances, this option can remove the transparent gaps that may appear on the edges of interpolated frames. Clamp Edges will cause a stretching artifact near the edges of the frame that is especially visible with objects moving through it or when the camera is moving.

Because of these artifacts, it is a good idea to only use clamp edges to correct small gaps around the edges of an interpolated frame.

Softness

Helps to reduce the stretchy artifacts that might be introduced by Clamp Edges.

If you have more than one of the Source Frame and Warp Direction checkboxes turned on, this can lead to doubling up of the stretching effect near the edges. In this case you'll want to keep the softness rather small at around 0.01. If you only have one checkbox enabled you can use a larger softness at around 0.03).

Source Frame and Warp Direction

This control set allows for the choosing of which frames and which vectors are used to create the in between frames. Each method ticked on will be blended into the result.

→ Prev Forward: Will take the previous frame and use the Forward vector to interpolate the new frame.

→ Next Forward: Will take the next frame in the sequence and use the Forward vector to interpolate the new frame.

→ Prev Backward: Will take the previous frame and use the Back Forward vector to interpolate the new frame.

→ Next Backward: Will take the next frame in the sequence and use the Back vector to interpolate the new frame.
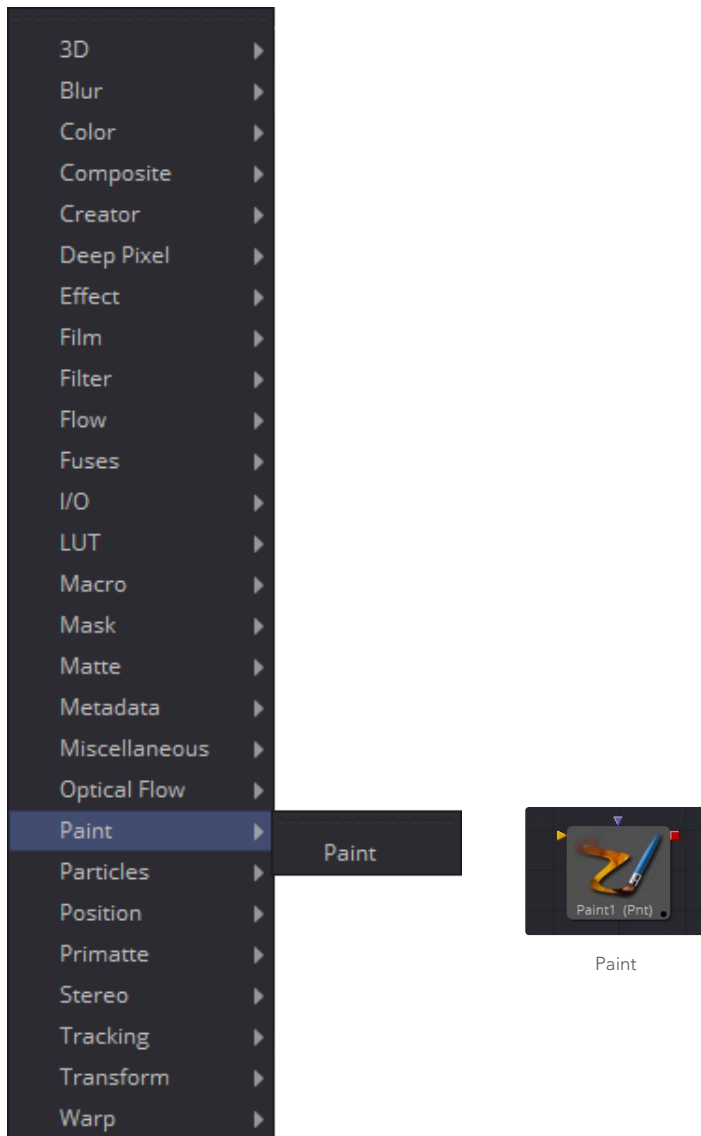
Paint Tool

Paint Tool

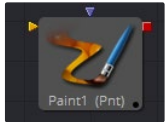# Paint Tool

Paint

Paint

Paint is an extremely flexible, stroke-based system for making changes directly to a series of images. Use the Paint tool for wire and rig removal, image cloning, or to rapidly create custom masks and mattes.

Fusion's paint can even be used to create new images and artistic elements from scratch.

Each Paint tool is made up of a series of brush strokes. These strokes are vector shapes created directly on a view. The type of brush used, the size of the stroke and the effect of the stroke on the image are all user-controllable. A wide range of apply modes and brush types are available.

Brush strokes can be made into editable polylines for fine control. They can be animated to change shape, length and size over time. The opacity and size of a stroke can be affected by velocity and pressure (when used with a supported tablet).

Unlimited undo and redo of paint provides the ability to experiment before committing changes to an image sequence. Paint strokes can be re-ordered, deleted and modified with virtually infinite flexibility.

Controls Tab
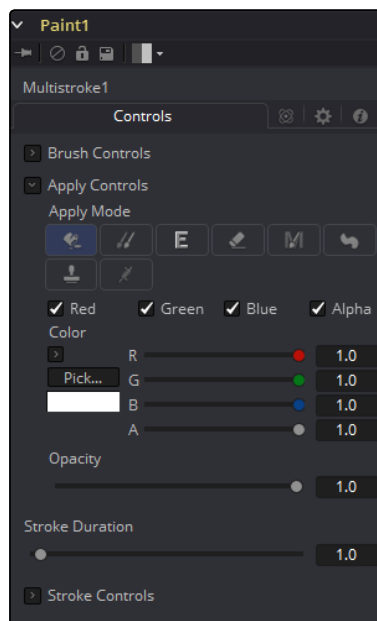
Not all of the controls described here appear in all modes. Certain controls are only useful in a specific Paint mode and are hidden when they are not applicable. Additionally, several of the controls are considered to be self-explanatory; the purpose of a Center control, Angle or Size control should be relatively straightforward to determine.

To reduce complexity, these controls are not all described. For further details on the functionality of the Controls tab, please see the Working with Paint Strokes - Animating Strokes section in this chapter.

Color Space

The Color Space array of buttons is only visible when the current mode is set to Fill. These are used to select the color space when sampling colors around the fill center for inclusion in the fill range.

R, G, B and Alpha

When selected, these checkboxes reflect which color channel is being painted. For example, with R, G and B off and Alpha on, painting will occur on the Alpha channel.

Brush Controls

Brush Shape

→ Soft Brush: The Soft Brush type is a circular brush with soft edges. Modify the size of the brush in the Viewer by holding the Command or Ctrl key down while dragging the mouse.

→ Circular Brush: A Circular Brush is a brush shape with hard edges. Resize this brush interactively.

→ Image Brush: The Image Brush allows images from any tool in the flow, or from a file system, to be used as a brush. See Creating Custom Brushes later in this chapter.

→ Single Pixel Brush: The Single Pixel Brush is perfect for fine detail work, creating a brush exactly one pixel in size. No anti-aliasing is applied to the single pixel brush.

→ Square Brush: A Square Brush is a brush shape with hard edges.

Vary Size

→ Constant: The brush will be a constant size over the stroke.

→ With Pressure: The stroke size will vary with the actual applied pressure.

→ With Velocity: The stroke size will vary with the speed of painting. The faster the stroke, the thinner it is.

Vary Opacity

→ Constant: The Constant brush will be a constant transparency over the entire stroke.

→ With Pressure: The stroke transparency will vary with the applied pressure.

→ With Velocity: The stroke transparency will vary with the speed of painting. The faster the stroke, the more transparent it is.

Softness

Use this control to increase or decrease the Softness of a soft brush.

Image Source

When using the Image Source brush type, select between three possible sources brush images.

Tool

The image source is derived from the output of a tool on the flow. Drag the tool into the Source Tool input to set the source.

Clip

The image source is derived from an image or sequence on disk. Any file supported by Fusion's Loader can be used. Locate the file using the filename Clip browser that appears to set the clip used as a source.

Brush

Images stored in the Fusion > Brushes directory are used as a brush for the Paint tool. Select the brush from the menu that appears.

Apply Controls

Apply Mode

→ Color: The Color Apply Mode paints simple colored strokes on the screen. When used in conjunction with an image brush, it can also be used to tint the brush.

→ Clone: The Clone Apply Mode copies portions of one image into another image, or to clones from the same image using adjustable positions and time offsets. Any image from the flow can be used as the source image.

→ Emboss: The Emboss Apply Mode embosses the portions of the image covered by the brush stroke.

→ Erase: Erase reveals the underlying image through all other strokes, effectively erasing portions of the strokes beneath it with out actually destroying the strokes.

→ Merge: This Apply Mode effectively Merges the brush onto the image. This mode behaves in much the same way as the Color Apply Mode but has no color controls. It is best suited for use with the image brush type.

→ Smear: Smear the image using the direction and strength of the brush stroke as a guide.

→ Stamp: Stamp the brush onto the image, completely ignoring any alpha channel or transparency information. This mode is best suited for applying decals to the target image.

→ Wire: This Wire Removal Mode is used to remove wires, rigging and other small elements in the frame by sampling adjacent pixels and drawing them in toward the stroke.

Stroke Controls

→ **Size:** This control adjusts the Size of the brush when the brush type is set to either soft brush or circle. The diameter of the brush is drawn in the Viewer as a small circle surrounding the mouse pointer. The size can also be adjusted interactively in the Viewer by holding the Command or Ctrl key while dragging the mouse pointer.

→ **Spacing:** The Spacing slider determines the distance between dabs (samples used to draw a straight line along the underlying vector shape that composes a stroke or polyline stroke). Increasing the value of this slider increases the density of the stroke, whereas decreasing the value is likely to cause the stroke to assume the appearance of a dotted line.

→ **Stroke Animation:** The Stroke Animation menu control provides several pre-built animation effects that can be applied to a paint stroke. This menu only appears for Vector strokes.

→ **All Frames:** This default displays the stroke for All Frames of the project where a valid target image is available to the Paint tool.

→ **Limited Duration:** This exists on the number of frames specified by the Duration slider.

→ **Write On:** When Write On is selected, an animation spline will be added to the paint stroke that precisely duplicates the timing of the paint stroke's creation. The stroke will be written on the image exactly as it was drawn. To adjust the timing of the Write On effect, switch to the Spline Editor and use the Time Stretcher mode to adjust the overall length of the animation spline. To smooth or manually adjust the motion, try reducing the points in the animation spline.

→ **Write Off:** Write Off will perform the reverse of write on, drawing the stroke starting from the end and working backward to the start of the stroke.

→ **Write On Then Off:** This mode will apply a Write On and then a Write Off animation mode to the stroke.

→ **Trail:** Selecting the Trail mode will cause both the start and end points of the stroke to be animated simultaneously, offset from each other by the amount specified in the duration control. This has the effect of creating a segment of the stroke that follows the stroke as if it were a path. As with the Write On and Off effects, this will start at the frame that is current when the animation mode is selected. The timing of the animation can be adjusted manually using the Spline or Timeline Editors.

→ **Duration:** Duration sets the duration of each stroke in frames. This control is only present for Multistrokes or when the stroke animation mode is set to Limited Duration. It is most commonly employed for frame-by-frame rotoscoping through a scene.

Each Vector stroke applied to a scene will have a duration in the Timeline that can be trimmed independently from one stroke to the next. The duration can be set to 0.5, which will allow each stroke to last for a single field only when the flow is processing in Fields mode.

→ **Write On and Write Off:** This range slider appears when the Stroke Animation is set to one of the Write On and Write Off methods. The range represents the beginning and end points of the stroke. Drag the low value upward to give the impression that the stroke is being erased, or drag the high value from 0.0 to 1.0 to give the impression that the stroke is being drawn on the screen. This control can be animated to good effect. It works most effectively when automatically animated through the use of the Write On, Write Off modes of the Stroke Animation menu.

→ **Make Editable:** This button only appears for Vector strokes. Clicking on 'Make Editable' turns the current stroke into a polyline spline so that the shape can be adjusted or animated.

Working with Paint Strokes

Strokes Menu
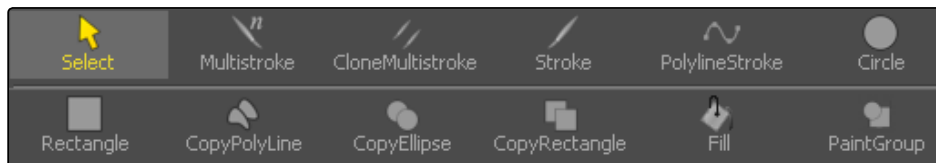
To create a new paint stroke, you can select the type of stroke you want from the menu that is displayed in the view. Please refer to Paint Stroke Modifiers in the Modifiers chapter for further explanation. When a paint stroke is selected or edited, a menu is displayed in the view to select different editing options.

Please refer to Working with Polylines for further explanation.

Types of Paint Strokes
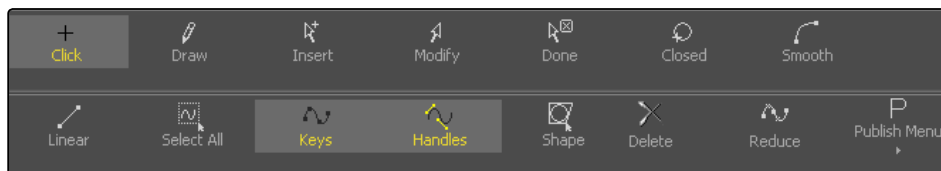
Circle

Creates a circular shape with animatable control over radius and center.

Clone Multistroke

Like the Multistroke described further below, but specifically meant to clone elements from one image to the other.

Copy Polyline

A Polyline area with animatable offset to clone elements from one image to the other.

Copy Rectangle

A rectangular shape area with animatable offset to clone elements from one image to the other.

Fill

Fills an area of the image based on adjustable color values.

Multistroke

Perfect for those 100-strokes-per-frame retouching paint jobs like removing tracking-markers. Much faster than the Stroke, but not editable later on.

Paint Group

Allows easy grouping of multiple strokes with full control over center and size.

Polyline Stroke

A fully editable stroke based on animatable Polylines. Can be connected to existing polylines like Masks or Animation Paths.

Rectangle

Creates a rectangular area.

Stroke

The 'standard' Stroke. Fully animatable and editable. Might become slow if hundreds of strokes are used in an image; for huge amounts of strokes it is better to use MultiStroke.

Particle Tools

24

Particle Tools

Particle Tools

3D ▶	
Blur ▶	
Color ▶	
Composite ▶	
Creator ▶	
Deep Pixel ▶	
Effect ▶	
Film ▶	
Filter ▶	
Flow ▶	
Fuses ▶	
I/O ▶	
LUT ▶	
Macro ▶	
Mask ▶	
Matte ▶	
Metadata ▶	
Miscellaneous ▶	
Optical Flow ▶	
Paint ▶	
Particles ▶	pAvoid
Position ▶	pBounce
Primatte ▶	pChangeStyle
Stereo ▶	pCustom
Tracking ▶	pCustomForce
Transform ▶	pDirectionalForce
Warp ▶	pEmitter
	pFlock
	pFriction
	pGradientForce
	pImageEmitter
	pKill
	pMerge
	pPointForce
	pRender
	pSpawn
	pTangentForce
	pTurbulence
	pVortex

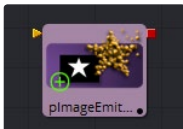| pAvoid	pFlock	pRender
pBounce	pFriction	pSpawn
pChangeStyle	pGradientForce	pTangentForce
pCustom	pImageEmitter	pTurbulence
pCustomForce	pKill	pVortex
pDirectionalForce	pMerge	
pEmitter	pPointForce	
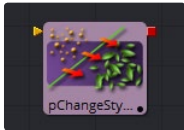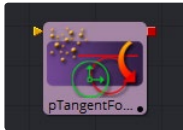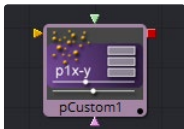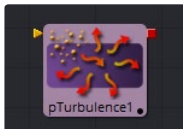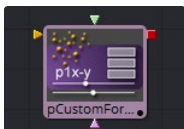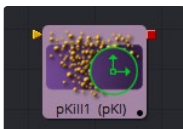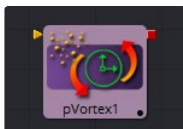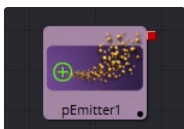
pAvoid [PAv]

The pAvoid tool is used to create a region or area within the image that affected particles will attempt to avoid entering and/or crossing.

It has two primary controls, one that determines the distance from the region a particle should be before it begins to move away from the region, and another to determine how strongly the particle moves away from the region.

A pAvoid tool creates a 'desire' in a particle to move away from a specific region. If the velocity of the particle is stronger than the combined distance and strength of the pAvoid region, the particle's desire to Avoid the region will not overcome its momentum and the particle will cross that region anyway.

Controls Tab
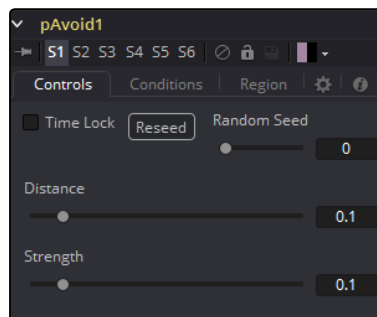
Randomize

The Seed slider and Randomize button are presented whenever a Fusion tool relies on a random result. Two tools with the same seed values will produce the same random results. Click on the Randomize button to randomly select a new seed value, or adjust the slider to manually select a new seed value.

Distance

Determines the distance from the region a particle should be before it begins to move away from the region.

Strength

Determines how strongly the particle moves away from the region. Negative values will make the particles move toward the region instead.

Conditions Tab
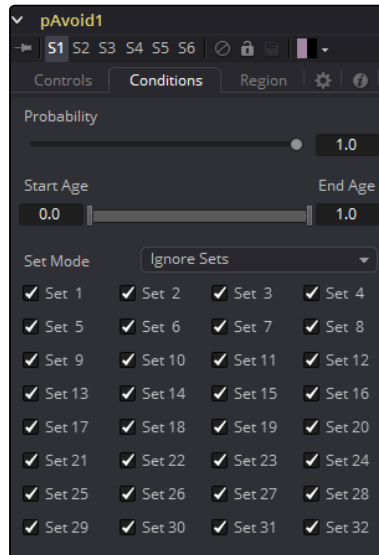
Regions Tab
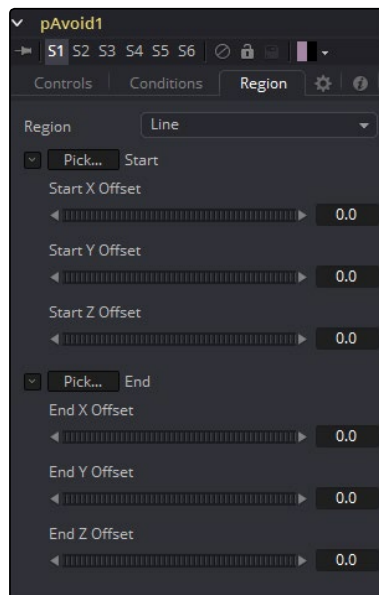
See Particle Common Controls in the Particles chapter.

pBounce [PBN]

The pBounce tool is used to create a region from which affected particles will bounce away when they come into contact with the region. The pBounce tool has three main controls, as described below.

Controls Tab
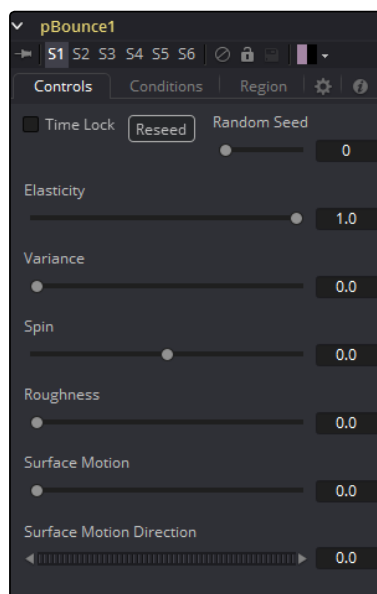
Randomize

The Seed slider and Randomize button are presented whenever a Fusion tool relies on a random result.

Two tools with the same seed values will produce the same random results. Click on the Randomize button to randomly select a new seed value, or adjust the slider to manually select a new seed value.

Elasticity

Elasticity affects the strength of a bounce, or how much velocity the particle will have remaining after impacting upon the Bounce region. A value of 1.0 will cause the particle to possess the same velocity after the bounce as it had entering the bounce. A value of 0.1 will cause the particle to lose 90% of its velocity upon bouncing off of the region.

The range of this control is 0.0 to 1.0 by default, but greater values can be entered manually. This will cause the particles to gain momentum after an impact, rather than lose it. Negative values will be accepted, but do not produce a useful result.

Variance

By default, particles that strike the Bounce region will reflect evenly off the edge of the Bounce region, according to the vector or angle of the region. Increasing the Variance above 0.0 will introduce a degree of variation to that angle of reflection. This can be used to simulate the effect of a rougher surface.

Spin

By default, particles that strike the region will not have their angle or orientation affected in any way. Increasing or decreasing the Spin value will cause the Bounce region to impart a spin to the particle based on the angle of collision, or to modify any existing spin on the particle. Positive values will impart a forward spin and negative values impart a backward spin. The larger the value, the faster the spin applied to the particle will be.

Roughness

This slider varies the bounce off the surface to slightly randomize particle direction.

Surface Motion

This slider makes the bounce surface behave as if it had motion, thus affecting the particles.

Surface Motion Direction

This thumbwheel control sets the angle relative to the bounce surface.

Conditions Tabs
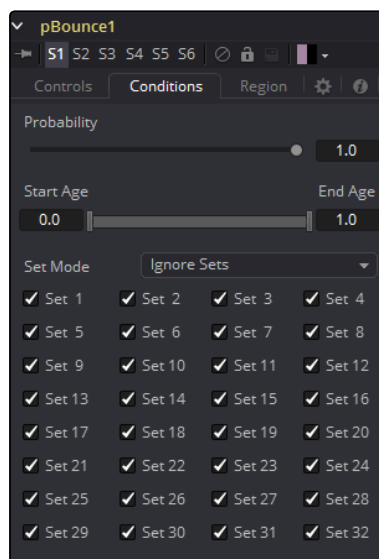
Regions Tab
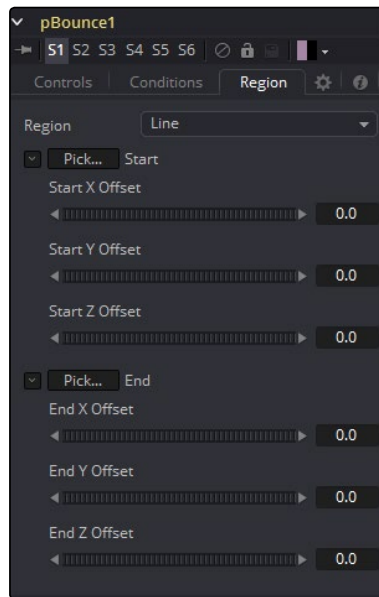
See Particle Common Controls in the Particles chapter.
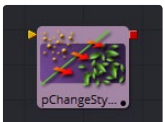
pChangeStyle

The pChangeStyle tool provides a mechanism for changing the appearance or style of particles that interact with a defined region. The primary controls in this tool perfectly mirror those found in the Style tab of the pEmitter tool. Particles that intersect or enter the region defined for this tool will change as described by this tool.

With the possible exception of the pCustom tool, this is the only tool that modifies the appearance of a particle, rather than its motion. It is often used to cause the appearance of particles changing in response to some event, like striking a barrier.

When using the pChangeStyle tool in this fashion, it would be natural to assume that the tool should be placed after the tool causing the event. As an example, consider the creation of a particle system that appears to change its style after bouncing off a pBounce using a line region. In this case, the pChangeStyle tool also uses a line region, positioned identically to the one in the pBounce tool. Placing the pBounce before the pChangeStyle in the flow causes the particles to bounce off the region before the pChangeStyle gets an opportunity to calculate its effect on the particle.

The result is that the particle is no longer intersecting with the pChangeStyle tool's region, and so the style never changes.

As a rule, to create a change in style that appears to be caused by a physical event created by another modifier tool in the flow, the pChangeStyle tool must be placed before that tool for the effect to work properly.

Style Tab
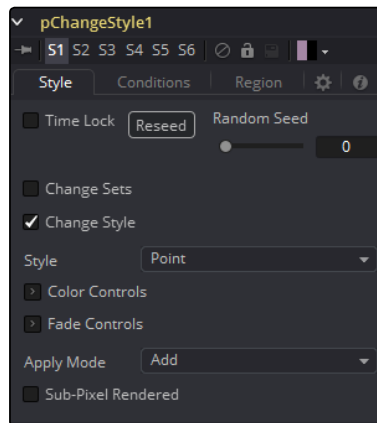
Randomize

The Seed slider and Randomize button are presented whenever a Fusion tool relies on a random result. Two tools with the same seed values will produce the same random results. Click on the Randomize button to randomly select a new seed value, or adjust the slider to manually select a new seed value.

Change Sets

This option allows the user to change the particle's Set to become influenced by other forces than the original particle. See Particle Common Controls in the Particles chapter to learn more about Sets.

Style

This option allows the user to change the particle's Style and thus the look. See Particle Styles in the Particles chapter to learn more about Styles.

Conditions Tab
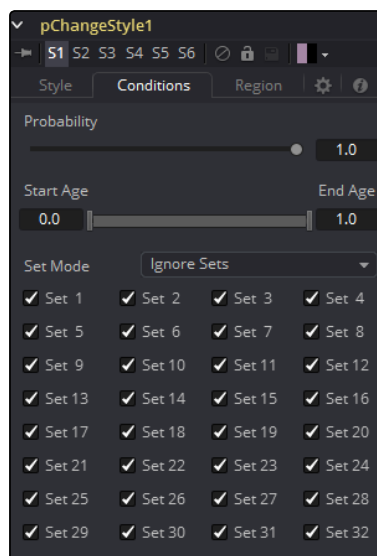
Regions Tab
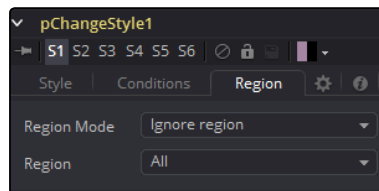
See Particle Common Controls in the Particles chapter.
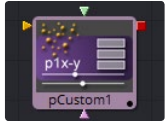
pCustom

The pCustom tool is used to create custom expressions that affect the properties of particles. This tool is almost identical to the Custom tool, except that the calculations affect properties of the particles rather than the properties of a pixel.

Numbers Tab
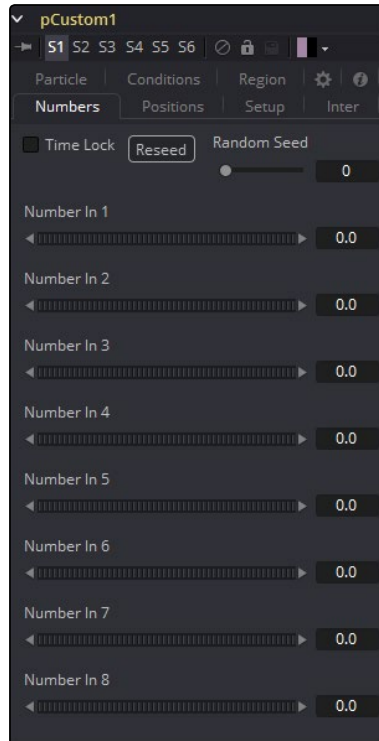
Conditions and Regions Tab

See Particle Common Controls in the Particles chapter.

The following particle properties are exposed to the pCustom control:

px, py, pz	particle position on the x, y, and z axis
vx, vy, vz	particle velocity on the x, y and z axis
rx, ry, rz	particle rotation on the x, y, and z axis
sx, sy, sz	particle spin on the x, y, and z axis
pxi1, pyi1	the 2d position of a particle, corrected for image 1's aspect
pxi2, pyi2	the 2d position of a particle, corrected for image 2's aspect
mass	not currently used by anything
size	the current size of a particle
id	the particle's identifier
r, g, b, a	the particles red, green, blue and alpha color values
rgnhit	this value is 1 if the particle hit the pcustom tools defined region
rgndist	this variable contains the particles distance from the region
condscale	the strength of the region at the particle's position
rgnix, rgniy, rgniz	values representing where on the region the particle hit
rgnnx, rgnny, rgnnz	region surface normal of the particle when it hit the region
w1, h1	image 1 width and height
w2 h2	image 2 width and height
i1, i2, i3, i4	the result of the intermediate calculations 1 through 4
s1, s2, s3, s4	the result of the setup calculations 1 through 4
n1..n8	the values of numeric inputs 1 through 8
p1x, p1y, p1z .. p4x, p4y, p4z	the values of position inputs 1 through 4
time	the current time or frame of the compositions
age	the current age of the particle
lifespan	the lifespan of the current particle

Additional information on the custom class of tools can be found in documentation for the Custom tool.

All of the operators, functions and conditional statements described for that tool apply to pCustom as well, including Pixel-read functions for the two image inputs (e.g., getr1w(x,y), getz2b(x,y), etc.).
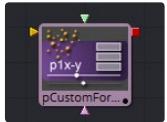
pCustomForce

The Particle Custom Force tool allows you to change the forces applied to a particle system or subset. This tool is quite likely the most complex and the most powerful tool in Fusion. Any user moderately experienced with scripting or C++ programming, should find the structure and terminology used by the Custom Force tool to be familiar.

The forces on a particle within a system can have their positions and rotations affected by forces. The position in XYZ and the Torque, which is the spin of the particle, are controlled by independent custom equations. The Custom Force tool is used to create custom expressions and filters to modify the behavior. In addition to providing three image inputs, this tool will allow for the connection of up to eight numeric inputs and as many as four XY position values from other controls and parameters in the flow.

Conditions Tab
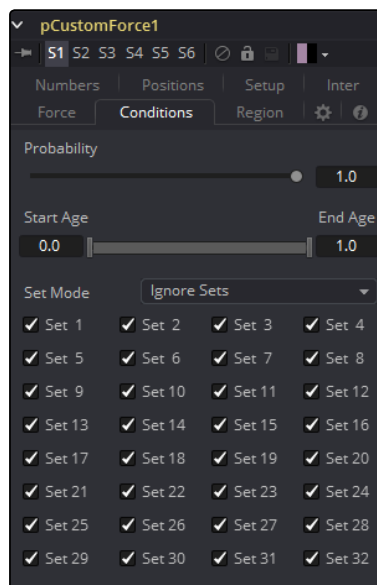
Regions Tab
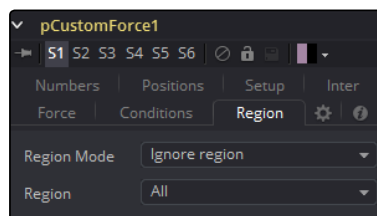
See Particle Common Controls in the Particles chapter.

Setup Tab
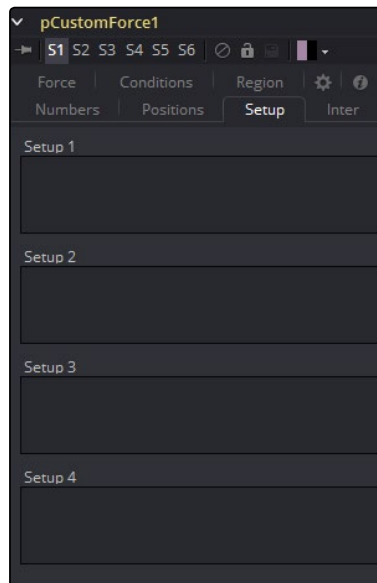
Numbers Tab
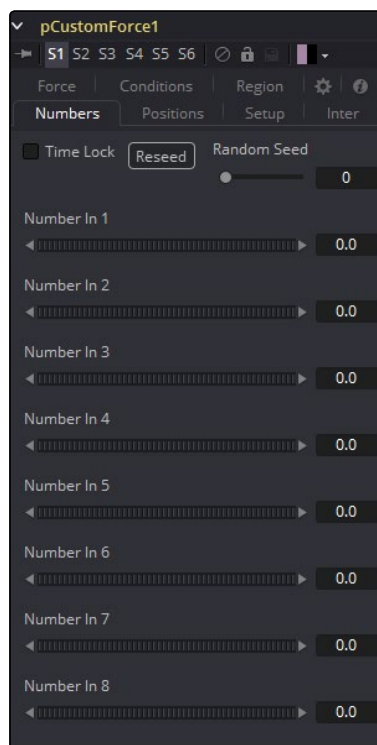
Inter Tab
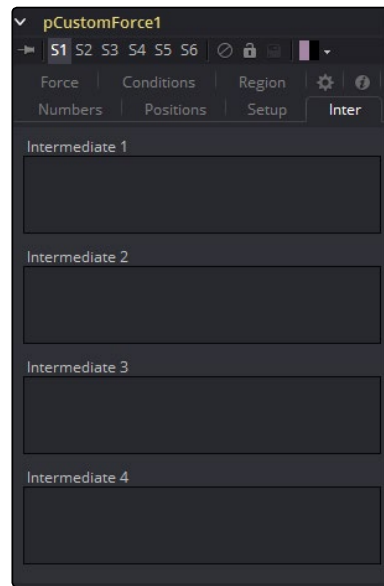
Force & Positions Tab
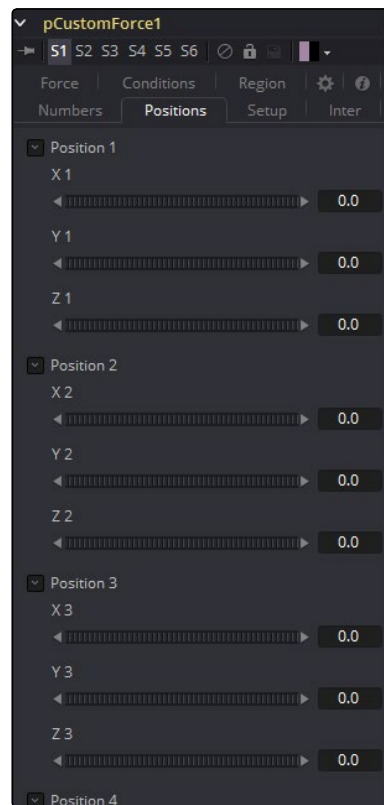
pDirectionalForce

This tool applies a uni-directional force that pulls the affected particles in a specified direction. Its primary controls affect the strength of the force, and the angle of the forces pull along the X, Y and Z axis.

As the most common use of this tool is to simulate gravity, the default direction of the pull is down along the Y axis (-90 degrees) and the default behavior is to ignore regions and affect all particles.

Controls Tab
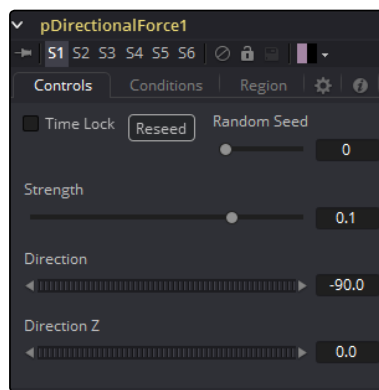
Randomize

The Seed slider and Randomize button are presented whenever a Fusion tool relies on a random result. Two tools with the same seed values will produce the same random results. Click on the Randomize button to select a new seed value randomly, or adjust the slider to select a new seed value manually.

Strength

Determines the power of the force. Positive values will move the Particles in the direction set by the controls, negative values will move the Particles in the opposite direction.

Direction

Determines the direction in X/Y Space.

Direction Z

Determines the direction in Z Space.

Conditions Tab
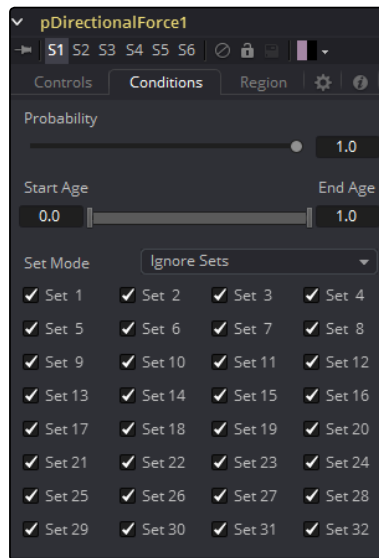
Regions Tab
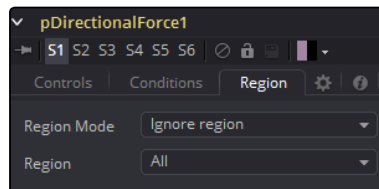
See Particle Common Controls in the Particles chapter.
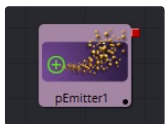
pEmitter

The pEmitter tool is the main source of Particles (pImageEmitter is another) and will usually be the first tool used in any new particle system. This tool contains controls for setting the initial position, orientation and motion of the particles, as well as controls for the visual style of each particle.

Like all other Particle tools (with the exception of the pRender tool), the pEmitter produces a particle set, not a visible image, and therefore cannot be displayed directly on a Viewer. To view the output of a particle system, add a pRender tool after the pEmitter.

Controls Tab

This tab contains settings that affect the physics of the particles emitted by the tool. These settings do not directly affect the appearance of the particles. They modify behavior like velocity, spin, quantity and lifespan instead.
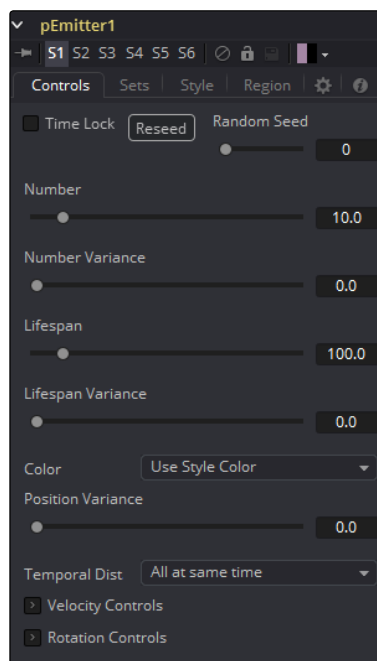
Randomize and Random Seed

The Random Seed slider is used to seed all of the variance and random number generators used by the tool when creating the particle system. Two pEmitter tools with exactly the same settings for all controls and the same random seed will generate exactly the same particle system. Changing the random seed will cause variation between the tools. Click on the Randomize button to automatically set a randomly chosen value for the Random Seed.

Style Tab
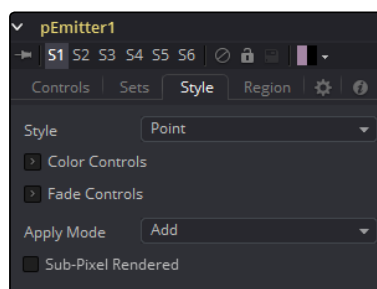
Number

This control is used to set the amount of new particles generated on each frame. A value of 1 would cause one new particle to be generated each frame. By frame 10, there would be a total of 10 particles in existence (unless Particle Lifespan was set to fewer than 10 frames).

Animate this parameter to specify the number of particles generated in total. For example, if only 25 particles in total are desired, animate the control to produce five particles on frame 0-4, then set a key on frame five to generate zero particles for the remainder of the project.

Number Variance

This modifies the amount of particles generated for each frame, as specified by the Number control. For example, if Number is set to 10.0 and Number Variance is set to 2.0, the emitter will produce anywhere from 9-11 particles per frame. If the value of Number Variance is more than twice as large as the value of Number, it is possible that no particles will be generated for a given frame.

Lifespan

This control determines how long a particle will exist before it disappears or 'dies.' The default value of this control is 100 frames, although this can be set to any value. The timing of many other particle controls is relative to the Lifespan of the particle. For example, the size of a particle can be set to increase over the last 80% of its life, using the Size Over Life graph in the Style tab of the pEmitter.

Lifespan Variance

Like Number Variance, the Lifespan Variance control allows the Lifespan of particles produced to be modified. If Particle Lifespan was set to 100 frames and the Lifespan Variance to 20 frames, particles generated by the emitter would have a lifespan of 90-110 frames.

Color Source

This provides the ability to specify from where the color of each particle is derived. The default setting is Use Style Color, which will provide the color from each particle according to the settings in the Style tab of the pEmitter tool.

The alternate setting is Use Color From Region, which overrides the color settings from the Style tab and uses the color of the underlying bitmap region.

The Use Color From Region option only makes sense when the pEmitter region is set to use a bitmap produced by another tool in the composition. Particles generated in a region other than a bitmap region will be rendered as white when the Use Color From Region option is selected.

Position Variance

This control determines whether or not particles can be 'born' outside the boundaries of the pEmitter region. By default, the value is set to zero, which will restrict the creation area for new particles to the exact boundaries of the defined region. Increasing this control's value above 0.0 will allow the particle to be born slightly outside the boundaries of that region. The higher the value, the 'softer' the region's edge will become.

Regions Tab
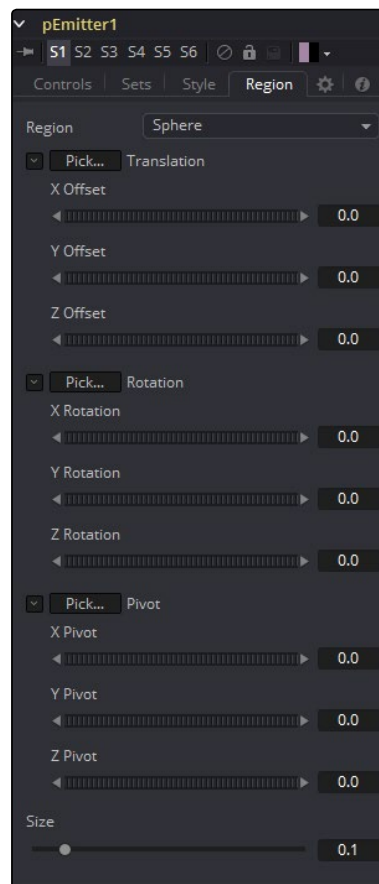
Velocity and Velocity Variance

These determine the initial speed or velocity of new particles. By default, the particle has no velocity and will not move from its point of origin unless acted upon by outside forces. A velocity setting of 10.0 would cause the particle to cross the entire width of the image in one step so a velocity of 1.0 would cause the particle to cross the width of the image over 10 frames.

Velocity Variance modifies the velocity of each particle at birth, in the same manner described in Lifespan Variance and Number Variance above.

Angle and Angle Variance

This determines the angle at which particles with velocity applied will be heading at their birth.

Angle Z and Angle Z Variance

This is as above, except this control determines the angle of the particles along the Z space axis (toward or away from the camera).

Rotation Mode

This menu control provides two options to help determine the orientation of the particles emitted. When the particles are spherical, the effect of this control will be unnoticeable.

Absolute Rotation

The particles will be oriented as specified by the Rotation controls, regardless of velocity and heading.

Rotation Relative To Motion

The particles will be oriented in the same direction as the particle is moving. The Rotation controls can now be used to rotate the particle's orientation away from its heading.

Rotation XYZ and Rotation XYZ Variance

These controls allow for Rotation of the individual particles. This can be particularly useful when dealing with a bitmap particle type, as the incoming bitmap may not be oriented in the desired direction.

Rotation XYZ Variance can be used to randomly vary the rotation by a specified amount around the center of the Rotation XYZ value to avoid having every particle oriented in the exact same direction.

Spin XYZ and Spin Variance

These provide a spin to be applied to each particle at birth. The particles will rotate ,x' degrees each frame, as determined by the value of Spin XYZ.

The Spin XYZ variances will vary the amount of rotation applied to each frame in the manner described by Number Variance and Lifespan Variance documented above.

Sets Tab

This tab contains settings that affect the physics of the particles emitted by the tool. These settings do not directly affect the appearance of the particles. They modify behavior like velocity, spin, quantity and lifespan instead.
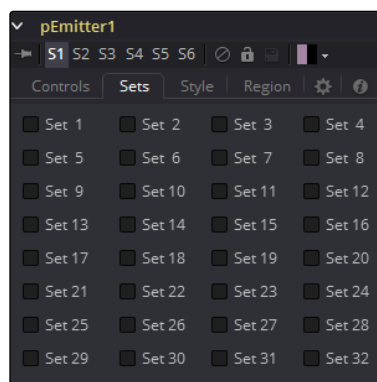
pFlock

Flocking is a mechanism that can be used to simulate the behavior of organic systems, such as a flock of birds or a colony of ants. Its use can make an otherwise mindless particle system appear to be motivated, or acting under the direction of intelligence.

The pFlock tool works through two basic principles. Each particle attempts to stay close to other particles and each particle attempts to maintain a minimum distance from other particles. The strength of these desires produces the seemingly motivated behavior perceived by the viewer.

Controls Tab
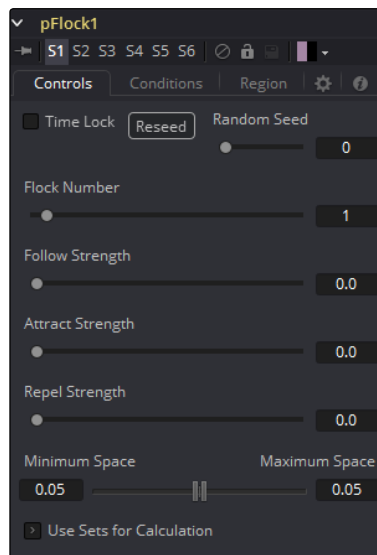
Randomize

The Seed slider and Randomize button are presented whenever a Fusion tool relies on a random result. Two tools with the same seed values will produce the same random results. Click on the Randomize button to randomly select a new seed value, or adjust the slider to manually select a new seed value.

Flock Number

The value of this control represents the number of other particles that the affected particle will attempt to follow. The higher the value, the more visible `clumping' will appear to be in the particle system and the larger the groups of particles will appear to be.

Follow Strength

This value represents the strength of each particle's desire to follow other particles. Higher values will cause the particle to appear to expend more energy and effort to follow other particles. Lower values increase the likelihood that a given particle will break away from the pack.

Attract Strength

This value represents the strength of attraction between particles. When a particle moves farther from other particles than the Maximum Space defined in the pFlock tool, it will attempt to move closer to other particles. Higher values cause the particle to maintain its spacing energetically, resolving conflicts in spacing more rapidly.

Repel Strength

This value represents the force applied to particles that get closer together than the distance defined by the Minimum Space control of the pFlock tool. Higher values will cause particles to move away from neighboring particles more rapidly, shooting away from the pack.

Minimum/Maximum Space

This range control represents the distance each particle attempts to maintain between it and other particles. Particles will attempt to get no closer or farther than the space defined by the Minimum/Maximum values of this range control. Smaller ranges will give the appearance of more organized motion. Larger ranges will be perceived as disorganized and chaotic.

Conditions Tab
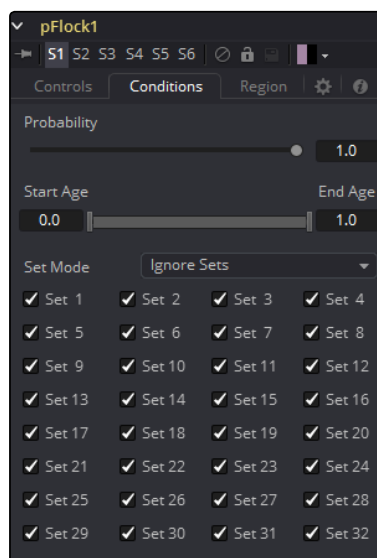
Regions Tab
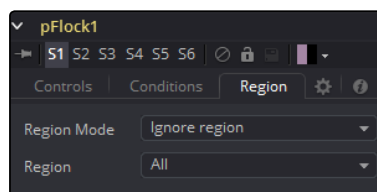
See Particle Common Controls in the Particles chapter.
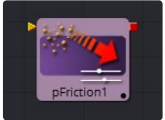
pFriction

The pFriction tool applies resistance to the motion of a particle, slowing the particle's motion through a defined region. This tool produces two types of Friction. One type reduces the Velocity of any particle intersecting/crossing the defined region, and one reduces or eliminates spin and rotation.

Controls Tab
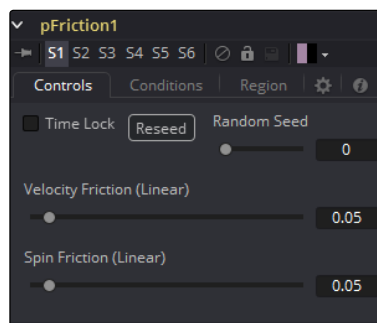
Randomize

The Seed slider and Randomize button are presented whenever a Fusion tool relies on a random result. Two tools with the same seed values will produce the same random results. Click on the Randomize button to randomly select a new seed value, or adjust the slider to manually select a new seed value.

Velocity Friction

This value represents the Friction force applied to the particle's Velocity. The larger the value, the greater the Friction, thus slowing down the particle.

Spin Friction

This value represents the Friction force applied to the particle's Rotation or Spin. The larger the value, the greater the friction, thus slowing down the rotation of the particle.

Conditions Tab
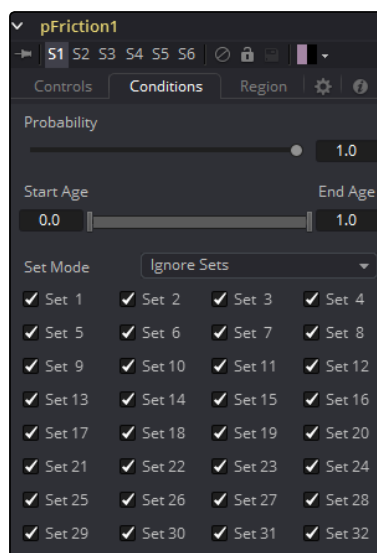
Regions Tab
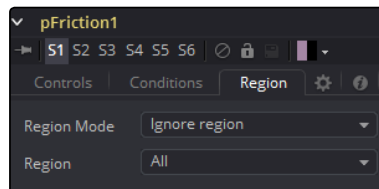
See Particle Common Controls in the Particles chapter.
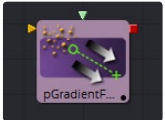
pGradientForce

The Gradient Force control accepts two inputs, one from a particle system and one from a bitmap image. The particles are affected by a force generated by the gradients in the alpha values of the input image. Particles will accelerate along the gradient, moving from white to black (high values to low).

This tool can be used to give particles the appearance of moving downhill, or of following the contour of a provided shape.

Controls Tab
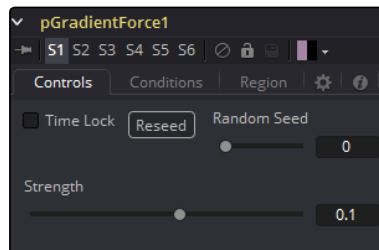
Randomize

The Seed slider and Randomize button are presented whenever a Fusion tool relies on a random result.

Two tools with the same seed values will produce the same random results. Click on the Randomize button to randomly select a new seed value, or adjust the slider to manually select a new seed value.

Strength

Gradient Force has only one specific control, it affects the strength of the force and acceleration applied to the particles. Negative values on this control will cause the Gradient Force to be applied from black to white (low values to high values).

Conditions Tab
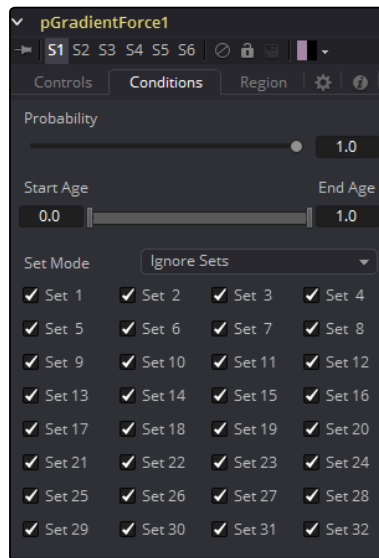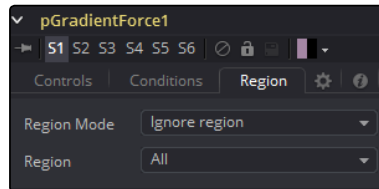
Regions Tab

See Particle Common Controls in the Particles chapter.
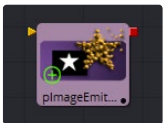
pImageEmitter

The pImageEmitter tool takes an input image and treats each pixel of the image as if it were a particle. The main differences between the pImageEmitter and the normal pEmitter is that instead of emitting particles randomly within a given region, this tool emits pixels in a regular 2D grid with colors based on the input image.

Sets Tab
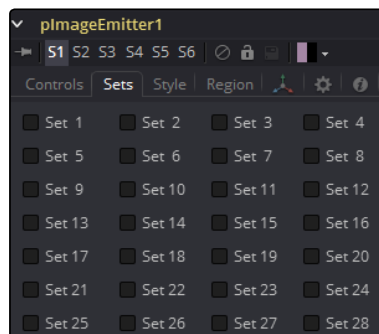
Controls Tab

The great majority of controls in this tool are identical to those found in the pEmitter, and those controls are documented there. Below are the descriptions of the controls unique to the pImageEmitter tool.
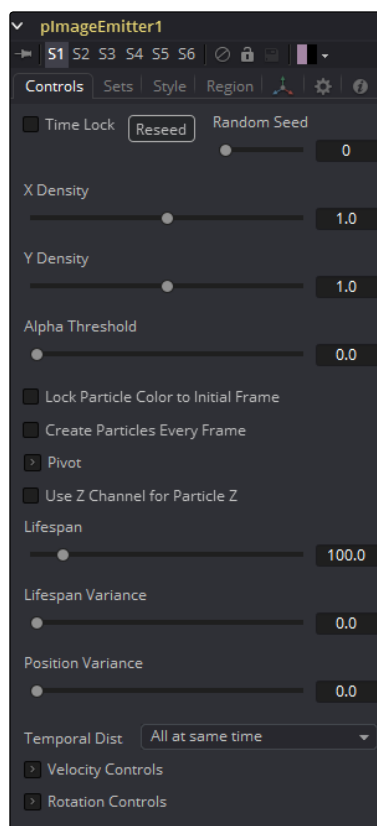
X and Y Density

The X and Y Density sliders are used to set the mapping of particles to pixels for each axis. They control the density of the sampling grid. A value of 1.0 for either slider indicates 1 sample per pixel. Smaller values will produce a looser, more pointillistic distribution of particles, while values above 1.0 will create multiple particles per pixel in the image.

Alpha Threshold

The Alpha Threshold is used for limiting particle generation so that pixels with semi-transparent alpha values will not produce particles. This can be used to harden the edges of an otherwise soft alpha channel. The higher the threshold value, the more opaque a pixel has to be before it will generate a particle. Note that the default threshold of 0.0 will create particles for every pixel, regardless of alpha, though many may be transparent and invisible.

Lock Particle Color to Initial Frame

Select this checkbox to force the particles to keep the color with which they were born throughout the life of the particle. If this is off, and the input image changes on successive frames, the particles will also change color to match the image. This allows video playback on a grid of particles.

Create Particles Every Frame

Enabling this creates a whole new set of particles every frame, instead of just one set on the frame. This can lead to very large particle systems, but allows some interesting effects, for example, if the particles are given some initial velocity or if emitting from an animated source. Try a small velocity, Angle Z of -90 and a seething Fast Noise as a source, to get smoothly-varying clouds of particles that you could fly through. Note that if this checkbox is left off, only one set of particles is ever created, and thus animating any of the emitter's other controls will have no effect.

X/Y/Z Pivot

These controls allow you to position the grid of emitted particles.
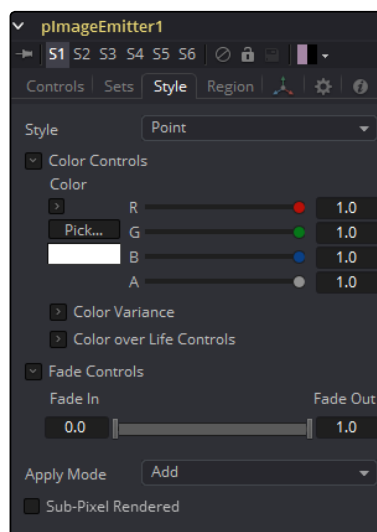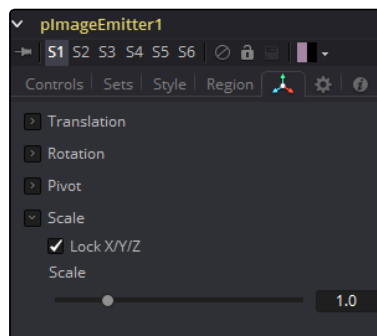
Use Z Channel for Particle Z

If the input image used to generate the particles has a Z depth channel, that channel can be used to determine the initial position of the particle in Z space. This can have an interesting hollow shell effect when used in conjunction with camera rotation in the pRender tool.

Regions Tab
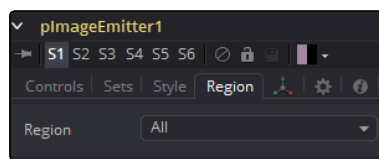
See Particle Common Controls in the Particles chapter.

Notes

Pixels with a black (transparent) alpha channel will still generate invisible particles, unless you raise the Alpha Threshold above 0.0. This can slow down rendering significantly.

An Alpha Threshold value of 1/255 = 0,004 is good for eliminating all fully-transparent pixels.

The pixels are emitted in a fixed-size 2D grid on the XY plane, centered on the Pivot position. Changing the Region from the default of All allows you to restrict particle creation to more limited areas. If you need to change the size of this grid, use a Transform 3D tool after the pRender.

Remember that the various emitter controls apply only to particles when they are emitted. That is, they set the initial state of the particle, and do not affect it for the rest of its lifespan. Since pImageEmitter (by default) emits particles only on the first frame, animating these controls will have no effect. However, if the Create Particles Every Frame checkbox is turned on, new particles will be emitted each frame, and will use the specified initial settings for that frame.
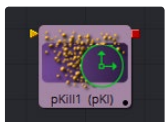
pKill

The great majority of controls in this tool are identical to those found in the pEmitter, and those controls are documented there. Below are the descriptions of the controls unique to the pImageEmitter tool.

The Kill tool is used to destroy (kill) any particle that crosses or intersects its region. It has no specific controls, as it has only one possible affect on a particle. The controls found in the Region tab are normally used to limit this tool, by restricting the effect to particles which fall within a certain region, age, set, or by reducing the probability of the tool applying to a given particle.

Conditions Tab
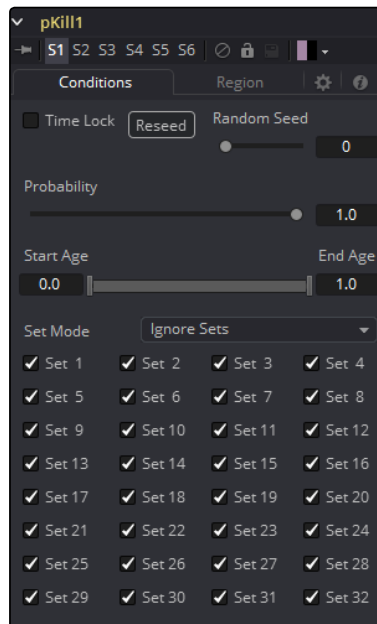
Regions Tab
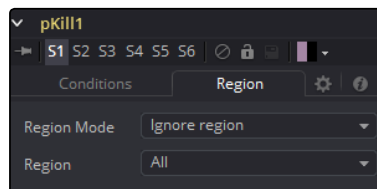
See Particle Common Controls in the Particles chapter.

pMerge

This tool has no controls whatsoever. It serves to combine particles from two streams. Any tools downstream of the Particle Merge tool will treat the two streams as one.

The combined particles will preserve any sets assigned to them when they were created, making it possible for tools downstream of the pMerge to isolate specific particles when necessary.

Control Tab
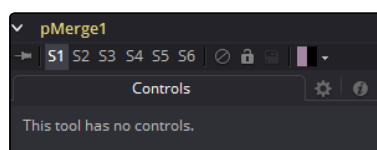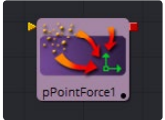
pPointForce

This tool applies a force to the particles that emanates from a single point in 3D space. The pPointForce can either attract or repel particles within its sphere of influence. There are four controls specific to the pPointForce tool.

Control Tab
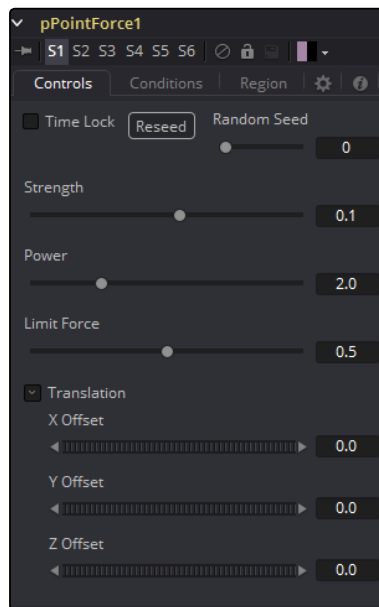
Randomize

The Seed slider and Randomize button are presented whenever a Fusion tool relies on a random result. Two tools with the same seed values will produce the same random results. Click on the Randomize button to randomly select a new seed value, or adjust the slider to manually select a new seed value.

Strength

This parameter sets the Strength of the force emitted by the tool. Positive values represent attractive forces. Negative values represent repellent forces.

Power

This determines the degree to which the Strength of the force falls off over distance. A value of zero causes there to be no falloff of strength. Higher values will impose an ever-sharper falloff in strength of the force with distance.

Limit Force

The Limit Force control is used to counter-balance potential problems with temporal sub-sampling. Because the position of a particle is only sampled once a frame (unless sub-sampling is increased in the pRender tool), it is possible that a particle can overshoot the Point Force's position and end up getting thrown off in the opposite direction. Increasing the value of this control reduces the likelihood that this will happen.

X, Y, Z Center Position

These controls are used to represent the X, Y, and Z coordinates of the point force in 3D space.

Conditions Tab
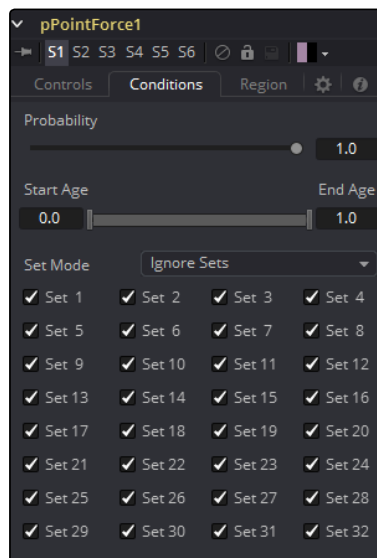
Regions Tab
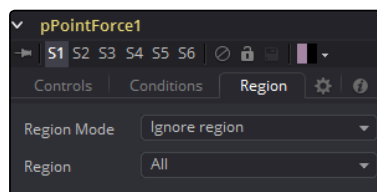
See Particle Common Controls in the Particles chapter.
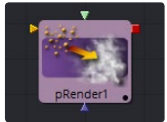
pRender [PRN]

The pRender tool converts the particle system to either an image or geometry. The default is a 3D particle system, which must be connected to a Renderer 3D to produce an image. This allows the particles to be integrated with other elements in a 3D scene before they are rendered.

Control Tab
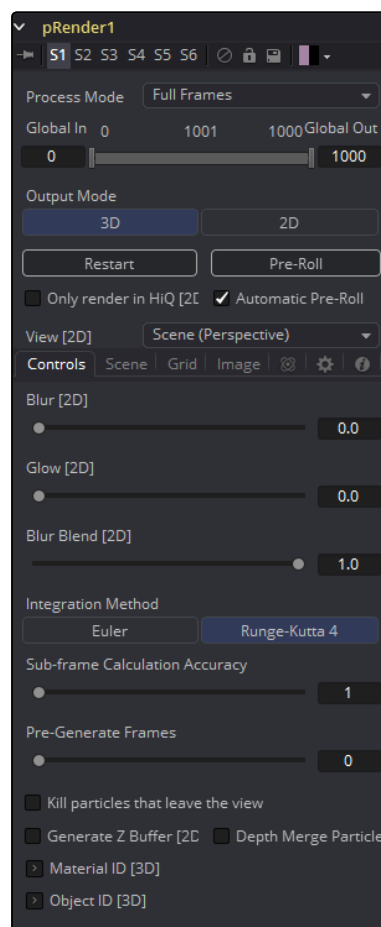
Output Mode (2D/3D)

While the pRender defaults to 3D output, it can be made to directly render a 2D image instead, as with DF4. This is done with the 3D and 2D buttons on the Output Mode control. If the pRender is not connected to a 3D-only or 2D-only tool, you can also switch it by selecting View > 2D Viewer from the display view's context menu.

In 3D mode, the only controls in the pRender tool that have any affect at all are Restart, Pre-roll and Automatic Pre-Roll, Sub-Frame Calculation Accuracy and Pre-Generate frames. The remaining controls affect 2D particle renders only. The pRender tool also has a Camera input on the flow that allows connection of a 3D}} /Camera 3D |Camera 3D tool. This can be used in both 2D and 3D modes to allow control of the viewpoint used to render an output image.

Render and the Display Views

When the pRender tool is selected in a flow, all of the onscreen controls from particle tools connected to it are presented in the display views. This provides a fast, easy-to-modify overview of the forces applied to the particle system as a whole.

Pre-Roll Options

Particle tools generally need to know the position of each particle on the last frame before they can calculate the affect of the forces applied to them on the current frame. This makes changing current time manually by anything but single frame intervals likely to produce an inaccurate image.

The controls here are used to help accommodate this by providing methods of calculating the intervening frames.

Restart

This control also works in 3D. Clicking on the Restart button will restart the particle system at the current frame, removing any particles created up to that point and starting the particle system from scratch at the current frame.

Pre-Roll

This control also works in 3D. Clicking on this button will cause the particle system to recalculate, starting from the beginning of the render range up to the current frame. It will not render the image produced. It will only calculate the position of each particle. This provides a relatively quick mechanism to ensure that the particles displayed in the views are correctly positioned.

If the pRender tool is displayed when the Pre-Roll button is selected, the progress of the pre-roll is shown in the display view, with each particle shown as point style only.

Automatic Pre-Roll

Selecting the Automatic Pre-Roll checkbox causes the particle system to automatically pre-roll the particles to the current frame whenever the current frame changes. This prevents the need to manually select the Pre-Roll button whenever advancing through time in jumps larger than a single frame. The progress of the particle system during an Automatic Pre-Roll is not displayed to the views, to prevent distracting visual disruptions.

About Pre-Roll

Pre-Roll is necessary because the state of a particle system is completely dependent on the last known position of the particles. If the current time were changed to a frame where the last frame particle state is unknown, the display of the particle is calculated on the last known position, producing inaccurate results.

To demonstrate, add a pEmitter and pRender tool to the composition. View the pEmitter in one of the display views. Right-click in the display view and select Views > 2D Viewer from the context menu.

Set the Velocity of the particles to 0.1. Place the pEmitter on the left edge of the screen and set the Current Frame to 0. Set a Render Range from 0-100 and press the Play button. Observe how the particle system behaves.

Stop the playback and return the current time to frame 0. Make sure that the Automatic Pre-Roll option is off in the pRender tool. Now try jumping from frame 0 to 10, then to frame 60 and 90. Do not pass through the frames in between. Use the current time edit control or click in the ruler directly to jump straight to the frame.

See how the particle system only adds to the particles it has already created and does not try to create the particles that would have been emitted in the intervening frames. Try selecting the Pre-Roll button in the Pre-Render tool. Now the particle system state is represented correctly.

For simple, fast rendering particle systems, it is recommended to leave the Automatic Pre-Roll option on. For slower particle systems with long time ranges, it may be desirable to only Pre-Roll manually, as required.

Only Render in Hi-Q

Selecting this checkbox causes the style of the particles to be over-ridden when the Hi-Q checkbox is de-selected, producing only fast rendering Point style particles. This is useful when working with a large quantity of slow Image-based or Blob-style particles. To see the particles as they would appear in a final render, simply enable the Hi-Q checkbox.

View

This drop-down list provides options to determine the position of the camera view in a 3D particle system. The default option of Scene (Perspective) will render the particle system from the perspective of a virtual camera, the position of which can be modified using the controls in the Scene tab. The other options provide orthographic views of the front, top and side of the particle system.

It is important to realize that the position of the onscreen controls for particle tools is unaffected by this control. In 2D mode the onscreen controls are always drawn as if the display view were showing the front orthographic view. (3D mode gets the position of controls right at all times.)

The View setting is ignored if a Camera 3D tool is connected to the pRender tool's Camera input on the Flow, or if the pRender is in 3D mode.

Output Mode

Blur, Glow and Blur Blend

These sliders apply a Gaussian blur, glows and blur blending to the image as it is rendered, which can be used to soften the particles and blend them together. The end result is no different than adding a Blur after the pRender tool in the flow. For 2D particles only.

Sub Frame Calculation Accuracy

This determines the number of sub-samples taken between frames when calculating the particle system. Higher values will increase the accuracy of the calculation but also increase the amount of time taken to render the particle system.

Pre-Generate Frames

This control is used to cause the particle system to pre-generate a set number of frames before its first valid frame. This is used to give a particle system an initial state from which to start.

A good example of when this might be useful is in a shot where particles are used to create the smoke rising from a chimney. Pre-Generate Frames would be set to a number high enough to ensure that the smoke is already present in the scene before the render begins, rather than having it just starting to emerge from the emitter for the first few frames.

Kill Particles that Leave the View

Selecting this checkbox control will automatically destroy any particles that leave the visible boundaries of the image. This can help to speed render times. Particles destroyed in this fashion will never return, regardless of any external forces acting upon them.

Generate Z Buffer

Selecting this checkbox will cause the pRender tool to produce a Z Buffer channel in the image. The depth of each particle is represented in the Z Buffer. This channel can then be used for additional depth operations like Depth Blur, Depth Fog, and Downstream Z Merging.

Enabling this option is likely to increase the render times for the particle system dramatically.

Depth Merge Particles

Enabling this option will cause the particles to be merged together using Depth Merge techniques, rather than layer-based techniques.

Scene Tab
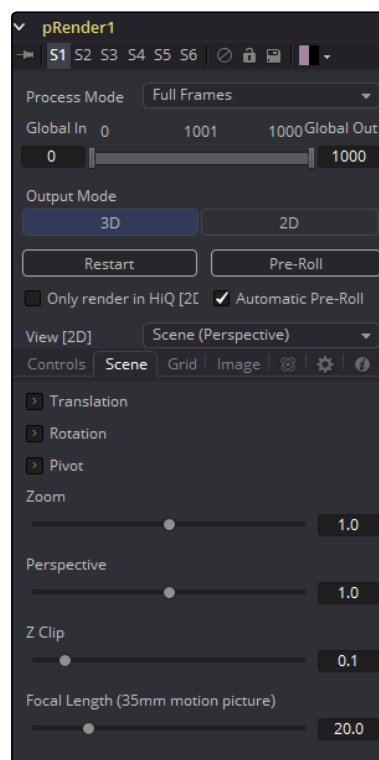
Z Clip

The Z Clip control is used to set a clipping plane in front of the camera. Particles that cross this plane are clipped, preventing them from impacting on the virtual lens of the camera and dominating the scene.

Grid Tab

None of the controls in this tab have any effect on 3D particles.

The Grid is a helpful, non-rendering display guide used to orient the 2D particles in 3D space. The grid is never seen in renders, just like a center crosshair is never seen in a render. The width, depth, number of lines and grid color can be set using the controls found in this tab. These controls cannot be animated.
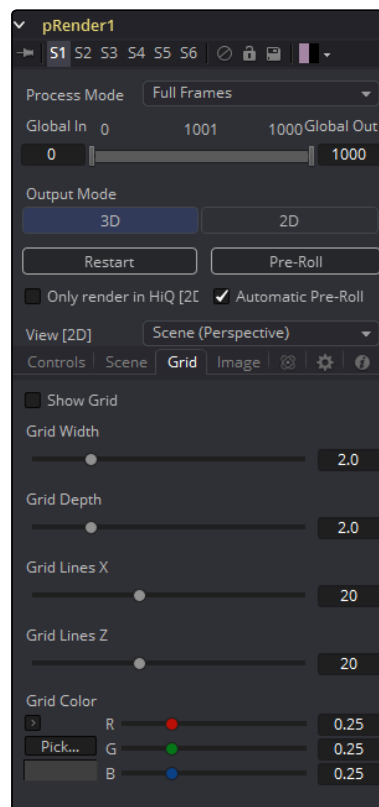
Image Tab

The controls in the Image tab of this tool determine the width, height and aspect of the image. Refer to the Creator Common Controls page for details on the use of these controls.
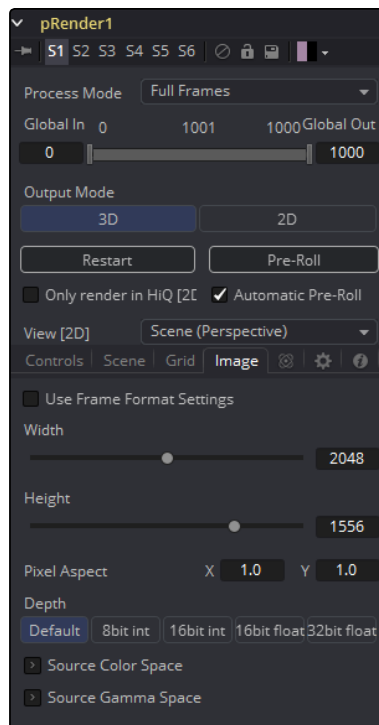
Motion Blur

As with other 2D tools in Fusion, Motion Blur is enabled from within the Fusion tab. You may set Quality, Shutter Angle, Sample Center and Bias, and Blur will be applied to all moving particles.

Note: Motion Blur on 3D mode particles (rendered with a Renderer 3D) also requires that identical motion blur settings are applied to the Renderer 3D tool.
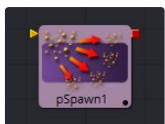
pSpawn [pSp]

The pSpawn tool makes each affected particle act as an emitter that can produce one or more particles of its own. The original particle continues until the end of its own lifespan, and each of the particles it emits becomes wholly independent with a lifespan and properties of its own.

As long as a particle falls under the effect of the pSpawn tool, it will continue to generate particles. It is important to restrict the effect of the tool with limiters like Start and End Age, Probability, Sets and Regions, and by animating the parameters of the emitter so that the tool is operative only when required.

Control Tab

The pSpawn tool has a large number of controls, most of which exactly duplicate those found within the pEmitter tool. There are a few controls that are unique to the pSpawn tool, and their effects are described below.
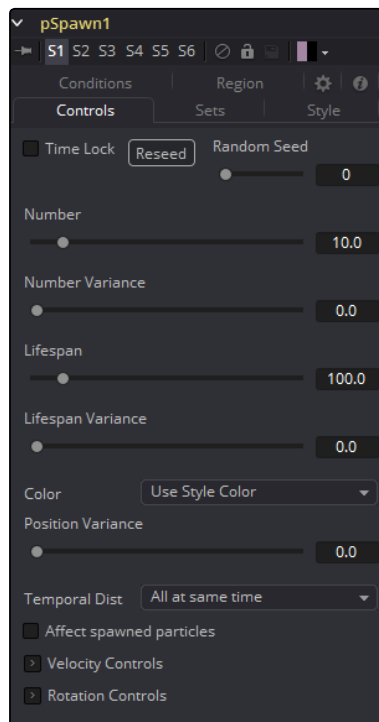
Affect Spawned Particles

Selecting this checkbox causes particles created by spawning to also become affected by the Spawn tool on subsequent frames. This can exponentially increase the number of particles in the system, driving render times up to an unreasonable degree. Use this checkbox cautiously.

Velocity Transfer

This control determines how much velocity of the source particle is transferred to the particles it spawns. The default value of 1.0 causes each new particle to adopt 100 percent of the velocity and direction from its source particle. Lower values will transfer less of the original motion to the new particle.

Regions Tab
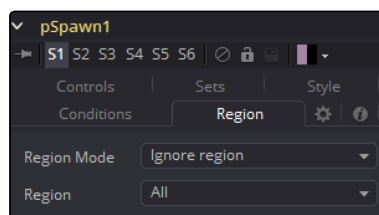
See Particle Common Controls in the Particles chapter.

pTangentForce [PTF]

This tool is used to apply a tangential force to the particles, a force that is applied perpendicularly to the vector between the pTangentForce's region and the particle it is affecting.

The controls for this tool are used to position the offset in 3D space and to determine the strength of the tangential force along each axis independently.

Control Tab
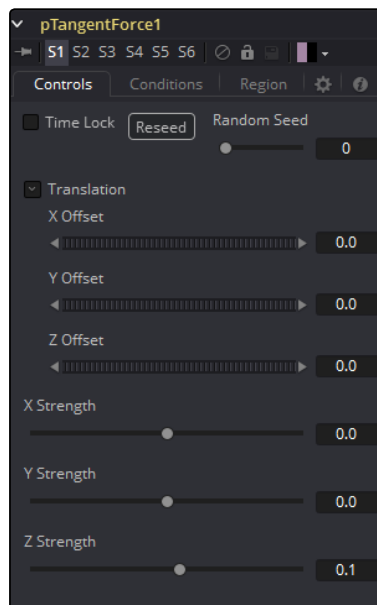
Randomize

The Seed slider and Randomize button are presented whenever a Fusion tool relies on a random result.

Two tools with the same seed values will produce the same random results. Click on the Randomize button to randomly select a new seed value, or adjust the slider to manually select a new seed value.

X, Y, Z Center Position

These controls are used to represent the X, Y, and Z coordinates of the Tangent force in 3D space.

X, Y, Z Center Strength

These controls are used to determine the Strength of the Tangent force in 3D space.
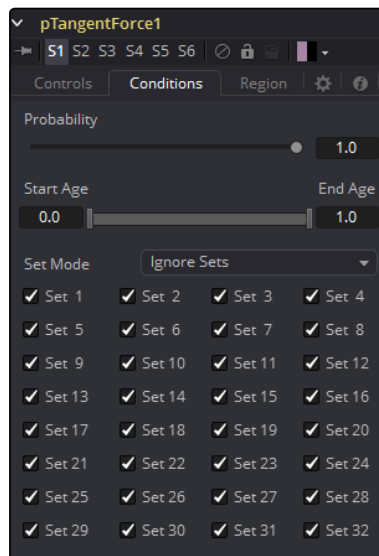
Conditions Tab

Regions Tab
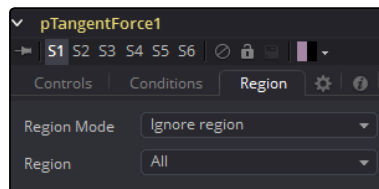
See Particle Common Controls in the Particles chapter.
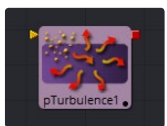
pTurbulence [PTʀ]

The pTurbulence tool imposes a frequency-based chaos on the position of each particle, causing the motion to become unpredictable and uneven. The controls for this tool affect the strength and density of the Turbulence along each axis.

Control Tab
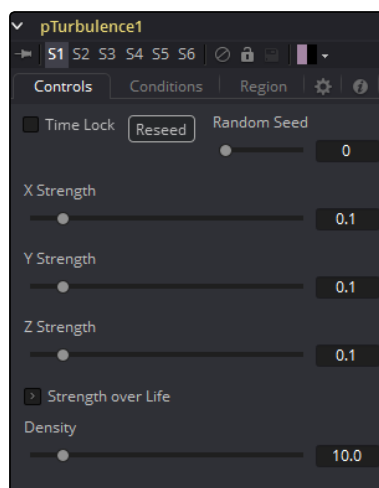
Randomize

The Seed slider and Randomize button are presented whenever a Fusion tool relies on a random result. Two tools with the same seed values will produce the same random results. Click on the Randomize button to randomly select a new seed value, or adjust the slider to manually select a new seed value.

X, Y and Z Strength

The Strength control affects the amount of chaotic motion imparted to particles.

Strength Over Life

This LUT control can be used to control the amount of turbulence applied to a particle according to its age. For example, a fire particle may originally have very little turbulence applied at the start of its life, and as it ages, the turbulence increases.

Density

Use this control to adjust the density of the turbulence. Higher values will produce finer variations in the turbulence produced.

Conditions Tab
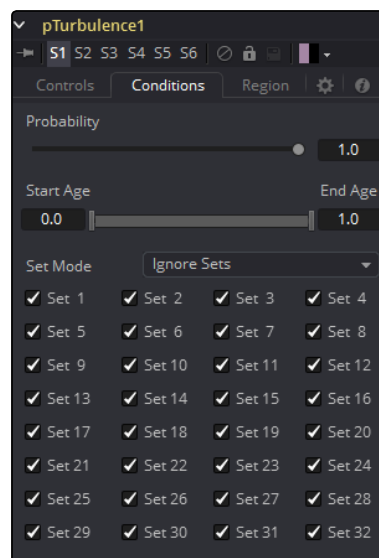
Regions Tab
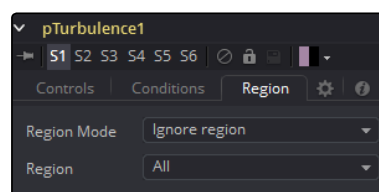
See Particle Common Controls in the Particles chapter.
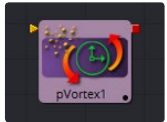
pVortex [PVT]

The pVortex tool applies a rotational force to each particle, causing them to be drawn toward the source of the Vortex. In addition to the Common Particle Controls, the pVortex tool also has the following controls.

Control Tab
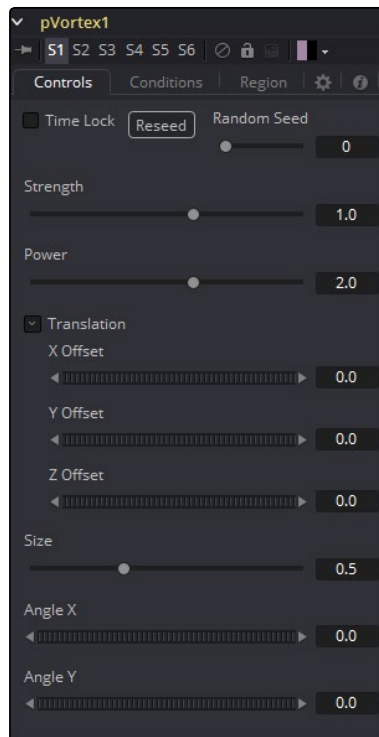
Randomize

The Seed slider and Randomize button are presented whenever a Fusion tool relies on a random result. Two tools with the same seed values will produce the same random results. Click on the Randomize button to randomly select a new seed value, or adjust the slider to manually select a new seed value.

Strength

This control determines the Strength of the Vortex Force applied to each particle.

Power

This control determines the degree to which the Strength of the Vortex Force falls off with distance.

X, Y, and Z Offset

Use these sliders to set the amount by which the vortex Offsets the affected particles.

Size

Used to set the Size of the vortex force.

Angle X and Y

These sliders control the amount of rotational force applied by the Vortex along the X and Y axis.

Conditions Tab
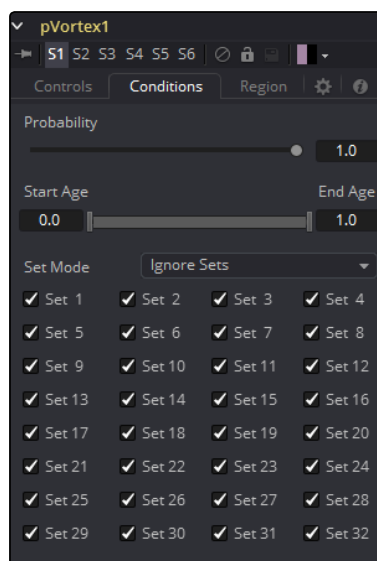
Regions Tab
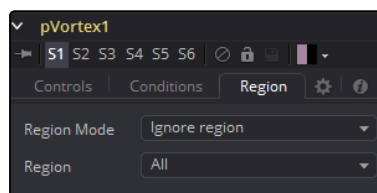
See Particle Common Controls in the Particles chapter.

Particle Common Controls

The Common Controls can be found in every Particle tool inside Fusion.

Conditions Tab

Probability

This control determines the Probability or percentage chance that the tool will affect any given particle.

The default value of 1.0 will affect all particles. A setting of 0.6 would mean that each particle has a 60 percent chance of being affected by the control.

Probability is calculated for each particle on each frame. For example, a particle that is not affected by a force on one frame has the same chance of being affected on the next frame.

Start/End Age

This range control can be used to restrict the effect of the tool to a specified percentage of the particle lifespan.

For example, to restrict the effect of a tool to the last 20 percent of a particle's life, set the start value to 0.8 and the end value remains at 1.0. The tool on frames 80 through 100 only affect a particle with a lifespan of 100 frames.

Set Mode and Sets

This menu control determines if the particle tool's effect will be applied to all particles, limited only to particles from a specified set(s), or applied to all particles except the selected set(s).

Sets are assigned by the tools that create particles the pEmitter, pImage Emitter, the pChangeStyle and the pSpawn tools.
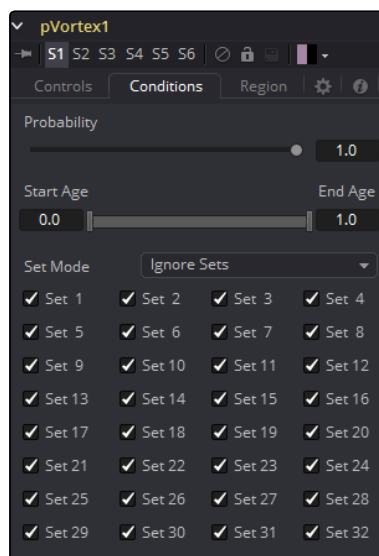
Regions Tab
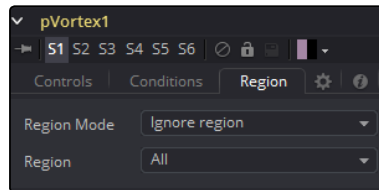
Region

Regions are used to restrict the tool's effect to a geometric region or plane, and to determine the area where particles are created in a pEmitter tool. There are seven types of regions, each with its own controls.

All

In 2D, the Particles will be created anywhere within the boundaries of the image. In 3D, this region describes a cube 1.0 x 1.0 x 1.0 units in size.

Bezier

Bezier mode uses a user-created polyline to determine the region where particles are created. The Bezier mode works in both 2D and 3D modes, however the Bezier polyline region can only be created in 2D.

To animate the shape of the polyline over time or to connect this polyline to another polyline, right-click on the Polyline label at the bottom of the control and select the appropriate option from the context menu.

Bitmap

A Bitmap source from one of the other tools in the composition will be used as the region where particles are born.

Cube

A full 3D Cube is used to determine the region within which particles are created. The height, width, depth and XYZ positions can all be determined by the user and animated over time.

Line

A simple Line control determines where particles are created. The Line is composed of two end-points, which can be connected to Paths or Trackers, as necessary. As with Bezier, this region type works in 3D, but the line itself can only be created and adjusted in 2D.

Mesh

Any 3D Mesh can be used as a region. In Mesh mode the region can also be restricted by the Object ID using the ObjectID slider. See below for a deeper explanation of how mesh regions work.

Rectangle

The Rectangle region type is like the Cube type, except that this region has no depth in Z space. Unlike other 2D emitter regions, this region can be positioned and rotated in Z space.

Sphere (3D)

This is a spherical 3D emitter region with size and center Z controls. Sphere (3D) is the default region type for a new pEmitter tool.

Start/End X,Y,Z Offset

(Line mode only) These controls define the Start and End point of the line in 3D Space.

Mesh Regions

Region Type

The Region Type control allows the artist to choose whether the region will include the inner volume, or just the surface. For example, when a mesh region is used with a pEmitter, this control would determine whether the particles are emitted from the surface or the full volume.
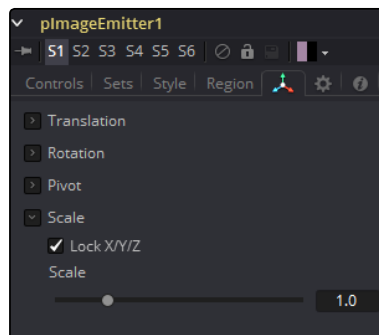
Winding Rule and Winding Ray Direction

The Winding Rule and Winding Ray Direction controls determine how the mesh region will handle particle creation with meshes that are not completely closed, as is common in many meshes imported from external applications. This scenario is common with imported mesh geometry, and even geometry which appears closed will frequently appear to 'leak' thanks to improperly welded vertices.

To determine if a particle is in the interior of an object, a ray is cast from infinity through that particle and then out to -infinity. The Winding Ray Direction determines which direction this ray is cast in. Each time a surface is pierced by the ray it is recorded and added onto a total to generate a winding number. Going against a surfaces normal counts as +1 and going with the normal counts as -1.

The Winding Rule is then used to determine what is inside/outside. For example, setting the Winding Rule to Odd means that only particles with odd values for the winding number are kept when creating the particles. The exact same approach is used to ensure that polylines that intersect themselves are closed properly.

For example, the following flow and image shows two image planes being used as a mesh region for particle creation.
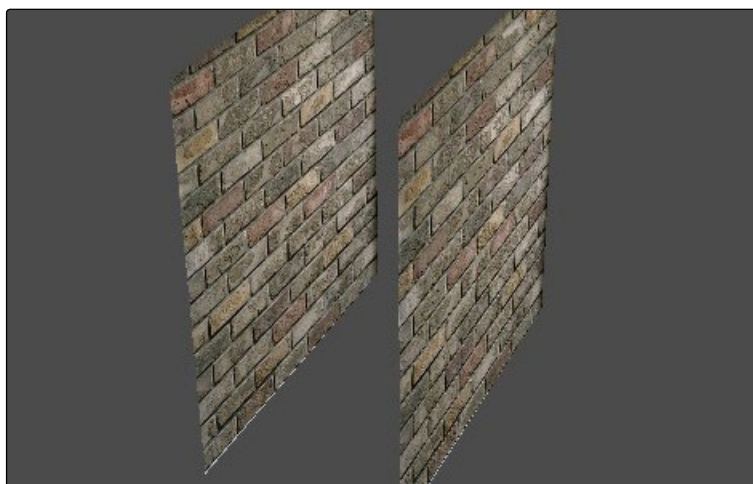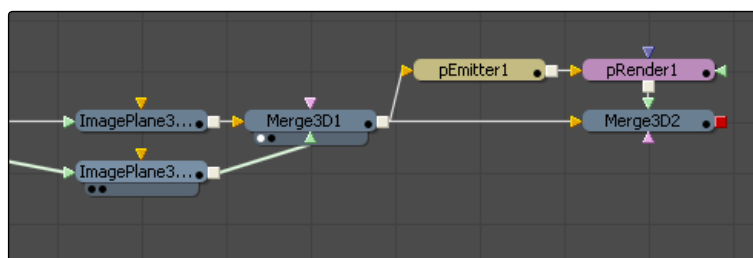
By setting the region's Winding Ray Direction to the Z (blue) axis, this mesh can then be treated as a closed volume for purposes of particle creation, as pictured below.
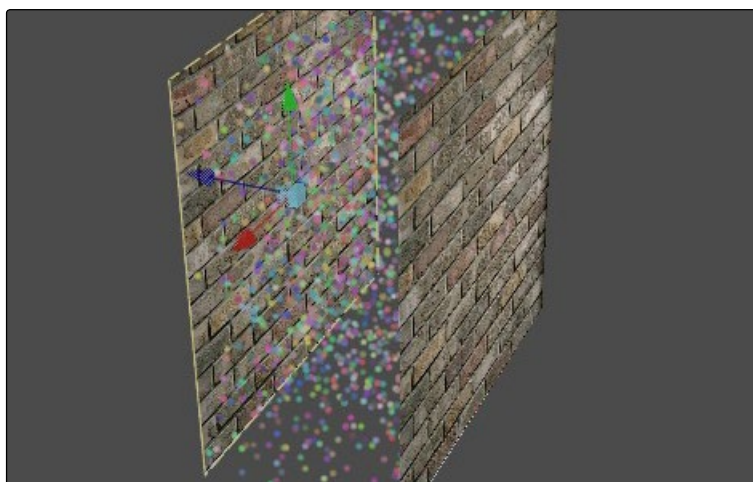
Limit By ObjectID, ObjectID

Selecting this checkbox allows the artist to use the slider found below the checkbox to filter the scene geometry so that only geometry with a matching ObjectID property is used as part of the region.

This menu control determines if the particle tool's effect will be applied to all particles, limited only to particles from a specified set(s), or applied to all particles except the selected set(s).

Sets are assigned by the tools that actually create particles. These are the pEmitter, pImage Emitter, the pChangeStyle and the pSpawn tools.

pStyle

The Styles tab occurs in the Particle Emitter, Particle Spawn, Particle ChangeStyle and Particle Image Emitter. In the Style tab, the type and look of the particles is determined.

Style Tab

The Style tab provides controls that affect the appearance of the particles, allowing the look and feel of the particles to be determined and animated over time.

Style Type

The Style Menu control provides access to the various types of particles supported by the Particle Suite. Each style has its own specific controls, as well as controls it will share with other styles.

Point Style

This option produces particles exactly one pixel in size. Controls that are specific to Point Style are Apply Mode and Sub Pixel Rendered.

Bitmap Style and Brush Style

Both the Bitmap and Brush Styles produce particles based on an image file. The Bitmap Style relies on the image from another tool in the flow and the Brush Style uses image files in the Brushes directory. They both have numerous controls for affecting their appearance and animation, described below.

Blob Style

This option produces large, soft spherical particles, with controls for Color, Size, Fade timing, Merge method and Noise.

Line Style

This style produces straight line-type particles with optional 'falloff.' The Size to Velocity control described below (under Size Controls) is often useful with this Line type. The Fade control adjusts the amount of falloff over the length of the line.

Point Cluster Style

This style produces small clusters of single pixel particles. Point Clusters are similar to the Point style, however they are more efficient when a large quantity of particles is required. This style shares controls with the Point style. Additional controls specific to Point Cluster style are Number of Points and Number Variance.

Color

This standard Color Control selects the color and alpha values of the particles generated by the emitter.

Color Variance

These range controls provide a means of expanding the colors produced by the pEmitter. Setting the Red variance range at -0.2 to +0.2 will produce colors that vary 20% on either side of the red channel, for a total variance of 40%. If the pEmitter is set to produce R0.5, G0.5, B0.5 (pure gray), the variance shown above will produce points with a color range between R0.3, G0.5, B0.5 and R0.7, G0.5, B0.5.

To visualize color space as values between 0-256 or as 0-65535, change the values used by Fusion using the Show Color As option provided in the General tab within the Preferences dialog.

Lock Color Variance

This checkbox locks the color variance of the particles. Unlocking this allows the color variance to be applied differently to each color channel, giving rise to a wider range of colors.

Color Over Life

This standard gradient control allows for the selection of a range of color values to which the particle will adhere over its lifetime.

The left point of the gradient represents the particle color at birth. The right point shows the color of the particle at the end of its lifespan.

Additional points can be added to the gradient control to cause the particle color to shift throughout its life.

This type of control can be extremely useful for fire-type effects (for example, the flame may start out blue, turn orange and end a darker red). The gradient itself can be animated over time by right-clicking on the control and selecting Animate from the context menu. All points on the gradient will be controlled by a single Color Over Life spline, which controls the speed at which the gradient itself changes. You may also use the From Image modifier, which produces a gradient from the range of colors in an image along a line between two points.

Size Controls

The majority of the Size Controls are self-explanatory. The Size and Size Variance controls are used to determine the size and degree of size variation for each particle. It is worth noting that the Point style does not have size controls (each point is a single pixel in size and there is no additional control).

When a Bitmap Particle style is used, a value of 1.0 indicates that each particle should be exactly the same size as the input bitmap. A value of 2.0 will scale the particle up in size by 200%. For the best quality particles, always try to make the input bitmap as big, or bigger, than the largest particle produced by the system.

For the Point Cluster style, the size control adjusts the density of the cluster, or how close together each particle will get.

There are additional size controls that can be used to further adjust the size of particles based on velocity and depth.

Size to Velocity

This increases the size of each particle relative to the Velocity or speed of the particle. The velocity of the particle is added to the size, scaled by the value of this control.

1.0 on this control, such as for a particle traveling at 0.1, will add another 0.1 to the size (velocity * sizetovelocity + size = newsize). This is most useful for Line styles, but the control can be used to adjust the size of any style.

Size Z Scale

This control measures the degree to which the size of each particle is increased or decreased according to its depth (position in Z space). The effect is to exaggerate or reduce the impact of perspective. The default value is 1.0, which provides a relatively realistic perspective effect.

Objects on the focal plane (Z = 0.0) will be actual-sized. Objects farther along Z will become smaller. Objects closer along Z will get larger.

A value of 2.0 will exaggerate the effect dramatically, whereas a value of 0.0 will cancel the effects of perspective entirely.

Size Over Life

This LUT spline control determines the size of a particle throughout its lifespan. The vertical scale represents a percentage of the value defined by the Size control, from 0 to 200%. The horizontal scale represents a percentage of the particle's lifespan (0 to 100%).

This graph supports all of the features available to a standard LUT editor. These features can be accessed by right-clicking on the graph. It is also possible to view and edit the graph spline in the larger Spline view.

Fade Controls

This simple range slider provides a mechanism for fading a particle at the start and end of its lifetime. Increasing the Fade In value will cause the particle to fade in at the start of its life. Decreasing the Fade Out value will cause the particle to fade out at the end of its life.

This control's values represent a percentage of the particle's overall life, therefore, setting the Fade In to 0.1 would cause the particle to fade in over the first 10% of its total lifespan. For example, a particle with a life of 100 frames would fade in from frame 0..10.

Merge Controls

This set of particle controls affects the way individual particles are merged together. The Subtractive/Additive slider works exactly as documented in the standard Merge tool. The Burn-In control will cause the particles to overexpose, or `blow out,' when they are combined together.

None of the Merge controls will have any effect on a 3D particle system.

Blur Controls

This set of particle controls can be used to apply a Blur to the individual particles. Blurring can be applied globally, by age, or by Z depth position.

None of the Blur controls will have any effect on a 3D particle system.

Blur and Blur Variance

These controls apply Blur to each particle. Unlike the Blur in the pRender tool, this is applied to each particle independently before the particles are merged together. The Blur Variance slider modifies the amount of blur applied to each particle.

Blur Over Life

This spline graph controls the amount of Blur that is applied to the particle over its life. The vertical scale represents a percentage of the value defined by the Blur control. The horizontal scale represents a percentage of the particle's lifespan.

This graph supports all of the features available to a standard LUT editor. These features can be accessed by right-clicking on the graph. It is also possible to view and edit the graph spline in the larger Spline view.

Z Blur (DoF) and DoF Focus

This slider control applies blur to each particle based on its position along the Z axis.

The DoF Focus range control is used to determine what area of the image remains in focus. Lower values along Z are closer to the camera. Higher values are farther away. Particles within the range will remain in focus. Particles outside that range will have the blur defined by the Z Blur control applied to them.

Apply Mode

This control only applies to 2D particles. 3D particle systems are not affected.

Add

Overlapping particles are combined by adding the color values of each particle together.

Merge

Overlapping particles are merged together.

Style Bitmap

(Bitmap Style Only) This control appears when the Bitmap style is selected, along with an orange Style Bitmap input on the tool's icon in the Flow view. Connect a 2D tool to this input to provide images to be used for the particles. You can do this on the Flow view, or you may drag and drop the image source tool onto the Style Bitmap control from the Flow or Timeline, or right-click on the control and select the desired source from the Connect To menu.

Brush

(Brush Style Only) This drop-down list shows the names of any image files stored in the Brushes directory. The location of the Brushes directory is defined in the Preferences dialog, under Path Maps. The default is the Brushes subdirectory within Fusion's install folder. If no images are in this directory, the only option in the menu will be None, and no particles will be rendered.

Animate

(Bitmap Style Only) This list determines how the animation of the bitmap source is applied to newly-created particles. It can be hard to visualize the impact of this control until it has been experimented with. A good way to experiment is to load the flow in the Fusion > Examples directory called pTextParticleAge.comp and try out the three settings. View the Text tool in the display view and the pRender tool another view, then step through the frames using the [and] keys.

Over Time

All particles use the image produced by the Style Bitmap tool at the current time, and change to each successive image together in step, as time increases. A particle created at frame 1 will contain the image at frame 1 of the Style Bitmap. At frame 2, the original particle will use the image from frame 2, and so will any new particles. All created particles will share exactly the same bitmap image from their source at all times.

Particle Age

Each particle animates through the sequence of images provided by the Style Bitmap tool, independently of other particles. In other words, an individual particle's appearance is taken from the Style Bitmap tool at successive times, indexed by its age.

Particle Birth Time

New particles take the image from the Style Bitmap tool at the current time and keep it unchanged until the end of the particle's lifespan. Thus, particles generated on a given frame will all have the same appearance and will stay that way.

Time Offset

(Bitmap Style Only) This control allows the bitmap source frame to be Offset in time from the current frame.

Time Scale

(Bitmap Style Only) This control can be used to scale the time range of the source bitmap images by a specified amount. For example, a scale of 2 will cause the particle created at frame 1 to be read from the bitmap source at frame 2.

Gain

(Bitmap and Brush Style Only) This control is used to apply a correction to the overall Gain of the image that is used as the bitmap. Higher values produce a brighter image, whereas lower values reduce both the brightness and the transparency of the image.

Noise

(Blob Style Only) Increasing this control's value will introduce grain-type noise to the blobby particle.

Fade

(Line Style Only) The Fade control adjusts the falloff over the line particle's length. The default value of 1.0 causes the line to fade out completely by the end of the length.

Sub Pixel Rendered

(Point and Point Cluster Style Only) This checkbox determines if the point particles are rendered with Sub Pixel precision, which provides smoother looking motion but blurrier particles that take slightly longer to render.

Number Of Points And Variance

(Point Cluster Style Only) The value of this control determines how many points are in each Point Cluster.

Position Tools

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Position Tools

Position Tools

Volume Fog

Volume Mask

Z to World
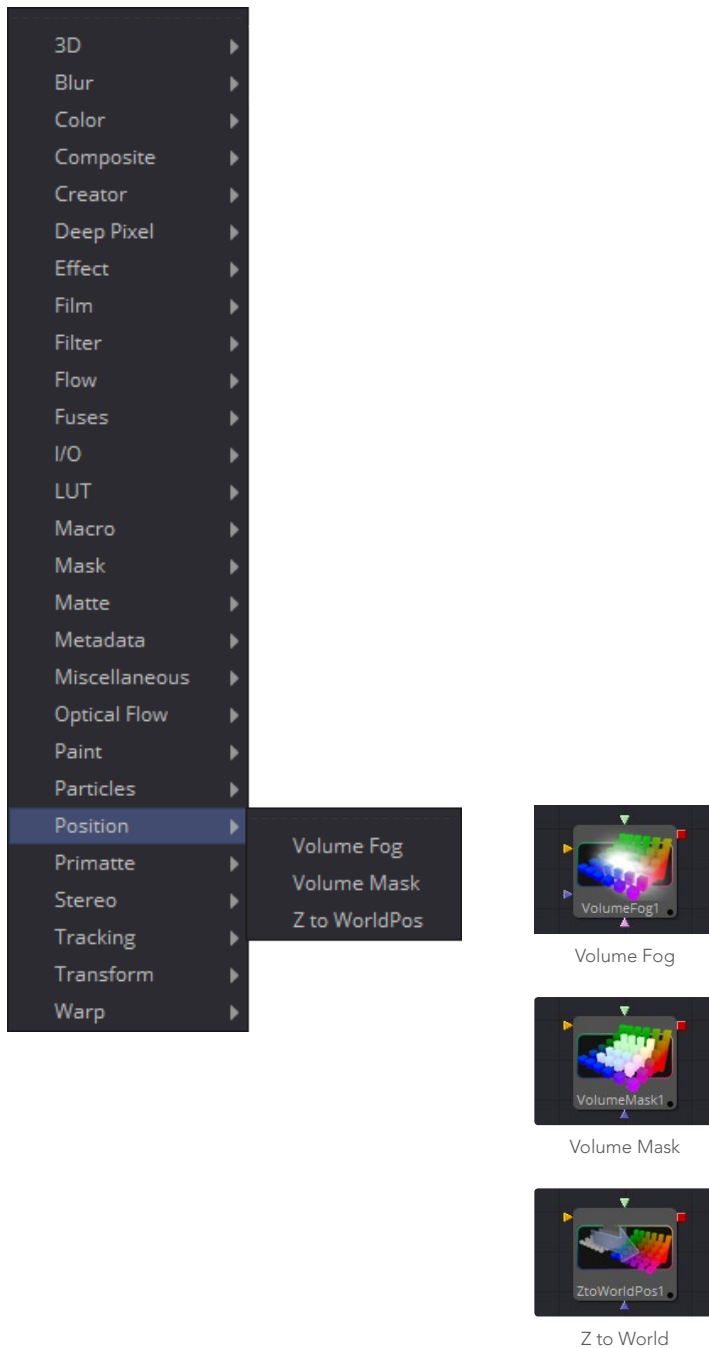
Volume Fog [VLF]

The Volume Fog tool is used to create sophisticated volumetric fog on images containing XYZ Position channels.

As opposed to 3D-rendered volumetric Fog, it works on 2D images and delivers much faster results and interactive feedback when setting up the fog. See the WPP Concepts section for further explanation on how this technology works and to learn about the required imagery.

Shape Tab
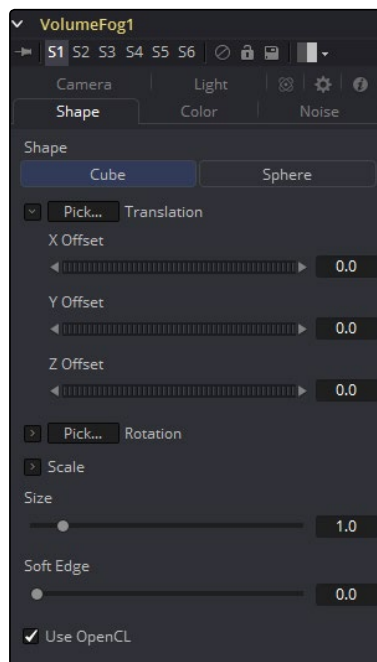
External Inputs

The following inputs appear on the tool's tile in the Flow Editor.

→ VolumeFog.Image: [orange, required] This input expects an image containing a World Position Pass in the XYZ Position channels.

→ VolumeFog.FogImage: [green, optional] For creating volumetric fog with varying depth and extent; an image sequence can be connected here.

→ VolumeFog.EffectMask: [blue, optional] The standard Effect Mask input as found on other Fusion tools.

→ VolumeFog.SceneInput: [pink, optional] This input expects a 3D scene containing a 3D Camera.

Shape

Toggle between a basic spherical or rectangular volume to be placed in your image. These Volumes can then be further refined by means of the MaskImage or MaskImage sequence.

Translation Pick

Left-click and hold this button to pick XYZ coordinates from any 3D scene or 2D image containing XYZ values, such as a rendered World Pass, to position the center of the Volume object. When picking from a 2D image, make sure it's rendered in 32-bit float to get full precision.

X, Y, Z Offset

These controls can be used to position the center of the fog volume manually or can be animated or connected to other controls in Fusion.

Rotation Pick

Left-click and hold this button to pick rotational values from any 3D Scene or 2D image containing those values, like an XYZ-Normal-Pass, to re-orient the volume.

When picking from a 2D image, like an XYZ-Normal-pass, make sure it's rendered in 32-bit float to get full precision and accurate rotational values.

X, Y, Z Rotation

Use these controls to rotate the Volume around its center.

X, Y, Z Scale

Scale the Volume in any direction from its center to further refine the overall Size value specified below.

Size

The overall Size of the volume created.

Soft Edge

Controls how much the Volume is faded toward the center from its perimeter to achieve a softer look.

Use OpenCL

Introduced with Fusion's OpenCL Supercomputing, this option renders the effect on the GPU rather than on the CPU. Depending on the graphics card used in the computer, this can boost the speed of the tool by a factor of 30 or more.

Color Tab
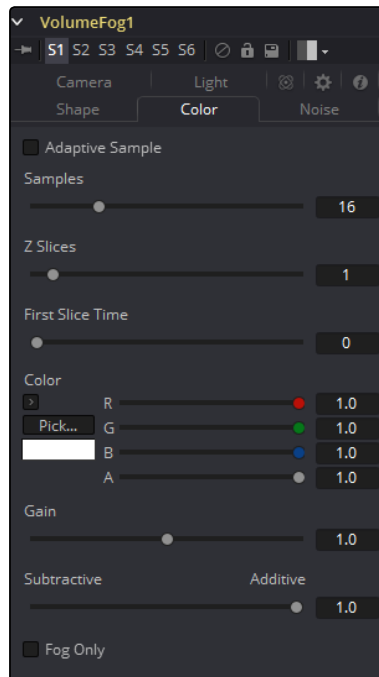
Samples

Determines how many times a "ray" shot into the volume will be evaluated before the final image is created. Not unlike raytracing, higher values lead to more detail inside the volume but also increase render times.

Z Slices

The higher this value, the more images from the connected MaskImage sequence will be used to form the Depth of the Volume.

You can, for example, use a FastNoise with a high Seethe Rate to create such a sequence of images. Be careful with the resolution of the images though. Higher resolutions can require a large amount of memory. As a rule of thumb, a resolution of 256 x 256 pixels with 256 Z Slices (i.e., forming a 256 x 256 x 256 cubic volume, which will use up to 256MB for full color 32-bit float data) should give you a good starting point.

First Slice Time

Determines which frame of the Global Range is used to deliver the first slice from the connected MaskImage sequence.

Make sure that both GlobalIn and GlobalOut as well as the valid range of your source tool fall within the range of FirstSliceTime + Z Slices.

Color

Allows you to modify the color of the Fog generated. This will multiply over any color provided by the connected MaskImage.

Gain

Increases or decreases intensity of the fog created. More Gain will lead to a stronger glow and less transparency in the fog. Lower values let the fog appear less dense.

Subtractive/Additive Slider

Similar to the Merge tool, this value controls if the fog is composed onto the image in additive or subtractive mode, leading to brighter or dimmer appearance of the fog.

Fog Only

Outputs the generated fog on a black background which then can be composited manually, or used as a mask on a Color Corrector for further refinement.

Camera Tab

For a perfect evaluation of a Volume, a Camera or 3D scene can be connected to the Scene input of the tool.
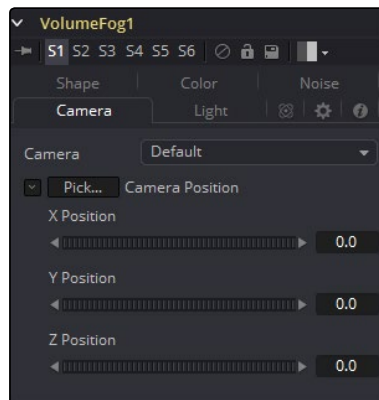
Camera

If multiple Cameras are available in the connected Scene input, this drop-down allows the user to choose the correct Camera needed to evaluate the Volume. Instead of connecting a Camera, position values can be provided manually or by connecting the XYZ values to other controls.

Translation Pick

Left-click and hold this button to pick XYZ coordinates from any 3D scene or 2D image containing XYZ values, like a rendered World Pass, to define the center of the Camera. When picking from a 2D image, make sure it's rendered in 32-bit float to get full precision.

X, Y, Z Offset

These controls can be used to define the center of the Camera manually or can be animated or connected to other controls in Fusion.

Light Tab

To utilize this feature you need to have actual lights in your 3DScene. Connect that scene, including Camera and Lights, to the 3D input of the tool.
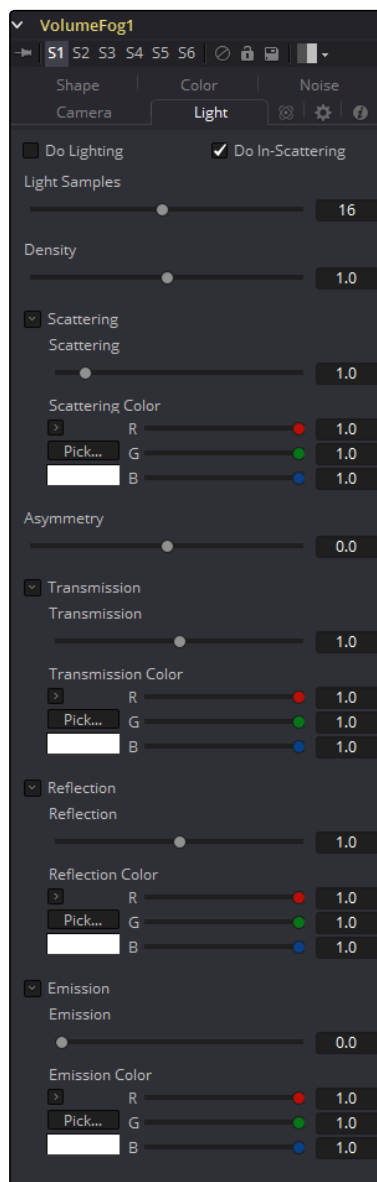
Do Lighting

Enables or disables lighting calculations. Keep in mind that when not using OpenCL (i.e., rendering on the CPU), these calculations may become a bit slow.

Do In-Scattering

Enables or disables light scattering calculations. The volume will still be lit according to the state of the Do Lighting checkbox, but scattering will not be performed.

Light Samples

Determines how accurate the lighting is calculated. Higher values mean more accurate calculation at the expense of higher render times.

Density

This is similar to Scattering in that it makes the fog appear thicker. With a high amount of scattering, though, the light will be scattered out of the volume before it has had much chance to travel through the fog, meaning it won't pick up a lot of the transmission color. With a high density instead, the fog still appears thicker, but the light gets a chance to be transmitted, thus picking up the transmission color before it gets scattered out. Scattering is affected by the light direction when Asymmetry is not 0.0. Density is not affected by light direction at all.

Scattering

Determines how much of the light bouncing around in the volume ends up scattering the light out of the fog. If the light scatters more, or more accurately, then there's a higher probability of the light being scattered out of the volume, hence less light is left to continue on through the fog. This option can make the fog seem denser.

Asymmetry

Determines in what direction the light is scattered. A value of 0 produces uniform, or isotropic, scattering, meaning all directions have equal probability. A value greater than 0 causes "forward scattering," meaning the light is scattered more into the direction of the light rays. This is similar to what happens with water droplets in clouds. A value smaller than 0 produces "back scattering," where the light is more scattered back toward the original light source.

Transmission

Defines the color that is transmitted through the fog. Light that doesn't get scattered out will tend toward this color. It is a multiplier, though, so if you have red light, but blue transmission, you won't see any blue.

Reflection

Changes the intensity of the light that is scattered out. It can be used to modify the overall color before Emission is added. This will be combined with the color channels of the volume texture and then used to scale the values. The color options and the color channels of the volume texture are multiplied together, so if the volume texture was red, setting the Reflection color options to blue would not make the result blue. In such a case they will multiply together to produce black.

Emission

This adds a bit of "glowing" to the fog, or adding energy/light back into the calculation. In fact, if there are no lights in the scene, and the fog emission is set to be 1.0, the results are similar to no lighting, like turning off the Do Lighting option. Glowing can also be done while producing a different kind of look, by having a Transmission greater than 1. This, however, would never actually happen in the real world.

Examples

In these examples we are looking at a volume from the outside. On the right you see how the VolumeFog looks with straight accumulation. That means the "Do Lighting" option is turned off.
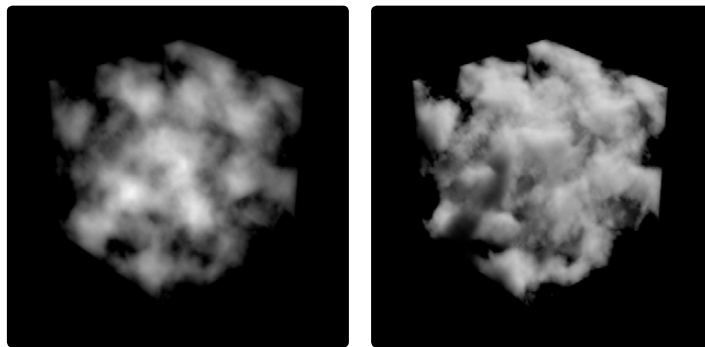
On the right, you see the same volume with lighting/scattering turned on and a single point light. Here we have a slightly more complex Volume.

On the left with straight accumulation, in the middle with lighting, scattering and a single point light. On the right the actual light in the scene has been moved, which also influences the look of the volume.
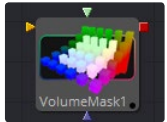
Volume Mask [VLM]

The Volume Mask tool is used to create volumetric masks from images containing XYZ Position channels.

This can, for example, be used to isolate objects for color correction without the need to track or roto the scene. See the WPP Concepts section for further explanation on how this technology works and to learn about the required imagery.

Shape Tab
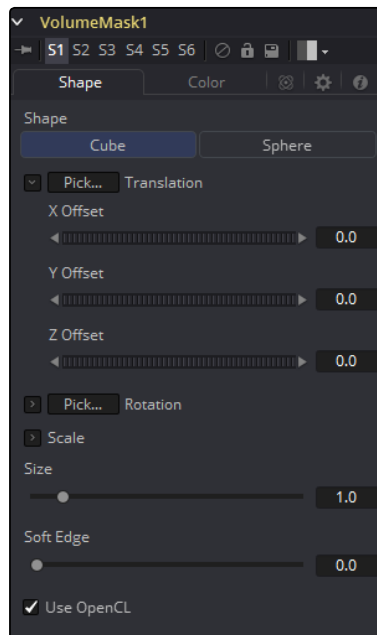
External Inputs

The following inputs appear on the tools tile in the Flow Editor.
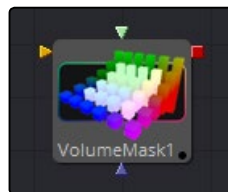
→ VolumeFog.Image: [orange, required] This input expects an image containing a World Position Pass in the XYZ Position channels.

→ VolumeFog.MaskImage: [green, optional] For refining the mask, an image can be connected here.

→ VolumeFog.EffectMask [blue, optional] The standard Effect Mask input as found on other Fusion tools.

→ VolumeFog.SceneInput [pink, optional] This input expects a 3D scene input containing a 3D Camera.

Shape

Toggle between a basic spherical or rectangular Mask to be placed in your image. The Mask can be further refined by means of the MaskImage.

Translation Pick

Left-click and hold this button to pick XYZ coordinates from any 3D scene or 2D image containing XYZ values, like a rendered World Pass, to position the center of the volumetric Mask. When picking from a 2D image make sure it's rendered in 32-bit float to get full precision.

X, Y, Z Offset

These controls can be used to position the center of the Mask manually or can be animated or connected to other controls in Fusion.

Rotation Pick

Left-click and hold this button to pick rotational values from any 3D scene or 2D image containing those values, like an XYZ-Normal-Pass, to re-orient the Mask.

When picking from a 2D image, like an XYZ-Normal-pass, make sure it's rendered in 32-bit float and WorldSpace coordinates to get full precision and the correct rotational values.

X, Y, Z Rotation

Use these controls to rotate the Mask around its center.

X, Y, Z Scale

Scale the Mask in any direction from its center to further refine the overall Size value specified below.

Size

The overall Size, in X, Y and Z, of the Mask created.

Soft Edge

Controls how much the Volume is faded toward the center from its perimeter to achieve a softer look.

Use OpenCL

Introduced with Fusion's OpenCL Supercomputing, this option renders the effect on the GPU rather than on the CPU. Depending on the graphics card used in the computer, this can boost the speed of the tool by a factor of 30 or more.

Color Tab
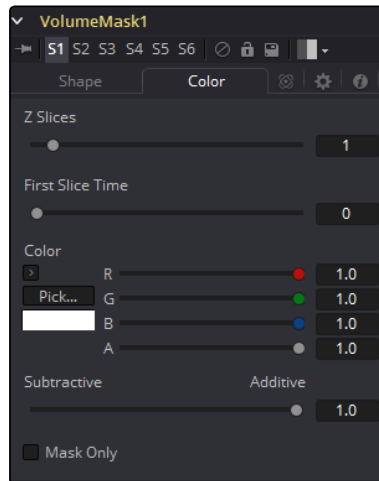
Color

Allows user to modify the color of the Mask generated. This will add to any color provided by the connected MaskImage.

Subtractive/Additive Slider

Similar to the Merge tool, this value controls if the Mask is composed onto the image in Additive or Subtractive mode, leading to brighter or dimmer appearance of the Mask.

Mask Only

Outputs the generated Mask on a black background, which then can be used as a mask on a Color Corrector for further refinement.

Camera Tab

For a perfect evaluation of a Volume, a Camera or 3D scene can be connected to the Scene input of the tool.
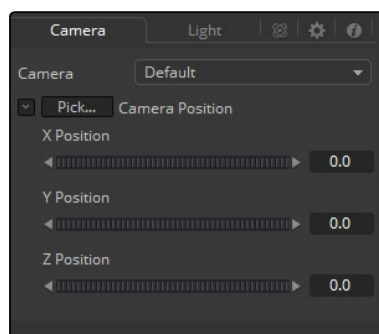
Camera

If multiple Cameras are available in the connected Scene input, this drop-down allows the user to choose the correct Camera needed to evaluate the Volume.

Instead of connecting a Camera, position values can also be provided manually or by connecting the XYZ values to other controls.

Translation Pick

Left-click and hold this button to pick XYZ coordinates from any 3D scene or 2D image containing XYZ values, like a rendered World Pass, to define the center of the Camera.

When picking from a 2D image, make sure it's rendered in 32bit float to get full precision.

X, Y, Z Offset

These controls can be used to define the center of the Camera manually or can be animated or connected to other controls in Fusion.

Z to World [ZₜW]

The Z to World tool is used to either generate a World Position Pass from a Z channel and a 3D Camera or a Z channel from a World Position Pass and a 3D Camera.

Creating a World Position Pass from Z depth can be useful when your 3D application is not capable of creating a WPP.

It can also be used when a 3D tracking software outputs a per-pixel Z depth together with the 3D Camera. Thus, the VolumeMask and Volumne Fog could be applied to real-world scenes. The quality of the resulting WPP depends largely on the quality of the incoming Z channel.

See the WPP Concepts section for further explanation on how this technology works and to learn about the required imagery.

Controls Tab
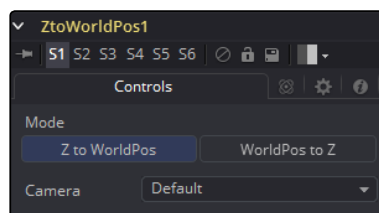
External Inputs

The following inputs appear on the tools tile in the Flow Editor.
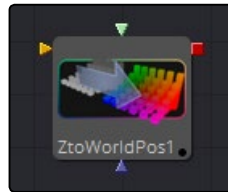
→ **ZtoWorld.Image:** [orange, required] This input expects an image containing a World Position Pass or a Z depth pass, depending on the desired operation.

→ **ZtoWorld.EffectMask:** [blue, optional] The standard Effect Mask input as found on other Fusion tools.

→ **ZtoWorld.SceneInput:** [pink, required] This input expects a 3D scene input containing a 3D Camera.

Mode

Toggle between creating a Z channel from a World Position Pass or vice versa.

Camera

If multiple Cameras are available in the connected Scene input, this drop-down allows the user to choose the correct Camera needed to evaluate the image.

WPP Concept

The Position tools in Fusion offer a completely new way of working with Masks and Volumetrics for footage containing XYZ Position channels. ZtoWorld offers the option to create those channels out of a Z channel and 3D Camera information. Just for the sake of this overview we will refer to the World Position Pass as WPP.

What is a WPP?

The WPP reflects each pixel's XYZ position in the original scene as RGB color values.

So if the face the pixel was derived from in the original scene sits at 0/0/0, the resulting pixel will have an RGB value of 0/0/0 and thus will be black. If said face sits at 1/0/0 in the original scene, the resulting pixel will be fully red. Of course if the coordinates of our face are something like -60/75/123, the pixel will hold those values as well.

As you can see here, due to the huge extent 3D scenes can have, the WPP channel should always be rendered in 32-bit floating point to provide the accuracy needed. This image shows a 3D Rendering of a scene with its center sitting at 0/0/0 in 3D Space and the according WPP. For better visibility the WPP has been normalized.

.
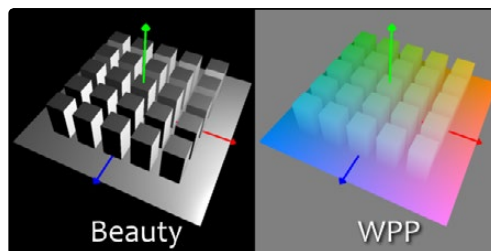
Different Coordinate Spaces

WPPs can be rendered in different Coordinate Spaces. These include World Space, Eye Space and Object Space. The image below depicts how those different spaces look, though the tools in Fusion require the WPP to be rendered in World Space.
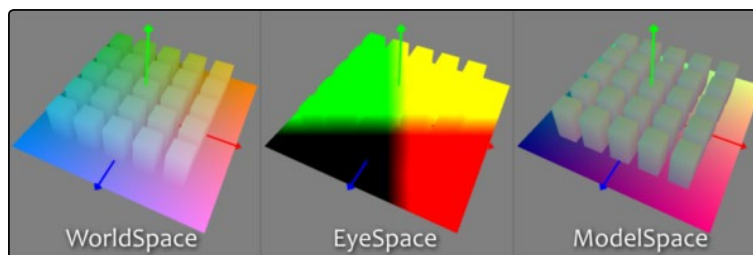
The Scene Input

The tools offer a Scene Input, which can either be a 3D Camera or a 3D scene containing a camera. While the camera is vital for the ZtoWorld tool, Volume Mask and Volume Fog will still generate their output without any camera attached or with the camera position set to 0/0/0.

However, connecting a camera that lines up with the original camera the WPP has been rendered from, or setting the camera's position manually, greatly improves accuracy and look of the resulting Fog or Mask.
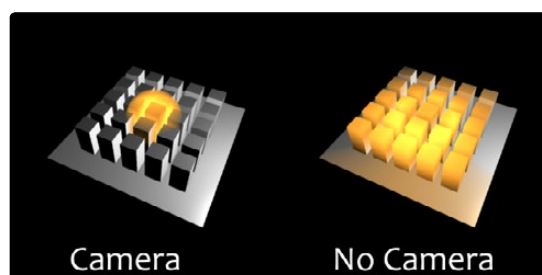
The "Invisible Sphere"

The example scene shown so far has an empty background, meaning there is nothing in the scene apart from the ground plane and the cubes.

If applying fog to a scene like that which is larger than said ground plane, the result will look similar to the "w/o Sphere" example shown below because with no WPP information outside the ground plane, the resulting value will be 0/0/0; the fog fills that area as well.

To get around that you can add an invisible bounding sphere to your scene to create "dummy" WPP values to help the Fog tool to create the correct volume as shown in "with Sphere" below.
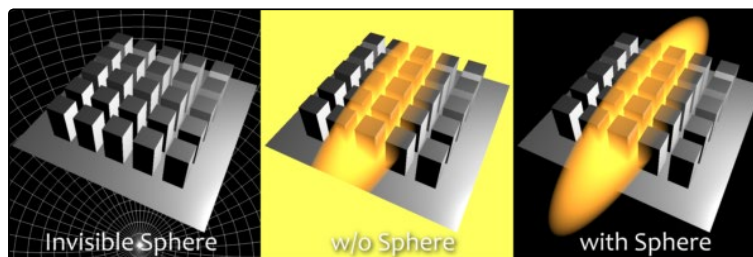
Primatte Keyer

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Primatte Keyer

Primatte Keyer
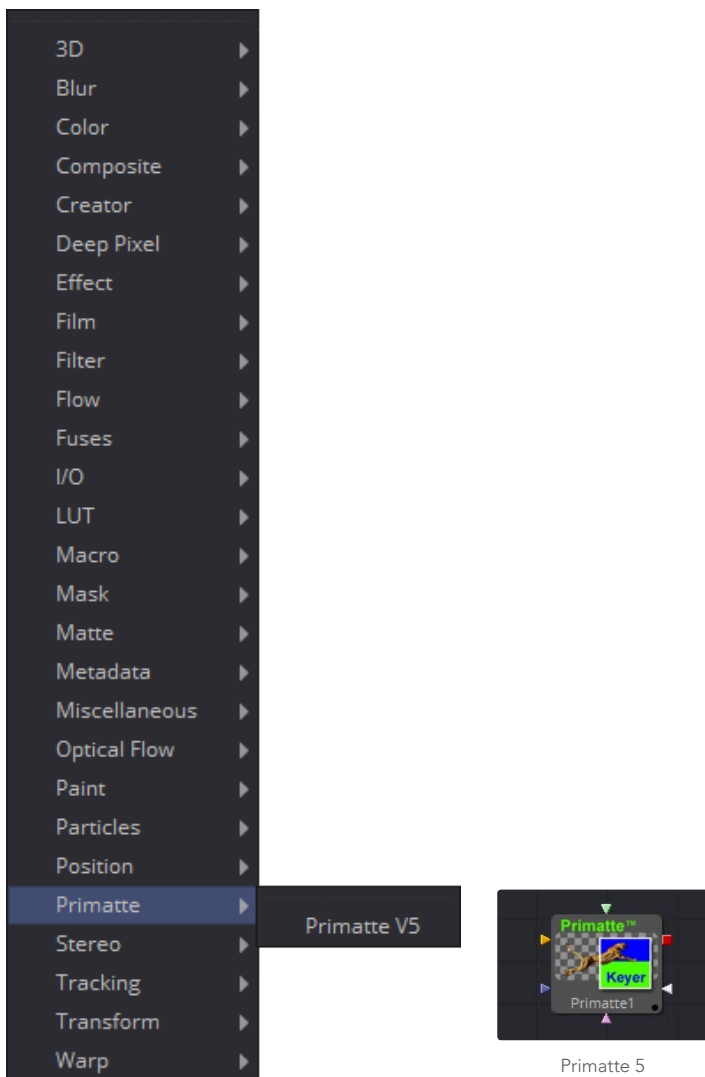
Primatte 5

Primatte 5

Primatte is an advanced keying system for Fusion. It's distributed and licensed by IMAGICA Corp. of America, Los Angeles, CA, USA. Primatte was developed by and is a trademark of IMAGICA Corp., Tokyo, Japan

External Inputs

→ **Orange (required):** The primary input. As opposed to other tools in Fusion, this is actually the "Foreground" input, since it holds the image to be keyed, or in other words, the image that is to be layered in the foreground of the composite. Connect the image to be keyed to this input.

→ **Green (optional):** In Primatte this is the Background input. It holds the background layer of the composite. If no image is connected, Primatte will just output the keyed element. Connect an image here to utilize Primatte's advanced edge blending options.

→ **Pink (optional):** The replacement image input.

→ **White (optional):** Garbage matte.

→ **Blue (optional):** Post Mask input.

Note: If the background input is connected, but the replacement image input is not, then the Image Replacement mode will use the background image, and the keyed foreground will be placed over that background. If the replacement image input is connected, then it'll be used for image replacement, and the keyed foreground will still be placed over the image from the background input.

Primatte Tab

Lock Color Picking

Activate this button once you finished adjusting your key. This prevents accidentally changing the settings by clicking into the view.

Auto Compute

This is most likely the first button you want to press when starting to key your footage. Primatte then automagically analyzes the original foreground image and determines the backing color and sets it as the central backing color. Then, using that information, analyzes the original foreground image and determines the foreground areas using the new Primatte V5 foreground detection routine. Then, internally, using the newly determined foreground areas performs the Clean FG Noise operation and determines a more desirable shape for the middle and outer polyhedrons. It then renders the composite using the generated polyhedrons. This does not automatically use the Adjust Lighting functionality, as it must be selected in a separate operation.

Select Background Color

Allows the user to select the background color, which is meant to be keyed in the view by means of a color picker. It uses the traditional Primatte method of taking the sampled backing screen color, projecting a line in the opposite direction on the hue wheel and generating artificial pixels that MAY represent the FG object. Then, using the artificially generated foreground pixels internally does the Clean FG Noise operation and creates the shape of the middle and outer polyhedrons. It then renders the composite using the generated polyhedrons. This does not automatically use the Adjust Lighting functionality, as it must be selected in a separate operation.

Clean Background Noise

Helps to remove any white regions in the dark screen area ("noise"), or shades of blue that did not get picked up on the first sample. Move the cursor through these areas while holding the left mouse button down to sample these whitish noise regions.

Clean Foreground Noise

If there are dark regions in the middle of the mostly white foreground object, that is, if the key is not 100% in some portion of the targeted foreground, use Clean Foreground with the same techniques as for Clean Background Noise, but this time sample the dark pixels in the foreground area until that area is as white as possible.

Spill Sponge

The quickest method for removing color spill on your object is the Spill Sponge to sample the spill areas away. By positioning the cursor over a bluish pixel and selecting it, the blue will disappear from the selected color region and be replaced by a more natural color. Additional spill removal should be done using the tools under the Fine Tuning tab or by using the Spill (-) feature. Both are explained further on in this manual.

Matte Sponge

Sometimes in the Primatte operation, a 100% foreground area (all white) will become slightly transparent (gray). You can clean those transparent areas up by using the Matte Sponge. Click on the transparent pixels and they will become 100% foreground. All of the spill-suppression information will remain intact.

Restore Detail

With this mode selected, the completely transparent background region sampled in the image window becomes translucent. This operation is useful for restoring lost hair details, thin wisps of smoke and the like. It shrinks the small polyhedron slightly.

Make Foreground Transparent

When this mode is selected, the opaque foreground color region sampled in the image window becomes slightly translucent. This operation is useful for the subtle tuning of foreground objects that are otherwise 100 percent covered with smoke or clouds. It can only be used one time on a

particular color. For a more flexible way to thin out a color region and be able to make multiple samples, you should use the Matte (-) tool. It expands the medium polyhedron slightly.

Spill(+)

Color spill will be returned to the sampled pixel color (and all colors like it) in the amount of one Primatte increment. This tool can be used to move the sampled color more in the direction of the color in the original foreground image. It can be used to nullify a Spill (-) step. This tool dents the Primatte large polyhedron in the color region sampled.

Spill(-)

Color spill will be removed from the sampled pixel color (and all colors like it) in the amount of one Primatte increment. If spill color remains, another click using this operational mode tool will remove more of the color spill. Continue using this tool until all color spill has been removed from the sampled color region. This tool expands the Primatte large polyhedron in the color region sampled.

Matte(+)

The matte will be made more opaque for the sampled pixel color (and all colors like it) in the amount of one Primatte increment. If the matte is still too translucent or thin, another click using this operational mode tool will make the sampled color region even more opaque. This can be used to thicken smoke or make a shadow darker to match shadows in the background imagery. It can only make these adjustments to the density of the color region on the original foreground image. It can be used to nullify a Matte (-) step. This tool dents the Primatte medium polyhedron in the color region sampled.

Matte(-)

The matte will be made more translucent for the sampled pixel color (and all colors like it) in the amount of one Primatte increment. If the matte is still too opaque, another click using this operational mode tool will make the sampled color region even more translucent. This can be used to thin out smoke or make a shadow thinner to match shadows in the background imagery. This tool expands the Primatte medium polyhedron in the color region sampled.

Detail(+)

The foreground detail will become less visible for the sampled pixel color (and all colors like it) in the amount of one Primatte increment. If there is still too much detail, another click using this operational mode tool will make more of it disappear. This can be used to remove smoke or wisps of hair from the composite. Sample where is visible and it will disappear. This is for moving color regions into the 100% background region. It can be used to nullify a Detail (-) step. This tool expands the Primatte small polyhedron in the color region sampled.

Detail(-)

When this operational mode is selected, foreground detail will become more visible for the sampled pixel color (and all colors like it) in the amount of one Primatte increment. If detail is still missing,

another click using this operational mode tool will make detail more visible. This can be used to restore lost smoke or wisps of hair. Sample where the smoke or hair just disappears and it will return to visibility. This is for restoring color regions that were moved into the 100% background region. It may start to bring in background noise if shooting conditions were not ideal on the foreground image. This tool dents the Primatte small polyhedron in the color region sampled.

Algorithms

→ Primatte: The Primatte algorithm mode delivers the best results and supports both the Solid Color and the Complement Color spill suppression methods. It is the algorithm that uses three multi-faceted polyhedrons (as described later in the this document) to separate the 3D RGB colorspace. It is also the default algorithm mode and, because it is computationally intensive, it may take the longest to render.

→ Primatte RT: Primatte RT is the simplest algorithm and therefore, the fastest. It uses only a single planar surface to separate the 3D RGB colorspace (as described later in the this document) and, as a result, does not have the ability to separate out the foreground from the backing screen as carefully as the above Primatte algorithm. Other disadvantages of the Primatte RT algorithm are that it does not work well with less saturated backing screen colors and it does not support the Complement Color spill suppression method.

→ Primatte RT+: Primatte RT+ is in between the above two options. It uses a six planar surface color separation algorithm (as described later in the this document) and will deliver results in between the other two in both quality and performance. Other disadvantages of the Primatte RT+ algorithm are that it does not work well with less saturated backing screen colors and it does not support the Complement Color spill suppression method.

Hybrid Rendering

After sampling the backing screen color and finding that the edges of the foreground object look very good, you sometimes find that an area of the foreground object is transparent. This is due to the foreground containing a color that is close to the backing screen color. When this transparency is removed using the Clean FG Noise operational mode, the edge of the foreground object picks up a fringe that is close to the backing screen color and it is very hard to remove without sacrificing quality somewhere else on the image. The Hybrid Render mode internally creates two keying operations: Body and Edge. The Edge operation is optimized around getting the best edge around the foreground object without any fringe effect. The Body operation is used to deal with the transparency within the foreground object. The resultant matte is created by combining these two mattes, Body and Edge, by blurring and then eroding the foreground object in the Body operation and then combining it with the matte created in the Edge operation.

The user first keys the main foreground area using the smart Select BG Color mode (or any of the other Primatte backing screen detection methods), until a good result is obtained with good edges around the foreground object. Then the user selects the Hybrid Render button and chooses the Clean FG Noise operational mode. When the transparent area is then sampled, the Primatte

V5 Hybrid Render mode will internally perform the 'Body/Edge' operation. This results in a final composite with good edges around the foreground object while still preserving the area within the foreground object that was transparent.

Hybrid Blur

Blurs the Body matte that has been automatically generated.

Hybrid Erode

This slider allows the user to adjust the amount of Erosion applied to the Hybrid Matte. The results can be viewed if the Hybrid Matte button has been activated.

Adjust Lighting

Prior to applying the Adjust Lighting operation, it is necessary to determine the backing screen color using one of the methods described above.

Upon performing one of those operations, the user then clicks on the Adjust Lighting button. Primatte will internally generate an artificial backing screen without the foreground object and use it to generate the pre-processed image that has an evenly lit backing screen behind the foreground object.

The default setting should detect all the areas of the Adjust Lighting grid that contain foreground pixels and deliver a smooth 'artificially created' optimized backing screen for the keying. Should it fail to do this, the user can adjust the settings of the algorithm by selecting the Adjust Lighting mode and then moving the Lighting S-Poly slider. The user can then see the result of the lighting adjustment by selecting Cntl 2 tab and clicking on the Auto Backing Screen button. This displays the optimized artificial backing screen that the Adjust Lighting mode creates. By again using one of the operations that sample the backing screen color (listed above), the new results will be visible. This operation can be repeated until a smooth, evenly lit optimized artificial backing screen is created.

Crop

This button reveals the Crop sliders to create a rectangular Garbage matte with the Primatte node. As opposed to Fusion's Crop tool, this will not change the actual image size.

Reset

Resets all of the Primatte key control data back to a blue or green screen.

Soft Reset

Resets just the Primatte features used since the Select Background Color operation was last completed.

Fine Tuning Tab
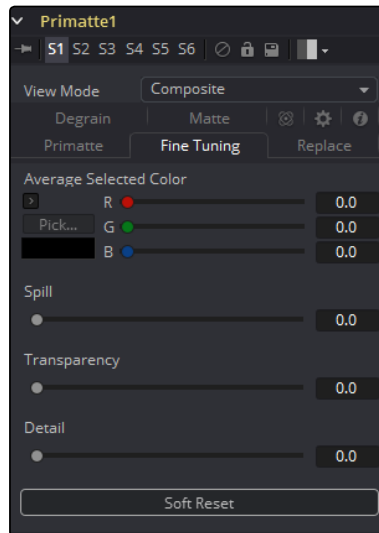
Pick

This shows the color selected (or registered) by the Fine Tuning operational mode.

Fine Tuning Sliders

When this operational mode is selected, the color of the sampled pixel within the image window is registered as a reference color for fine tuning. It is displayed in the Color Chip below the Detail slider. To perform the tuning operation, sample a color region on the image, select a Fine Tuning slider and move the slider to achieve the desired effect. See the Fine Tuning Sliders tool descriptions further on in this chapter for more details on slider selection.

Spill

This Spill slider can be used to remove spill from the registered color region. The more to the right the slider moves, the more spill will be removed. The more to the left the slider moves, the closer the color component of the selected region will be to the color in the original foreground image. If moving the slider all the way to the right does not remove all the spill, re-sample the color region and again move the slider to the right. These slider operations are additive. This result achieved by moving the slider to the right can also be achieved by clicking on the color region using the Spill (-) operational mode. This slider bulges the Primatte large polyhedron near the registered color region.

Transparency

The Transparency slider can be used to make the matte more translucent in the registered color region. Moving this slider to the right makes the registered color region more transparent. Moving the slider to the left makes the matte more opaque. If moving the slider all the way to the right does not make the color region translucent enough, re-sample the color region and again move the

slider to the right. These slider operations are additive. This result achieved by moving the slider to the right can also be achieved by clicking on the color region using the Matte (-) operational mode. This slider bulges the Primatte medium polyhedron near the registered color region.

Detail

The Detail slider can be used to restore lost detail. After choosing the Fine Tuning operational mode and selecting a color region, moving this slider to the left makes the registered color region more visible. Moving the slider to the left makes the color region less visible. If moving the slider all the way to the left does not make the color region visible enough, re-sample the color region and again move the slider to the left. These slider operations are additive. This result achieved by moving the slider to the left can also be achieved by clicking on the color region using the Detail (-) operational mode. This shrinks the small polyhedron, which contains all the blue or green background colors, and releases pixels that were close to the background color. The Small Polyhedron Slider in the Fine Tuning mode is useful for restoring pixels that were lost because they were so similar to the background color. This slider dents the Primatte small polyhedron near the registered color region.

Replace Tab

Allows the user to choose between the three methods of color spill replacement as covered in detail in Spill Replacement Options above.
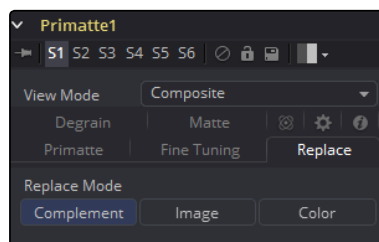
Complemental

Replaces the spill color with the complement of the backing screen color.

Image

Replaces the spill color with colors from a defocused version of the background image.

Color

Replaces the spill color with a 'user selected' solid color.

Degrain Tab

The Grain Tools are used when a foreground image is highly compromised by film grain. As a result of the grain, when backing screen noise is completely removed, the edges of the foreground object often become harsh and jagged, leading to a poor key.
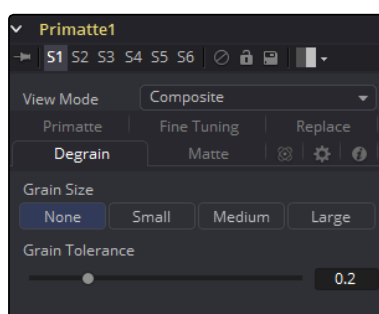
Grain Size

The Grain Size selector provides a range of grain removal from Small to Large. If the foreground image has a large amount of film grain-induced pixel noise, you may lose a good edge to the foreground object when trying to clean all the grain noise with the Clean Background Noise Operation Mode. These tools allow the user to clean up the grain noise without affecting the quality of the key.

None

No degraining will be performed.

Small

The average color of a small region of the area around the sampled pixel. This should be used when the grain is very dense.

Medium

The average color of a medium-sized region of the area around the sampled pixel. This should be used when the grain is less dense.

Large

The average color of a larger region of the area around the sampled pixel. This should be used when the grain is very loose.

Grain Tolerance

Adjusting this slider increases the effect of the Clean Background Noise tool without changing the edge of the foreground object.

Matte Tab

These controls behave the same as in the other Fusion Keyer tools. Please have a look at the Matte Control.
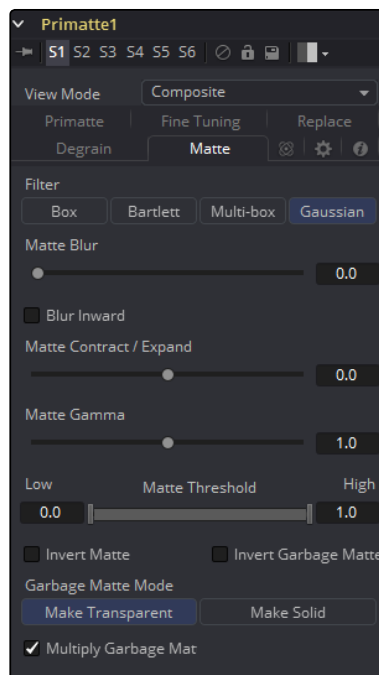
Basic Operation Tutorial

Auto Compute Tools

Note: This version of Primatte has a new feature that may eliminate the first three steps of using Primatte. It is called the Auto Compute button and may make your keying operation much easier. Click on this button as a first step and it may automatically sense the backing screen color, eliminate it, and even get rid of some of the foreground and background noise that would normally be cleaned up in Steps 2 (Clean Background Noise) and 3 (Clean Foreground Noise) of the Primatte operation. If you get good results, then jump ahead to the Spill Removal tools.

If you don't get the results you wanted from Auto Compute, continue from this point on to get the basic Primatte operation procedures. The basic functionality for the Primatte interface is centered on the Operational Mode Selector buttons and the image window.

Select Background Color

There are four main steps to using the Primatte; Select Background Color is the first step. Ensure that the Select Background Color button is selected (it should be at this time as it is the default Operational Mode when you start Primatte).

→ Position the cursor in the blue screen area (or whatever background color you are using), usually somewhere near the foreground object. Sample the targeted background color. Release the mouse button and Primatte will start the compositing process. If the foreground shot was done under ideal shooting conditions, Primatte will have done 90-95% of the keying in this one step.

→ Primatte will work equally well with any color backing screen. It does not have to be a specific shade of green or blue.

→ If you dragged the cursor in the blue area, Primatte averages the multi-pixel sample to get a single color to which to adjust. Sometimes Primatte works best when only a single pixel is sampled instead of a range of pixels. The color selected at this point in the Primatte operation is critical to the operation of the spark from this point forward. Should you have difficulties further along in the tutorial after selecting a range of blue shades, try the Select Background Color operation again with a single dark blue pixel or single light blue pixel. You can also switch to the Alpha Channel view and click around in the blue screen area to see the different results you get when the initial sample is made in different areas. Make sure the View Mode buttons at the top of the Primatte interface has the Black Mode selected.

→ If you would rather make a 'rectangular or box selection' and not use the 'snail trail or line' sampling method, you can switch between the two methods by clicking on either the Line or Box buttons in the top left-hand corner of the image window. The third method, Median, is the same as Line selection, except that each point sampled is the result of taking a 3x3 region around the point the user clicked and then applying a median filter. This can potentially reduce any noisy pixels.

→ If the foreground image has a shadow in it that you want to keep in the composite, do not select any of the dark blue pixels in the shadow and the shadow will come along with the rest of the foreground image.
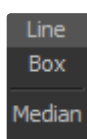
→ The second and third steps in using Primatte require viewing the Matte View in the monitor window. Make sure the View Mode buttons at the top of the Primatte interface has the Black Mode selected.
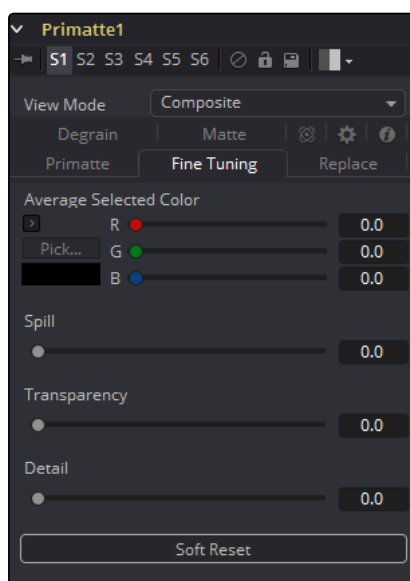
→ Click on the Alpha Channel/RGB button located below the Viewer. The image displayed will change to a black and white 'matte' view of the image that looks like this:
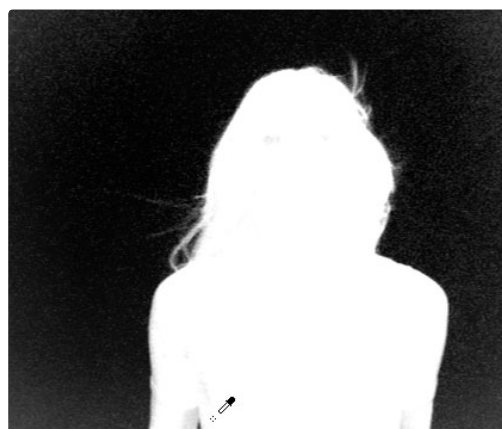
Clean Background Noise

Clean Background Noise

Change the Operational Mode Selector from Select Background Color to Clean Background Noise. If there are any white regions in the dark, `blue screen area,' this is referred to as 'noise.' Technically, it is some shades of blue that did not get picked up on the first sample and should be removed. Move the cursor through these areas if using the Line Sampling method (or make a box around them if using the Box Sampling method), and sample these whitish noise regions. When you let up on the mouse button, Primatte will process the data and eliminate the noise. Repeat this procedure as often as necessary to clear the noise from the background areas. Sometimes increasing the brightness of your monitor or the screen gamma allows you to see noise that would otherwise be invisible.

| Before Background noise removal | After Background noise removal |

Note: You do not need to remove every single white pixel to get good results. Most pixels displayed as a dark color close to black in a key image will become transparent and virtually allow the background to be the final output in that area. Consequently, there is no need to eliminate all noise in the blue screen portions of the image. In particular, if an attempt is made to meticulously remove noise around the foreground object, a smooth composite image is often difficult to generate.

Tip When clearing noise from around loose, flying hair or any background/foreground transitional area, be careful not to select any of areas near the edge of the hair. Leave a little noise around the hair as this can be cleaned up later using the Fine Tuning tool.

Clean Foreground Noise

Clean Foreground Noise

If there are dark regions in the middle of the mostly white foreground object, that is, if the key is not 100% in some portion of the targeted foreground, choose Clean Foreground Noise from the Operational Mode Selector pop-up menus. Use the same techniques as for Clean Background Noise, but this time sample the dark pixels in the foreground area until that area is as white as possible.

Before Foreground noise removal   After Foreground noise removal

Removing Spill Setup
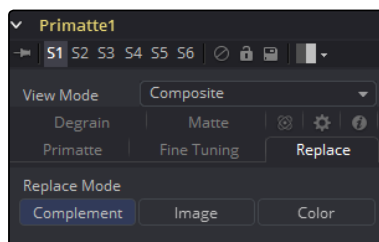
These were the steps necessary to create a clean 'matte' or 'key' view of the image. With this key, the foreground can be composited onto any background image. However, if there is `spill' on the foreground object from light that was reflected off the background, a final operation is necessary to remove that background spill to get a more natural looking composite.

For the fourth step in the Primatte operation, return the Composite view to the monitor window by clicking again on the Alpha/RGB toggle button. Now change the View mode to Composite. This will turn off the Alpha Channel viewing mode and the monitor window will again display the Composite view with the background image. The sample image below has gone through the first three steps and has examples of spill. Notice the blue fringe to her hair and a blue tint on her right cheek, arm and chest.

Spill Removal - Method #1

Spill Sponge

→ There are three ways in Primatte to remove the spill color. The quickest method is to select the Spill Sponge button from the Operational Mode area and then sample the spill areas away. By just positioning the cursor over a bluish pixel and selecting it, the blue will disappear from the selected color region and be replaced by a more natural color. Additional spill removal should be done using the tools under the Fine Tuning tab or by using the Spill (-) feature. Both are explained further on in this manual.

Note: All spill removal/replacement operations in Primatte can be modified using the Background Spill Replacement tools under the Replace tab. Spill can be replaced with either the complement of the background color, a solid color selected by the user or by colors brought from a defocused copy of the background. Depending on the spill conditions, one of these options should provide the results you are looking for. See the information in Section 5, Spill Replacement Options for more details.

Note: Primatte's Spill Removal tools work on 'color regions.' In the image above, samples should be made on the light flesh tones, the dark flesh tones, the light blonde hair, the dark blonde hair and the red blouse color regions. One sample in each color region will remove spill from all similar colors in the foreground image.

If the spilled color was not been totally removed using the Spill Sponge, or if the result of the Spill Sponge resulted in artifacts or false coloring, a fine-tuning operation Spill (-) tool should be used instead for a more subtle and sophisticated removal of the spilled background color.

Spill Removal - Method #2

→ Select the Fine Tuning tab in the Primatte interface.
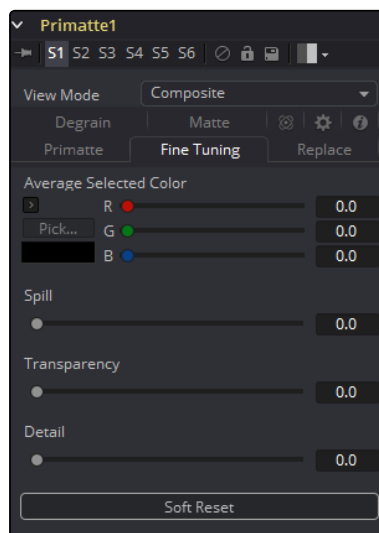
→ Using the zoom and pan capabilities of the Fusion application, zoom into an area that has some blue edges or spill.

→ Using the cursor, sample a color has spill in it. When you let up on the mouse button, Primatte will register the color selected (or an average of multiple pixels) in the Pick... Color Chip. For most images, the Spill slider is all that is required to remove any remaining bluespill. The more to the right the slider moves, the more background screen color will be removed from the sampled pixels. The more to the left the slider moves, the more the selected pixels will move toward the color in the original foreground image.

Note: When using the slider in the Fine Tuning tab to remove spill, spill color replacement will be replaced based on the setting of the Spill Replacement options.

Tip: It is better to make several small adjustments to the bluespill areas than a single major one.

You can use the other two sliders in the same way for different key adjustments. The Detail slider controls the matte softness for the color that is closest to the background color. For example, you can recover lost rarefied smoke in the foreground by selecting the Fine Tuning mode, clicking on the area of the image where the smoke just starts to disappear and moving the Detail slider to the left. The Transparency slider controls the matte softness for the color that is closest to the foreground color. For example, if you have thick and opaque smoke in the foreground, you can make it semi-transparent by moving the Transparency slider to the right after selecting the pixels in the Fine Tuning mode.

Tip: If the foreground image changed color dramatically during the fine-tuning process, you can recover the original color by selecting an area of the off-color foreground image and moving the Spill slider slightly to the left. This may introduce blue spill back into that color region. Again, use the Fine Tuning option to suppress the blue, but make smaller adjustments this time.

Spill Removal - Method #3

This method uses a fairly recent Primatte tool that is covered in detail in the next section: Repeatable Sampling Tools.

Note: If these final 'spill suppression' operations have changed the final compositing results, you may have to return to earlier operations to clean up the matte. If the Composite view looks good, it is a good idea to go back and take a final look at the Alpha Channel view. Sometimes in the Primatte operation, a 100% foreground area (all white) will become slightly transparent (gray). You can clean those transparent areas up by using the Matte Sponge tool. After selecting the Matte Sponge tool, just click on the transparent pixels and they will become 100% foreground. All of the spill-suppression information will remain intact. Alternatively, you can go to the Alpha Channel view and then using the Fine Tuning option, select those transparent areas and move the Transparency slider slightly to

the left. This will move that color region from 0-99% foreground with spill suppression to 100% foreground with spill suppression and should solve the problem. The Matte (+) tool will also work to solve this problem.

Matte Sponge

Repeatable Sampling Tools

Most of the Primatte operations are done using a 'mouse sampling' operation. The only exceptions are the Fine Tuning operational mode and its sliders. The Fine Tuning operation gives a continuous valuator for fine-tuning, but some of the sliders are not often used because results are often unpredictable or not subtle enough. Note: Another weak point in previous versions of Primatte is the lack of functionality to attenuate and thicken the existing matte density. This version of Primatte offers a more intuitive, easy-to-use and powerful user interface called Repeatable Sampling.

In addition to the conventional Primatte operation modes previously mentioned, six other tools are added:

→ Spill (+)

→ Spill (-)

→ Matte (+)

→ Matte (-)

→ Detail(+)

→ Detail(-)

The Spill Sampling Tools

Using the Spill (+) and Spill (-) modes, you can gradually remove or recover the spill intensity on the foreground object by sampling the referenced color region repeatedly. The conventional Spill Sponge tool removed the spill component in a single action at one level and did not allow sampling the same pixel a second time. Even though just a small amount of spill needed to be removed, the Spill Sponge removed a preset amount without allowing any finer adjustment.

Effect of Spill (+/-) Repeatable Sampling

Using the zoom and pan capabilities of the Fusion application, zoom into an area that has some blue edges and click on a pixel with some spill on it. Repeated clicking will incrementally remove the spill. Continue this operation until the desired result is achieved.

The Matte Sampling Tools

The Matte (+) and Matte (-) modes are used to thicken or attenuate the matte information. If you want a thinner shadow on a foreground object, you can use the Matte (-) mode as many times as you like to make it more transparent. On the other hand, you can use the Matte (+) mode to make the matte thicker in that color region.

(-) ◄——— **Matte** ———► (+)

Effect of Matte (+/-) Repeatable Sampling
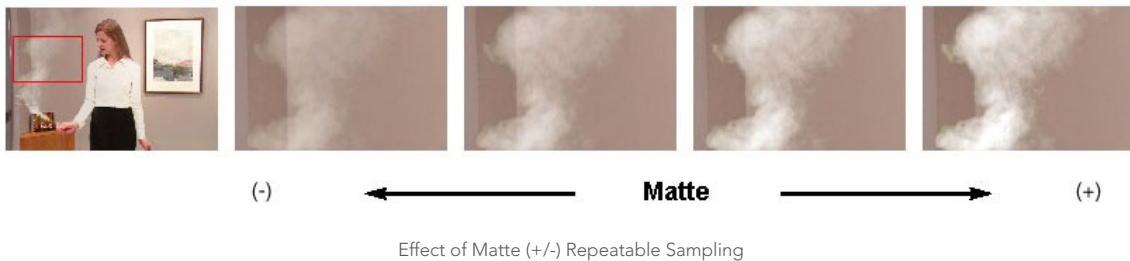
The Detail Sampling Tools

The Detail (+) and Detail (-) modes are a refined version of Clean Background Noise and Restore Detail. For example, when you see some dilute noise in the backing area but don't want to remove it completely because it affects some fine detail in a different area, try using Detail (-). It will attenuate the noise gradually as multiple samples are made on the pixel. You should stop the sampling when important fine details start to disappear.

(-) ◄——— **Detail** ———► (+)

Effect of Detail (+/-) Repeatable Sampling

Spill Replacement Options
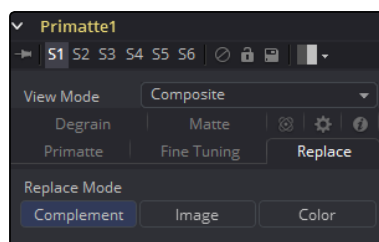
The proper processing of spill on foreground objects is one of the many useful features of Primatte. You can move between these three modes to see how they affect the image clip you are working

with. The three methods are as follows:

→ Complemental Spill Replacement (Complement)

→ Defocus Spill Replacement (Image)

→ Solid Color Spill Replacement (Color)

Complemental Replacement Mode

This is the default Spill Replacement mode. This mode will maintain fine foreground detail and deliver the best quality results. If foreground spill is not a major problem, this mode is the one that should be used.
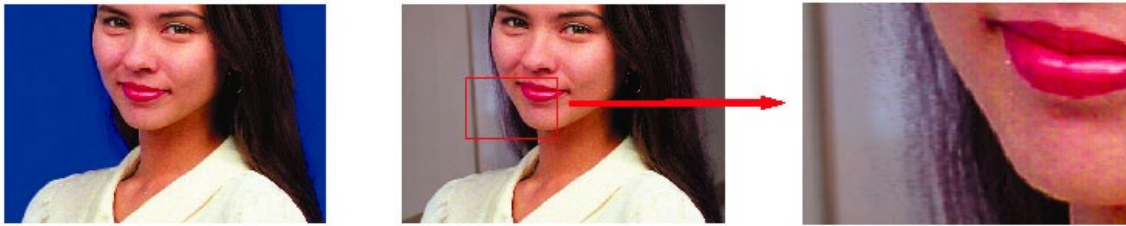
Complemental Replacement Mode maintains fine detail.

The Complemental Replacement mode is sensitive to foreground spill. If the spill intensity on the foreground image is rather significant, this mode may often introduce serious noise in the resultant composite.

Solid Color Replacement Mode

Defocus Replacement Mode

The Defocus Replacement mode uses a defocused copy of the background image to determine the spill replacement colors instead of a solid palette color or just the complement color. This mode can result in good color tone on the foreground object even with a high contrast background. As in the example below, spill can even be removed from frosted glass using this feature and still retain the translucency. On the negative side, the Defocus Replacement mode sometimes results in the fine edge detail of the foreground objects getting lost. Another problem could occur if the user wanted to later change the size of the foreground image against the background. Since the background/

foreground alignment would change, the applied color tone from the defocused image might not match the new alignment.
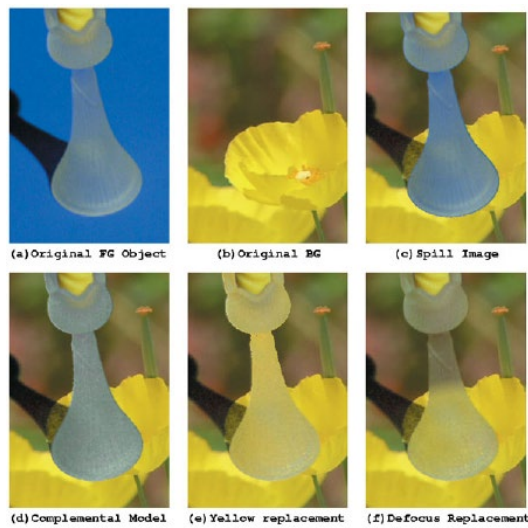
Blue Suppression of a Frosted Glass Object

Solid Color Replacement Mode

In the Solid Color Replacement mode, the spill component will be replaced by a 'user defined' palette color. While the Complemental Replacement mode uses only the backing color complement to remove small amounts of spill in the original foreground, the Solid Color Replacement mode tries to assuage the noise using the 'user defined' palette color. Changing the palette color for the solid replacement, the user can apply good spill replacement that matches the composite background. Its strength is that it works fine with even serious blue spill conditions.

Smooth Spill Processing with Solid Color Replacement

On the negative side, when using the Solid Color Replacement mode, fine detail on the foreground edge tends to be lost. The single palette color sometimes cannot make a good color tone if the background image has some high contrast color areas.

Matte Blur Inward Feature

A new method of defocusing or blurring the matte has been added. This new feature can be set to only blur inward toward the center of the foreground subject. The conventional Primatte defocus feature affected the matte edges in both directions (inward and outward) and sometimes introduced a halo artifact around the object edge in the composite view. This was most evident when using the Complemental Replacement mode. With the Blur Inward switch On, the matte defocus functions only in the inward direction of the foreground subject (toward the center of the white area). The final result is that it removes small and dark noise in the backing area without picking them up again in the Clean Background Noise mode and sometimes results in softer, cleaner edges on the foreground objects. Background Noise mode and sometimes results in softer, cleaner edges on the foreground objects.

| Normal | Conventional Defocus | Inward Defocus |

External Garbage Matte Input

Primatte accepts a hand-drawn matte as the external matte to hide the unnecessary garbage like light arms, microphones and other undesirable foreground object. Areas that are white in the Garbage Matte clip will take the pixels from the background and areas that are black will be from the composite image. This External Garbage Matte can also be inverted.

Stereo Tools

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Stereo Tools

Stereo Tools

3D ▶	
Blur ▶	
Color ▶	
Composite ▶	
Creator ▶	
Deep Pixel ▶	
Effect ▶	
Film ▶	
Filter ▶	
Flow ▶	
Fuses ▶	
I/O ▶	
LUT ▶	
Macro ▶	
Mask ▶	
Matte ▶	
Metadata ▶	
Miscellaneous ▶	
OpenCL ▶	
Optical Flow ▶	
Paint ▶	
Particles ▶	
Position ▶	
Primatte ▶	
Stereo ▶	Anaglyph
Tracking ▶	Combiner
Transform ▶	Disparity
Warp ▶	Disparity To Z
	Global Align
	New Eye
	Splitter
	Stereo Align
	Z To Disparity

Anaglyph

New Eye

Combiner

Splitter

Disparity

Stereo Align

Disparity To Z

Z To Disparity

Global Align
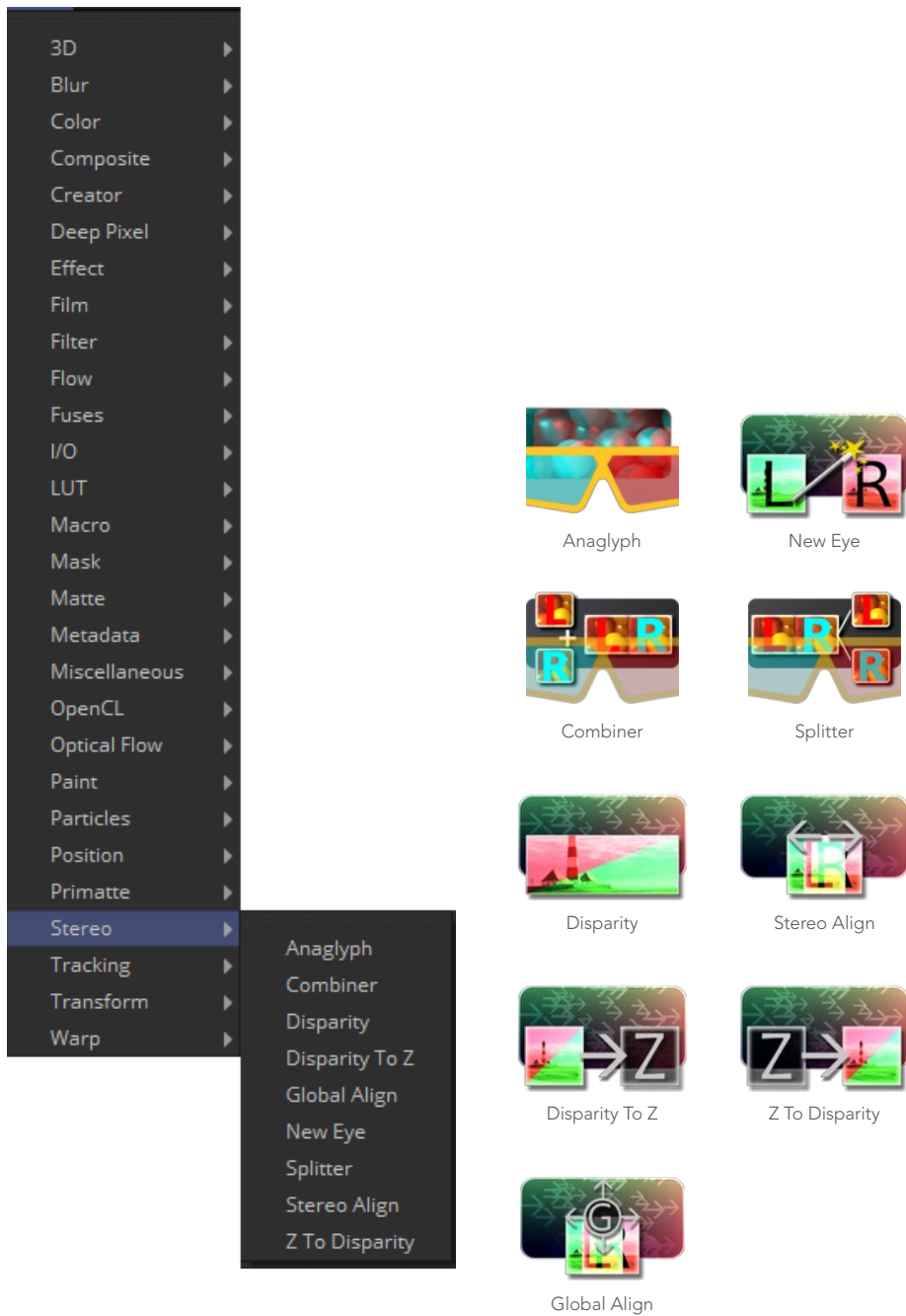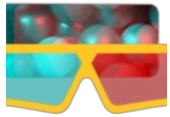
Anaglyph [Aɴᴀ]

The Anaglyph tool is used to create stereoscopic images by combining separate left eye and right eye images. It is most commonly used at the end of a stereoscopic workflow to display or deliver the final result. Stereoscopic tools are only available in Fusion Studio.

Controls Tab

When using separate images for the left and right eye, the left eye image is connected to the orange input and the right eye image is connected to the green input of the tool. When using either horizontally or vertically stacked images containing both left eye and right eye information, these only connect to the orange input. Based on one of the methods described below, the separate images are then combined to create a stereoscopic output

.
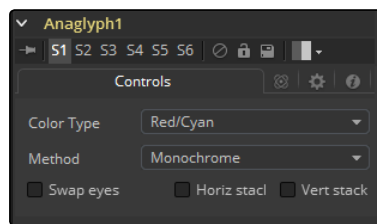
Color Type Menu

The ColorType menu allows you to choose between different color encodings to fit your preferred display device. To match your stereo glasses you can choose between Red/Cyan, Red/Green, Red/Blue, Amber/Blue and Green/Magenta encoding; Red/Cyan turns out to be the most commonly used.
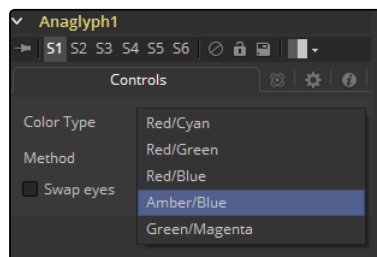
Method Menu

In addition to the color used for encoding the image, you can also choose five different methods: Monochrome, Half-color, Color, Optimized and Dubois.
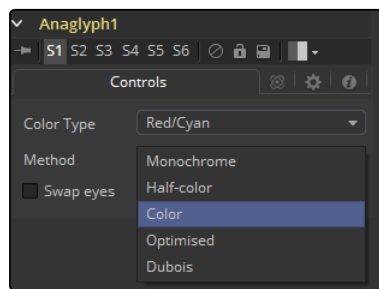
Monochrome

The left eye contains the luminance of the left image, and the right eye contains the luminance of the right image (e.g., the luminance of the left image is placed in the output red channel, and the luminance of the right image is placed in the output green and blue channels).

Half-Color

The left eye contains the luminance of the left image, and the right eye contains the color channels from the right image that match the glasses color for that eye (e.g., the luminance of the left image is placed in the output red channel, and the green and blue channels of the right image are placed in the output green and blue channels).
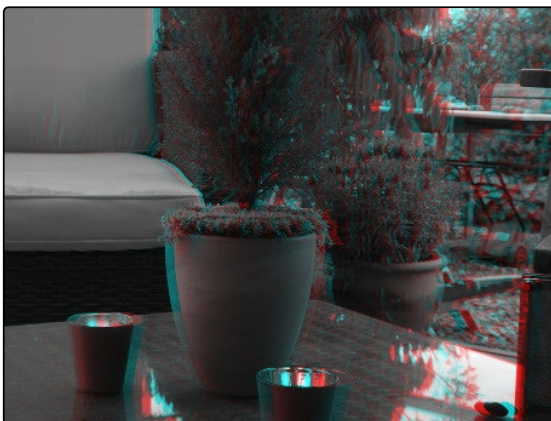
Monochrome
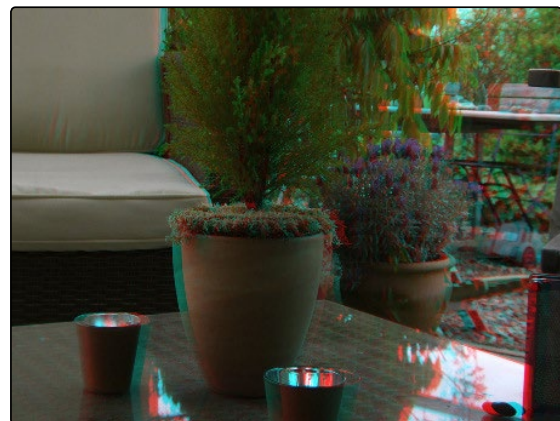
Half-Color

Color

The left eye contains the color channels from the left image that match the glasses color for that eye, and the right eye contains the color channels from the right image that match the glasses color for that eye (e.g., the red channel of the left image is placed in the output red channel, and the green and blue channels of the right image are placed in the output green and blue channels).
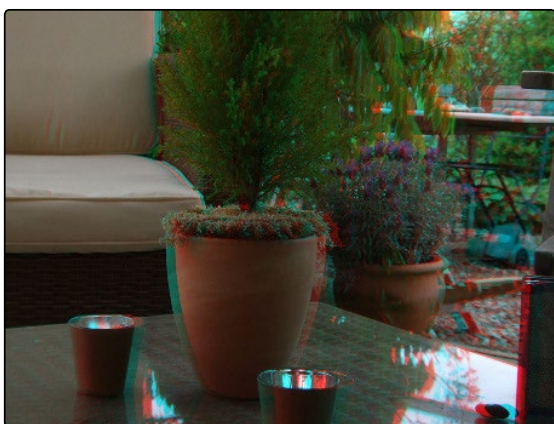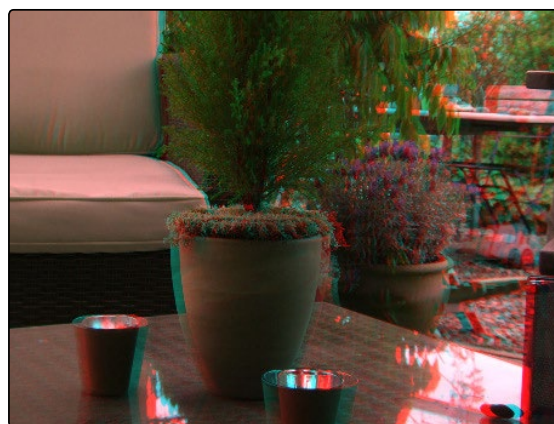
Color   Optimized

Optimized

Used with red/cyan glasses, for example, the resulting brightness of what shows through the left eye will be substantially less than the brightness of the right eye. Using typical ITU-R 601 ratios for luminance as a guide, the red eye would give 0.299 brightness, while the cyan eye would give 0.587+0.114=0.701 brightness - over twice as bright. The difference in brightness between the eyes can produce what's referred to as retinal rivalry or binocular rivalry, which can destroy the stereo effect. The Optimized method generates the right eye in the same fashion as the Color method. The left eye also uses the green and blue channels, but in a combination with increased brightness that reduces retinal rivalry. Since it uses the same two channels from each of the source images, it doesn't reproduce the remaining one (e.g., 1.05× the green and 0.45× the blue channels of the left image is placed in the output red channel, and the green and blue channels of the right image are placed in the output green and blue channels. Red from both the left and right images is not used.).

Dubois

Images with fairly saturated colors can produce retinal rivalry with Half-color, Color and Optimized methods because the color is only visible in one eye. For example, with red/cyan glasses, a saturated green object looks black in the red eye, and green in the cyan eye. The Dubois method uses the spectral characteristics of (specifically) red/cyan glasses and CRT (Trinitron) phosphors to produce a better anaglyph and in the end tends to reduce retinal rivalry caused by such color differences in each eye, and also tends to reduce ghosting produced when one eye 'leaks' into the other eye. The particular calculated matrix we use is designed for red/cyan glasses and isn't available for other glasses types. Since it is also derived from CRT color primaries, it may not give the best results with

a common LCD (though it'll still likely produce less retinal rivalry and ghosting than the other methods).
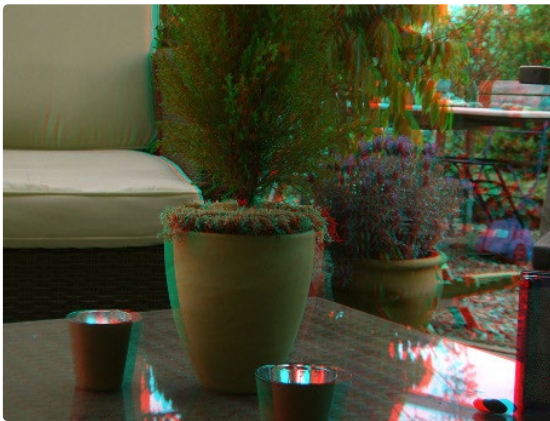
Dubois

Swap Eyes
Allows the user to easily swap the left and right eye input.

Horiz Stack
Takes an image that contains both left and right eye information stacked horizontally. These images are often referred to as 'crosseyed' or 'straight stereo' images. You only need to connect that one image to the orange input of the tool. It then creates an image half the width of the original input, using the left half of the original image for the left eye and the right half of the original image for the right eye. Color encoding takes place using the specified color type and method.

Vert Stack
Takes an image that contains both left and right eye information stacked vertically. You only need to connect that one image to the orange input of the tool. It then creates an image half the height of the original input, using the bottom half of the original image for the left eye and the top half of the original image for the right eye. Color encoding takes place using the specified color type and method.

Combiner [Com]

The Combiner tool takes two stereoscopic inputs and creates so called stacked images with the left and right eye, either side by side or on top of each other. Stereoscopic tools are only available in Fusion Studio

Controls Tab

To stack the images, the left eye image is connected to the orange input and the right eye image is connected to the green input of the tool.
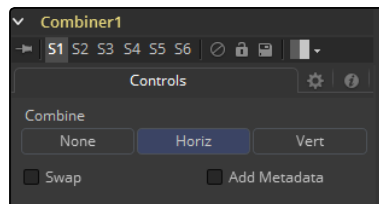
None
No operation will take place. The output image is identical to the left eye input.

Horiz
Both images will be stacked horizontally, or side-by-side, with the image connected to the left eye input on the left. This will result in an output image double the width of the input image.

Vert
Both images will be stacked vertically, or on top of each other, with the image connected to the left eye input on the bottom. This will result in an output image double the height of the input image.

Swap Eyes
Allows the user to easily swap the left and right eye input.

Disparity [DIS]

Stereoscopic tools are only available in Fusion Studio.

Disparity generates the left/right shift between the frames in a stereo pair. It also generates the vertical disparity between the left/right images, which is usually a lot smaller than the horizontal disparity and ideally should be 0 to minimize viewing discomfort. When viewing the output of the Disparity tool in the views, the human eye can distinguish quality/detail in the Disparity map better by looking at either the grayscale X disparity or Y disparity, rather than looking at the combined XY disparity as a Red/Green color image.

The generated disparity is stored in the output image's Disparity aux channel, where the left image contains the left > right disparity and the right image contains the right > left disparity. Because disparity works based upon matching regions in the left eye to regions in the right eye by comparing colors and gradients of colors, it is important that colors in the two eyes are as similar as possible. Thus, it is a good idea to color correct ahead of time. It is also a good idea to crop away any black borders around the frames, as this will confuse the disparity tracking (and also cause problems if you are using ColorCorrector's histogram match ability to do the color matching).

In Stack mode, left and right outputs will output the same image. If the left and right images have a global vertical offset bigger than a few pixels from each other, it can help the disparity tracking algorithm if you approximately vertically align features in the left/right eyes ahead of time using a Transform tool. Small details tend to get lost in the tracking process when you have a large vertical offset between left/right eyes.

Consider using a SmoothMotion tool to smooth your Disparity channel. This can help reduce time-dependent flickering when warping an eye. Also think about whether you want to remove lens distortion before computing disparity. If you do not, your Disparity map will become a combined Disparity and Lens Distortion map. This can have advantages and disadvantages. One disadvantage is if you then do a vertical alignment you are also removing lens distortion effects. When trying to reduce the computation time, start first with adjusting the Proxy and Number of Iterations sliders.

The Disparity tool does not support RoI or DoD.

Inputs/outputs

Left Input
Connect either the left eye image or the stacked image.

Right Input
Connect the right eye image. This input is invisible unless Stack Mode is set to Separate.

Left Output
This holds the left eye image with a new Disparity channel, or a Stacked Mode image with a new disparity channel.

Right Output

This holds the right eye image with a new Disparity channel. This output is only visible if Stack Mode is set to Separate.

Controls
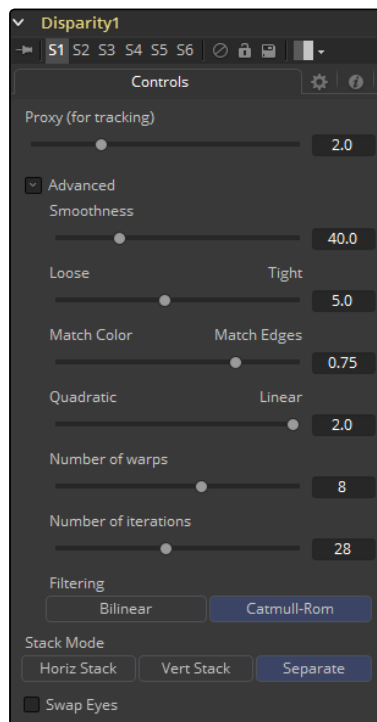
Proxy (for tracking)

The input images are re-sized down by the proxy scale, tracked to produce the disparity, and then the resulting disparities are scaled back up. This option is purely to speed up calculation of the disparity, which can be slow. The computational time is roughly proportional to the number of pixels in the image. This means a proxy scale of 2 will give a 4x speed up and a proxy scale of 3 will give a 9x speed up. In general, 1:1 proxy will give the most detailed flow, but keep in mind that this is highly dependent on the amount of noise and film grain, which if present in large quantities can completely obliterate any gains moving from 2:1 to 1:1 proxy and in some situations even make things worse (in some sense you can think of the Proxy setting as acting as a simplistic low-pass filter for removing noise/grain).

Stack Mode

Determines how the input images are stacked.

When set to Separate, the Right Input & Output will appear and separate left and right images need to be connected.

Swap Eyes

With Stacked Mode, image stereo pairs, left and right images can be swapped.

Advanced
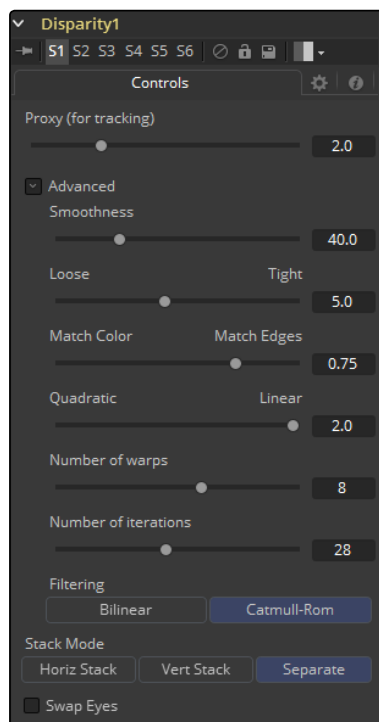
The Advanced Control section has parameter controls to tune the Disparity map calculations. The default settings have been chosen to be the best default values from experimentation with many different shots and should serve as a good standard. In most cases, tweaking of the advanced settings will not be needed.

Smoothness

This controls the Smoothness of the disparity. Higher smoothness helps deal with noise, while lower smoothness brings out more detail.

Edges

This slider is another control for smoothness but applies smoothing based upon the color channel. It tends to have the effect of determining how edges in the disparity follow edges in the color images. When it is set to Loose, the disparity becomes smoother and tends to overshoot edges. When it is set to Tight, edges in the disparity align more tightly with the edges in the color images and details from the color channels start to slip into the disparity, which is not usually desirable.

As a rough guideline, if you are using the disparity to produce a Z-channel for post effects like depth of field, then you can experiment with making it tighter, but if you are using the disparity to do interpolation, you might want to keep it looser.

In general, if it is too tight, there can be problems with streaked out edges when the disparity is used for interpolation.

Match Weight

This controls how the matching of neighborhoods in the left to neighborhoods in the right image is done. When set to Match Color, large structural color features are matched. When set to Match Edges, small sharp variations in the color are matched. Typically, a good value for this slider is in the [0.7, 0.9] range, although on some shots values closer to 0.0 work well. Setting this option higher tends to improve the matching results in the presence of differences due to smoothly varying shadows or local lighting variations between the left and right images. The user should still do a color match on the initial images so they are as similar as possible; this option tends to help with local variations (e.g., lighting differences due to light passing through a mirror rig).

Mismatch Penalty

This controls how the penalty for mismatched regions grows as they become more dissimilar. The slider gives the choice between a balance of Quadratic and Linear penalties. Quadratic strongly penalizes large dissimilarities while Linear is more robust to dissimilar matches. Moving this slider toward Quadratic tends to give a disparity with more small random variations in it, while Linear produces smoother, more visually pleasing results.

Number of Warps

Turning this option down makes the disparity computations faster. In particular, the computational time depends linearly upon this option. To understand what this option does, you need to understand that the Disparity algorithm progressively warps the left image until it matches with the right image. After some point, convergence is reached and additional warps are just a waste of computational time. The default value in Fusion is set high enough that convergence should always be reached. You can tweak this value to speed up the computations, but it is good to watch how the disparity is degrading in quality at the same time.

Number of Iterations

Turning this option down makes the disparity computations faster. In particular, the computational time depends linearly upon on this option. Just like adjusting Number of Warps, at some point adjusting this option higher will give diminishing returns and not produce significantly better results. By default, this value is set to something that should converge for all possible shots and can be tweaked lower fairly often without reducing the disparity's quality.

Filtering

This controls Filtering operations used during flow generation. Catmull-Rom filtering will produce better results, but at the same time, turning on Catmull-Rom will increase the computation time steeply.

Disparity To Z [D2Z]

Description

DisparityToZ takes a 3D camera and an image containing a Disparity channel as inputs and outputs the same image but with a newly computed Z channel. Stereoscopic tools are only available in Fusion Studio

Optionally, this tool can output Z into the RGB channels. Ideally, either a stereo Camera3D or a tracked stereo camera is connected into DisparityToZ, however, if no camera is connected, the tool provides artistic controls for determining a Z channel. The depth created by this tool can be used for post effects like fogging or depth of field.

The Z values produced become more incorrect the larger (negative) they get. The reason is that disparity approaches a constant value as Z approaches -infinity. So Z = -1000 and Z = -10000 and Z = -100000 may map to D=142. 4563 and D=142. 4712 and D=142. 4713. As you can see, there is only 0.0001 in D to distinguish between 10,000 and 100,000 in Z. The maps produced by Disparity are not accurate enough to make distinctions like this.

Inputs/outputs

Left Input
Connect either the left eye image or the stack image.

Right Input
Connect the right eye image. This input is invisible unless Stack Mode is set to Separate.

Stereocamera
An external stereo camera tool.

Left Output
Holds the left eye image with a new Z channel or a stacked mode image with a new Z channel.

Right Output
Holds the right eye image with a new Z channel. This output is only visible if Stack Mode is Separate.

Controls
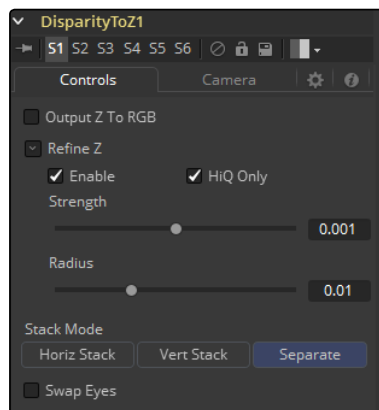
In addition to outputting Z values in the Z channel, this option promotes the color channels to float32 and outputs the Z values into the color channels as {z, z, z, 1}. This option is useful to get a quick look to see what the Z channel looks like. Note that Dimension's Z values are negative, getting more negative the further you are from the camera, so you will need view Normalization On to see them correctly.

Output Z to RGB

Rather than keeping the Z values within the associated aux-channel only, they will be copied into the RGB channels for further modification with any of Fusion's tools.

Refine Z

This option refines the depth map based upon the RGB channels. The refinement causes edges in the flow to align more closely to edges in the color channels. The downside is that unwanted details in the color channels start to show up in the flow. You may want to experiment with using this option to soften out harsh edges for Z-channel post effects like depth of field or fogging.

HiQ Only

This option only processes in HiQ.

Strength

Increasing this slider does two things. It smooths out the depth in constant color regions and moves edges in the Z channel to correlate with edges in the RGB channels.

Increasing the refinement has the undesirable effect of causing texture in the color channel to show up in the Z channel. You will want to find a balance between the two.

Radius

This is the radius of the smoothing algorithm.

Camera Tab

If you need correct real-world Z values because you are trying to match some effect to an existing scene, you should use the External Camera options to get precise Z values back. If you just want any Z-buffer and are not that particular about the exact details on how it is offset and scaled, or if there is no camera available, the Artistic option might be helpful.

External Mode
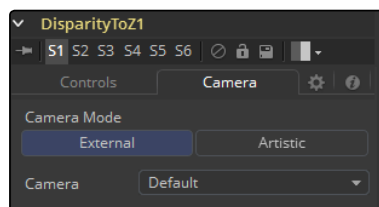
An input will appear on the flow to connect an existing stereo Camera3D. This can either be a single stereo Camera3D (i.e., its eye separation is set to non-zero), or a pair of (tracked) Camera3Ds connected together via the Camera3D > Stereo > RightCamera input.

Artistic Mode
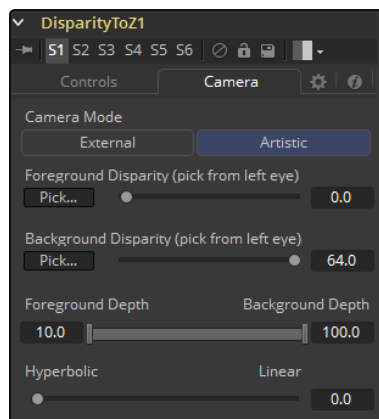
If you do not have a camera, you can adjust these controls to produce an "artistic" Z channel whose values will not be physically correct but still useful. To reconstruct the Disparity > Z Curve, pick (D, Z) values for a point in the foreground and a point in the background

If artistic mode is a little too "artistic" for you and you want more physically-based parameters to adjust (e.g., convergence and eye separation), you can always create a bogus Camera3D, connect it into the DisparityToZ > Camera input, and then fiddle with the Camera3D's controls.

Foreground Disparity (pick from left eye)

This is the disparity for the closest foreground object. It will get mapped to depth value specified by the Foreground Depth control. Any objects with disparity outside of the range [ForegroundDisparity, BackgroundDisparity] will have their disparity values clipped to this range leading to flat areas in the Z channel, so make sure that you pick values that enclose the actual disparity range.

Background Disparity (pick from left eye)

This is the disparity for the furthest background object. It will get mapped to the depth value specified by the Background Depth control. One way to think of this input is as the upper limit to disparity values for objects at -infinity. This value should be for the left eye. The corresponding value in the right eye will be the same in magnitude but negative.

Foreground Depth

This is the depth to which Foreground Disparity will be mapped. Think of this as the depth of the nearest object. Note that values here are positive depth.

Background Depth

This is the depth to which Background Disparity will be mapped. Think of this as the depth of the most distant object.

Falloff

Falloff controls the shape of the depth curve between the requested foreground and background depths. When set to Hyperbolic, the disparity-depth curve behaves roughly like depth = constant/disparity. When set to Linear, the curve behaves like depth = constant*disparity. Hyperbolic tends to emphasize Z features in the foreground, while linear gives foreground/background features in the Z channel equal weighting. Unless there's a specific reason not to, prefer Hyperbolic, as it is more physically accurate, while Linear does not correspond to nature and is purely for artistic effect.

Global Align [GA]

As opposed to Stereo Align, this tool does not utilize optical flow at all. It's meant as a fast and convenient way to do simple stereo alignment for both X and Y as well as rotation. Stereoscopic tools are only available in Fusion Studio.

Global Align comes in handy at the beginning of the tool chain to visually correct major differences between left and right eye before calculating Disparity.

Manual correction of large discrepancies between left and right, as well as applying an initial color matching, helps Disparity to generate more accurate results.

Controls
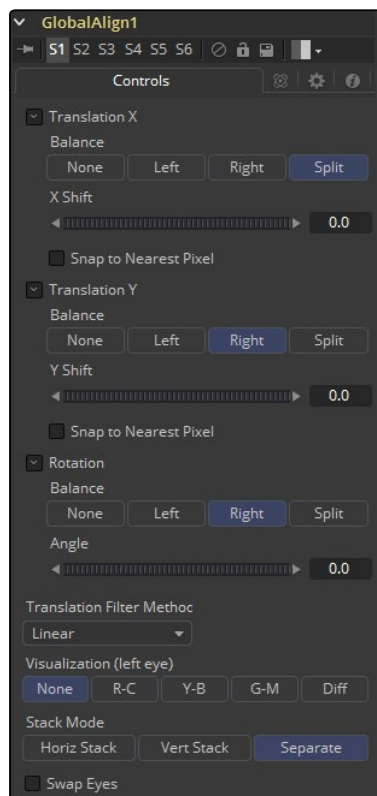
Translation X and Y

→ Balance: Determines how the global offset is applied to the stereo footage.

→ None: No translation is applied.

→ Left Only: The left eye is shifted, while the right eye remains unaltered.

→ Right Only: The right eye is shifted, while the left eye remains unaltered.

→ Split Both: Left and right eyes are shifted in opposite directions.

Snap to Nearest Pixel

While adjusting the translation slider, this option ensures that the image is shifted in full pixel amounts only to maintain optimum quality. This avoids sub-pixel rendering of the image, which could result in subtle blurring.

Rotation

→ Balance: Determines how the global rotation is applied to the stereo footage.

→ None: No rotation is applied.

→ Left Only: The left eye is rotated, while the right eye remains unaltered.

→ Right Only: The right eye is rotated, while the left eye remains unaltered.

→ Split Both: Left and right eyes are rotated in opposite directions.

Angle

The angle of the rotation. Keep in mind that the result depends on the Balance settings. If only rotating one eye by, for example, 10 degrees, a full 10 degree rotation will be applied to that eye.

When applying rotation in Split mode, one eye will receive a -5 degree and the other eye a +5 degree rotation.

Translation Filter Method

A dropdown to choose a filter method that delivers the best results depending on the content of your footage.

Visualization

This control allows for different color-encodings of the left and right eye to conveniently examine the results of the above controls without needing to add an extra Anaglyph or Combiner tool.

Set this to None for final output.

Stack Mode

Determines how the input images are stacked.

When set to Separate, the right input and output will appear and separate left and right images need to be connected.

Swap Eyes

With Stacked Mode, image stereo pairs, left and right images can be swapped.

New Eye [NE]

This option constructs a New Eye by interpolating between two existing eyes using the embedded Disparity channels. This tool can also be used to replace one view with a warped version of the other. In Stack Mode, L and R outputs will output the same image. Stereoscopic tools are only available in Fusion Studio.

You can map the left eye onto the right eye and replace it. This can be helpful when removing errors from certain areas of the frame.

NewEye does not interpolate the aux channels, but rather destroys them. In particular, the Disparity channels are consumed/destroyed. Add another Disparity tool after the NewEye if you want to generate Disparity for the realigned footage.

Inputs/outputs

Left Input

Connect either the left eye image or the stacked image.

Right Input

Connect the right eye image. This input is invisible unless Stack Mode is set to Separate.

Left Output

This holds the left eye image with a new Disparity channel, or a Stacked Mode image with a new disparity channel.

Right Output

This holds the right eye image with a new Disparity channel. This output is only visible if Stack Mode is set to Separate.

Controls
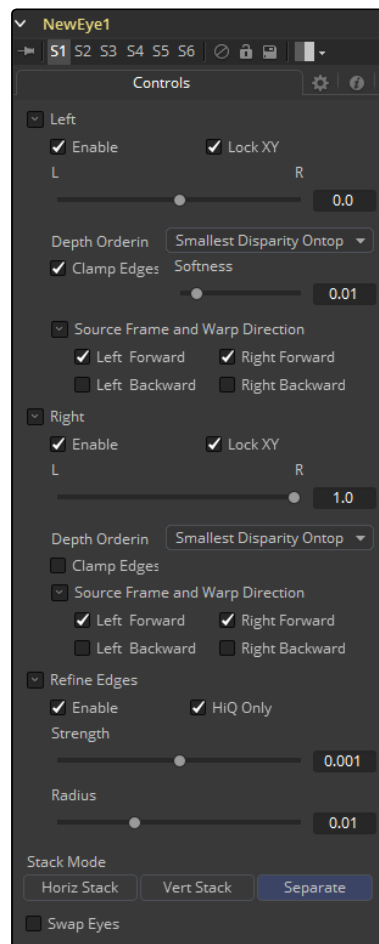
Enable

When an eye is enabled, NewEye will replace it with an interpolated eye. For example, if the left eye is your "master" eye and you are recreating the right eye, you would disable the left eye and enable the right eye.

Lock XY

Locks the X and Y interpolation parameters. When they are unlocked you can provide separate interpolation factors for using the X and Y disparity. For example, if you are working with the right eye and you have the X Interpolation slider set to 1.0 and the Y Interpolation slider set to -1.0, you will be effectively interpolating the left eye onto the right eye but vertically aligned to the left eye.

Interpolation

Interpolation determines where the frame we are interpolating is relative to the two source frames: Left and Right. An interpolation parameter of -1.0 will give frame Left back and a parameter of 1.0 will give frame Right back. A parameter of 0.0 will give a result that is halfway between Left and Right.

Depth Ordering

The Depth Ordering is used to determine which parts of the image should be rendered on top. When warping images there is often overlap. When the image overlaps itself, there are two options for which should be drawn on top.

→ **Largest Disparity Ontop:** The larger disparity values will be drawn on top in the overlapping image sections.

→ **Smallest Disparity Ontop:** The smaller disparity values will be drawn on top in the overlapping image sections.

Clamp Edges

Under certain circumstances, this option can remove the transparent gaps that may appear on the edges of interpolated frames. Clamp Edges will cause a stretching artifact near the edges of the frame that is especially visible with objects moving through it or when the camera is moving.

Because of these artifacts, it is a good idea to only use clamp edges to correct small gaps around the edges of an interpolated frame.

Softness

Helps to reduce the stretchy artifacts that might be introduced by Clamp Edges.

If you have more than one of the Source Frame and Warp Direction checkboxes turned on, this can lead to doubling up of the stretching effect near the edges. In this case you'll want to keep the softness rather small at around 0.01. If you only have one checkbox enabled you can use a larger softness at around 0.03.

Source Frame and Warp Direction

The output of this tool is generated by combining up to four different warps. You can choose to use either the color values from the left or right frame in combination with the Forward (left > right) Disparity or the Backward (right > left) Disparity. Sometimes you will want to replace an existing eye. For example, if you want to regenerate the right eye, you would only use left eye warps.

It is good to experiment with various options to see which gives the best effect. Using both the left and right eyes can help fill in gaps on the left/right side of images. Using both the Forward/ Backward Disparity can give a doubling up effect in places where the disparities disagree with each other.

→ **Left Forward:** This will take the Left frame and use the Forward Disparity to interpolate the new frame.

→ **Right Forward:** This will take the Right frame and use the Forward Disparity to interpolate the new frame.

→ **Left Backward:** This will take the Left frame and use the Back Disparity to interpolate the new frame.

→ **Right Backward:** This will take the Right frame and use the Back Disparity to interpolate the new frame.

Splitter [SPL]

The Splitter takes a stacked input image, for example created with the Combiner, and provides two output images: a left eye and a right eye. Stereoscopic tools are only available in Fusion Studio.

Controls Tab
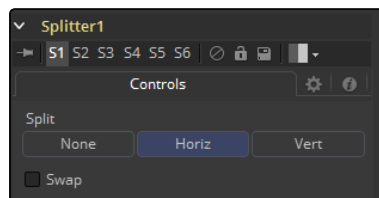
None

No operation will take place. The output image on both outputs is identical to the input image.

Horiz

The tool expects a horizontally stacked image. This will result in two output images, each being half the width of the input image.

Vert

The tool expects a vertically stacked image. This will result in two output images, each being half the height of the input image.

Swap Eyes

Allows the user to easily swap the left and right eye output.

Stereo Align [SA]

This extremely versatile tool for fixing Stereo issues can be used for doing any of the following or combinations of:

→ Vertical Alignment of one eye to the other

→ Changing the convergence

→ Changing the eye separation

By combining these operations in one tool, you can execute them using only a single image resampling. In essence, this tool can be thought of as applying scales and translation to the disparities, and then using the modified disparities to interpolate between the views.

Changing the eye separation can cause a lot of holes to appear and it may not be possible to fill them since the information needed may not be in either image. Even if the information is there, the disparity may have mismatched the holes. You may have to fill the holes in manually. For now, this tool will modify just the RGBA channels.

StereoAlign does not interpolate the aux channels, but rather destroys them. In particular, the Disparity channels are consumed/destroyed. Add another Disparity tool after the StereoAlign if you want to generate Disparity for the realigned footage. Stereoscopic tools are only available in Fusion Studio.

Controls
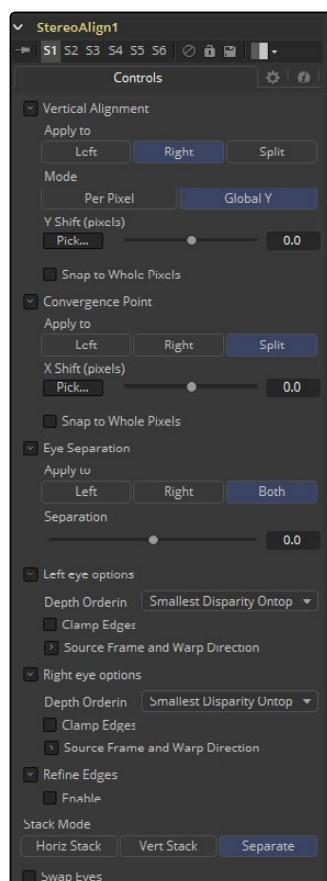
Vertical Alignment

This option determines how the Vertical Alignment is split between two eyes. Usually the left eye is declared inviolate and the right eye is aligned to it to avoid resampling artifacts.

When doing per pixel vertical alignment, it may be helpful to roughly pre-align the images by a global Y-shift before disparity computation because the disparity generation algorithm can have problems resolving small objects that move large distances.

Also note that you have to be careful about lens distortion because, even if two cameras are perfectly vertically aligned, they will still have vertical disparities due to lens distortion. It is probably a good idea to remove the lens distortion before computing the Disparity since, by doing a vertical alignment of the right eye, you are in effect removing the Y-component of the lens distortion in the right eye and it will look wrong later when you try to redistort it.

→ **Right:** Only the right eye is adjusted.

→ **Left:** Only the left eye is adjusted.

→ **Both:** The vertical alignment is split evenly between the left and right eyes.

Mode

→ **Global:** The eyes are simply translated up or down by the Y-shift to match up.

→ **Per Pixel:** The eyes are warped pixel-by-pixel using the Disparity to vertically align.

Keep in mind that this can introduce sampling artifacts and edge artifacts.

Y-shift

Y-shift is only available in Global Mode. You can either adjust the Y-shift manually to get a match or drag the pick button, which picks from the Disparity channel of the left eye. Also remember that, if you use this tool to modify disparity, you can't pick from the tool's output.

Snap

You can snap the global shift to whole pixels using this option. In this mode there is no resampling of the image, but rather a simple shift is done so there will be no softening or image degradation.

Convergence

Convergence is just a global X-translation of L/R images.

Eyes

This determines which eyes are affected by convergence. In most cases, this will be set to both. If you set the eyes to Both/Split, then the convergence will be shared 50-50 between both eyes. Sharing the convergence between both eyes means you get half the shift in each eye, which in turn means smaller holes and artifacts that need to be fixed later. The tradeoff is that you've resampled both eyes now rather than keeping one eye as a pure reference master.

X-shift

X-shift can be picked from the Disparity channels for easy point to feature alignment.

Snap

You can snap the global shift to whole pixels using this option. In this mode there is no resampling of the image, but rather a simple shift is done so there will be no softening or image degradation.

Eye Separation

Eye separation changes the distance between the left/right eyes, causing objects in the left/right eyes to converge/diverge further apart depending on their distance from the camera.

This has the same effect as Eye Separation option in Camera3D.

Separation

This is a scale factor for eye separation.

→ When set to 0.0, this leaves the eyes unchanged.

→ Setting it to 0.1 increases the shifts of all objects in the scene by a factor of 10% in each eye.

→ Setting it to 0.1 will scale the shifts of all objects 10% smaller.

Unlike the Split option for vertical alignment, which splits the alignment effect 50-50 between both eyes, the Both option will apply 100-100 eye separation to both eyes. If you are changing eye separation, it can be a good idea to enable per-pixel vertical alignment or the results of interpolating from both frames can double up.

Stack Mode

In Stack Mode, L and R outputs will output the same image.

If HiQ is off, the interpolations are done using nearest neighbor sampling leading to a more "noisy" result.

Clamp Edges

Under certain circumstances, this option can remove the transparent gaps that may appear on the edges of interpolated frames. Clamp Edges will cause a stretching artifact near the edges of the frame that is especially visible with objects moving through it or when the camera is moving.

Because of these artifacts, it is a good idea to only use clamp edges to correct small gaps around the edges of an interpolated frame.

Softness

Helps to reduce the stretchy artifacts that might be introduced by Clamp Edges.

If you have more than one of the Source Frame and Warp Direction checkboxes turned on, this can lead to doubling up of the stretching effect near the edges. In this case you'll want to keep the softness rather small at around 0.01. If you only have one checkbox enabled you can use a larger softness at around 0.03.

Example
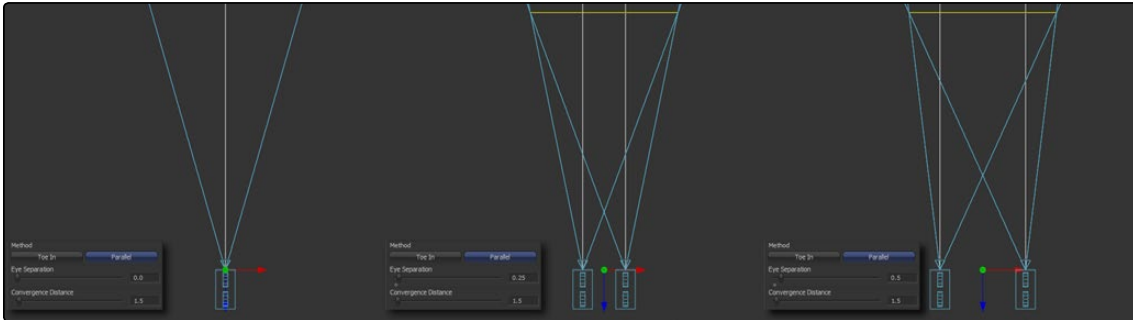
Different settings for Eye Separation:
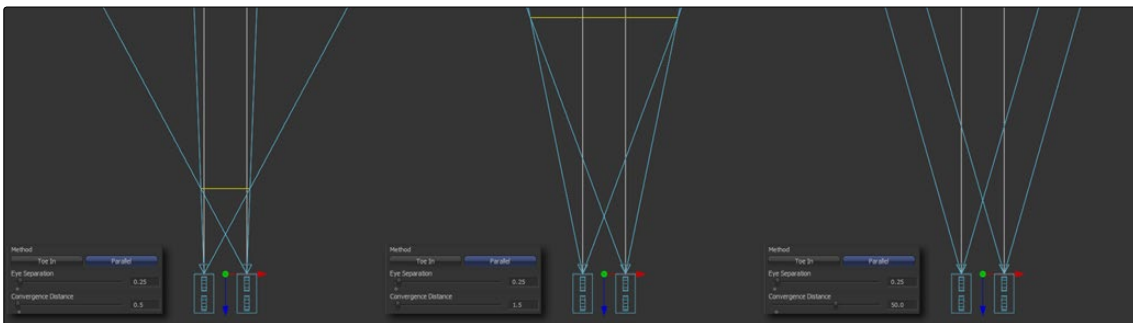
and Convergence:

Z To Disparity [Z2D]

ZToDisparity takes a stereo camera and an image containing a Z channel and outputs the same image but with Disparity channels in it. This is useful for constructing a Disparity map from CG renders, which will be more accurate than the Disparity map created from the Disparity generator tool. Stereoscopic tools are only available in Fusion Studio

Inputs/outputs

Left
This is the left image or stack input.

Right
This is the right image.

Stereocamera
A stereo perspective camera may be either a Camera3D with eye separation or a tracked L/R Camera3D.

Left Output

This is the left image or stack output containing new Disparity channel.

Right Output

This is the right image that contains a new Disparity channel. This output will be hidden in Stack Mode.

Controls
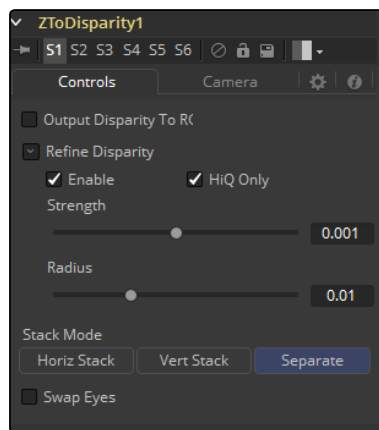
Output Disparity To RGB

In addition to outputting disparity values into the Disparity channel, this option causes ZToDisparity to also output the disparity values into the color channels as {x, y, 0, 1}. When enabled, this option will automatically promote the RGBA color channels to float32. This option is useful for a quick look to see what the Disparity channel looks like.

Refine Disparity

This refines the Disparity map based upon the RGB channels.

Strength

Increasing this slider does two things. It smooths out the depth in constant color regions and moves edges in the Z channel to correlate with edges in the RGB channels. Increasing the refinement has the undesirable effect of causing texture in the color channel to show up in the Z channel. You will want to find a balance between the two.

Radius

This is the pixel-radius of the smoothing algorithm.

Camera Tab

If you need correct real-world disparity values because you are trying to match some effect to an existing scene, you should use the External Camera options to get precise disparity values back. If you just want any disparity and do not particular care about the exact details on how it is offset and scaled, or if there is no camera available, then the Artistic option might be helpful.

External
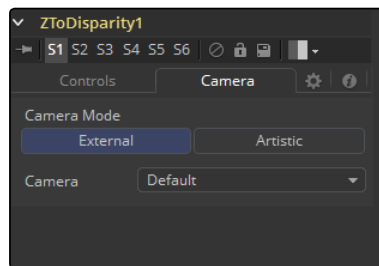
An input will appear on the flow to connect an existing stereo Camera3D, and use the Camera settings to determine the Disparity settings.

Artistic
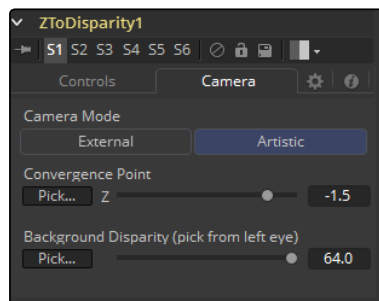
If you do not have a camera, you can adjust these controls to produce an "artistic" Disparity channel whose values will not be physically correct but good enough for compositing hacks. There are two controls to adjust:

Convergence Point

This is the Z value of the convergence plane. This corresponds to the negative of the Convergence Distance control that appears in Camera3D. At this distance, objects in the left and right eyes are at exactly the same position (i.e., have zero disparity). Objects closer appear to pop out of the screen, and objects further appear behind the screen.

Background Disparity (pick from left eye)

This is the Disparity of objects in the distant background. You can think of this as the upper limit to disparity values for objects at infinity. This value should be for the left eye. The corresponding value in the right eye will be the same in magnitude but negative.

Tracker Tools

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Tracker Tools

Tracker Tools
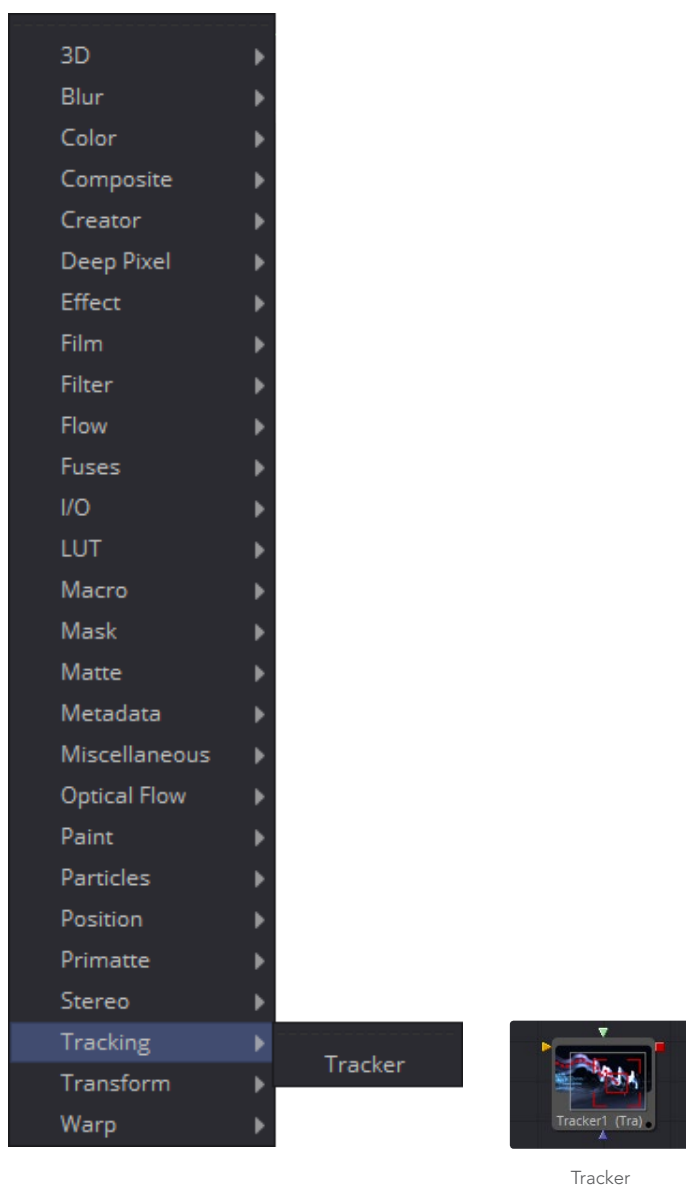
Tracker

Tracker [TRA]

The Tracker is used to detect and follow one or more pixel patterns across frames in moving video. The tracking data can then be used to control the position or values of other tools in the composition (for example, the center of a Drip). Additionally, trackers can be used to stabilize an image, or to apply de-stabilization to one image based on the motion of another.

Please also refer to the Tracking Explained section in the User Manual.

Trackers Tab
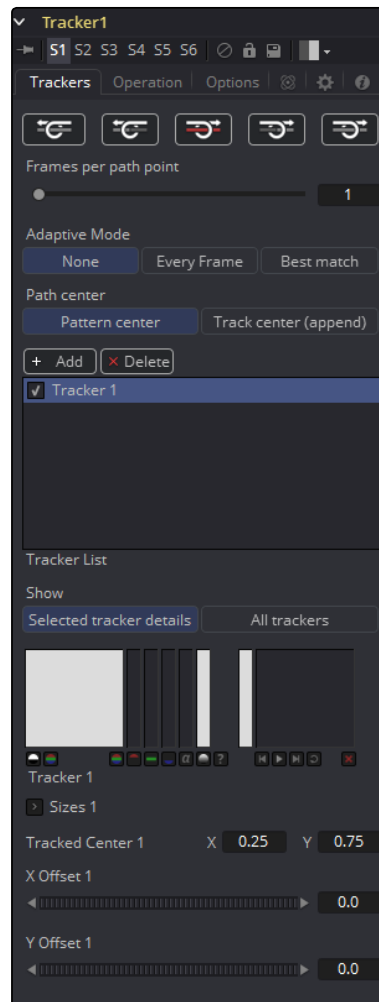
Track Buttons

There are four buttons used to initiate tracking and one in the middle used to stop a track in progress. These buttons can track the current pattern forward or backward in time. Hold the mouse pointer over each button for a moment, and a tooltip with the name of the button will appear.

The buttons operate as follows:

→ **Track Reverse:** Clicking on this button will cause all Active trackers to begin tracking their patterns, starting at the end of the render range and moving backward through time until the beginning of the render range.

→ **Track Reverse From Current Time:** Clicking on this button will cause all Active trackers to begin tracking their patterns, starting at the current frame and moving backward through time until the beginning of the render range.

→ **Stop Tracking:** Clicking on this button will Stop the tracking process immediately. This can also be achieved by pressing ESC. This button will only be active when tracking is in process.

→ **Track Forward From Current Time:** Clicking on this button will cause all Active trackers to begin tracking their patterns, starting at the current frame and moving forward through time until the end of the render range.

→ **Track Forward:** Clicking on this button will cause all Active trackers to begin tracking their patterns, starting at the first frame in the render range and moving forward through time until the end of the render range.

Frames Per Path Point

The value of this slider determines how often the Tracker sets a Keyframe on the Path. The normal default is 1, which sets a Keyframe on the tracked path at every frame. Increasing the value of this slider will cause the tracked path to be less accurate. This may be desirable if the track is returning fluctuating results, but under normal circumstances this control should be left at its default value.

If the project is field rendered, a value of 1 sets a Keyframe on every field. Since the tracker is extremely accurate, this will result in a slight up-and-down jittering due to the position of the tracked pattern fields. For fielded footage tracked in Field mode, you will get better results setting this slider to a value of 2, which will result in one keyframe per frame of your footage.

Adaptive Mode

Fusion is capable of re-acquiring the tracked pattern, as needed, to help with complex tracks. This button array determines what mode of Adaptive tracking is employed.

None

If selected, Fusion searches only for the pattern originally selected in each single frame.

Every Frame

If selected, Fusion re-acquires the pattern every frame. This helps the tracker compensate for gradual changes in profile and lighting over time.

Best Match

If selected, the Tracker will compare the pattern acquired at each frame and compare it to the original selected pattern. If the variation between the two patterns exceeds the threshold amount defined by the Match Tolerance control, Fusion will not re-acquire the pattern on that frame. This helps to avoid tracker drift caused by transient artifacts that cross the pattern's path (such as a shadow).

Path Center

The two buttons in this button array determine how the Tracker behaves when re-positioning a pattern. These controls are used when switching a path from one pattern to another, which happens when a pattern leaves the frame, or changes so significantly it can no longer be tracked.

Pattern Center

When Pattern Center is the Active mode, the tracked path continues from the center of the new path. This is appropriate when replacing an existing path entirely, but when trying to append to a path using a new pattern, this will cause a discontinuity.

Track Center (append)

When Track Center (append) is selected, the path tracked by a new pattern will be appended to the existing path. The Path created is automatically offset by the required amount. This technique will work best if the new pattern is located close to the position of the old pattern to avoid any problems with parallax or lens distortion.

This mode can also be used to virtually continue the tracking of patterns that move out of the frame or get obstructed by other objects.

Add/Delete Tracker

Use these to add or delete Trackers from your Tracker List.

Add

Add a new Tracker.

Delete

Delete the tracker that is currently selected in the Tracker List.

Tracker List

The Tracker List shows the names of all of the patterns created on this Tracker. It is also used to add new Trackers.

The Tracker tool is capable of hosting a virtually unlimited number of Tracker patterns.

→ Click on the Add button immediately above the list to add a new Tracker pattern.

→ Each pattern appears in the list by name, next to a small checkbox. Clicking on the name of the pattern will select that pattern.

→ The controls below the list will change to affect that pattern only. Click once on a selected pattern to rename the pattern to something more descriptive.

→ Clicking on the checkbox changes the state of the Tracker.

Tracker States

→ **Enabled (Black Checkbox):** An Enabled pattern will re-track each time the Track is initiated. Its path data is available for use by other tools, and the data is available for Stabilization and Corner Positioning.

→ **Suspended (Gray Checkbox):** A Suspended pattern does not re-track when the Track is initiated. The data is locked to prevent additional changes. The data from the Path is still available for other tools, and the data is available for advanced Tracking modes like Stabilization and Corner Positioning.

→ **Disabled (Clear):** A Disabled pattern does not create a path when tracking is initialized, and its data is not available to other tools, or for advanced Tracking operations like Stabilization and Corner Positioning.
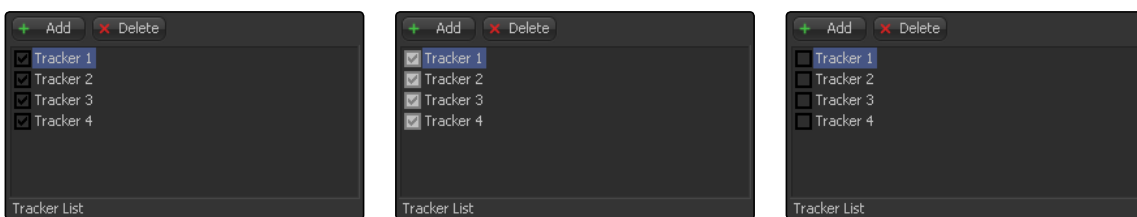
Show

These two buttons determine what controls are displayed in the tool controls. They have no effect on the operation of the Tracker; they only affect the interface.

Selected Tracker Details

When Selected Tracker Details is selected, the controls displayed pertain only to the currently selected Tracker. You will have access to the Pattern Window and the Offset sliders.

All Trackers

When All Trackers is selected, the pattern window for each of the Trackers is displayed simultaneously below the Tracker List.

Left Pattern Display

The Pattern Display has two image windows next to each other, and a series of status bars. The window on the left shows the pattern initially selected, while the one on the right shows a real-time display of the current pattern as tracking progresses.

As the onscreen controls are moved for a pattern, the display in the leftmost window will update to show the pattern. As the pattern is moved, the vertical bars immediately to the right of the image display indicate the clarity and contrast of the image channels.

The channel, or channels, with the best clarity are automatically selected for tracking. These channels have a white background in the vertical bar representing that channel. The automatic tracking can be allowed to stand, or you can override the automatic selection and choose the channel used for tracking by disabling the button labeled with a question mark, and selecting the button beneath the channel to track.

Under normal circumstances, the channel selected is indicated in the Pattern Display. If the selected channel is blue, then a grayscale representation of the blue channel for the pattern appears. The image is only represented in full color if all three channels are selected for tracking.

Override this behavior by selecting the Show Full Color button beneath the Pattern Display, instead of the Show Selected Channel button.

As Fusion looks for the channel with the highest contrast automatically, you might end up tracking the blue channel, especially on scanned film material. Unfortunately the blue channel on most film stock contains the most grain as well, which naturally leads to unclean tracks. Before tracking it's always a good idea to zoom into your footage and check the RGB channels individually.

Right Pattern Display

The Pattern Display on the right indicates the actual pattern acquired for tracking. This display is clear until the first time the selected pattern is actually tracked. The Pattern Display becomes active during tracking, displaying the pattern that Fusion acquires from frame to frame.

As the tracking occurs, the pattern from each frame is accumulated into a Flipbook, which can be played back in the Pattern window after tracking by using the transport controls at the bottom of the window.

While the track is progressing, the vertical bar immediately to the right of the pattern shows how confident Fusion is that the current pattern matches the originally selected pattern. A green bar indicates a high degree of confidence that the current pattern matches the original. A yellow bar indicates less certainty, and a red bar indicates that Fusion has detected extreme variations in the current pattern, and is no longer certain of its accuracy.

After tracking, the pattern display will show a small Flipbook of the track for that pattern, overlaid with a frame number to help identify problem frames for the Track.

Pattern Width and Height

Use these controls to adjust the width and height of the selected Tracker pattern manually. The size of the Tracker pattern can also be adjusted in the Viewer, which is the normal method, but small adjustments are often easier to accomplish with the precision of manual controls.

Search Width and Height

The search area defines how far Fusion will look in the image from frame to frame to re-acquire the pattern during tracking. As with the Pattern Width and Height, the Search Area can be adjusted in the Viewer, but you may want to make small adjustments manually using these controls.
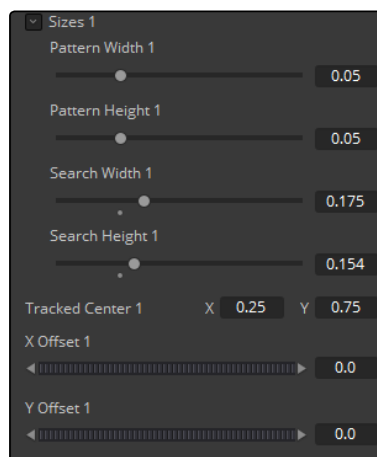
Tracked Center

This positional control indicates the position of the Tracker's center. To remove a path from a Tracker pattern, right-click on this control and select Remove Path from the contextual menu.

X and Y Offset

You will often need to track the position of an object in the scene, but that object does not provide for a very reliable pattern. The Offsets permit the tracking of something close to the intended object instead. Use these Offsets to adjust the reported position of the Tracker so that the data is reported for the intended pattern instead of the actual one.

The Offset can also be adjusted directly in the view by activating the positioner's Offsets icon next to your view.

Operation Tab

The Tracker tool is capable of performing a wide variety of functions, from match moving an object into a moving scene, smoothing out in a shaky camera movement, or replacing the content of a sign. Use the options and buttons in the Operation tab to select the function performed by the Tracker tool. Please also refer to the Tracking Explained section in the Appendices.
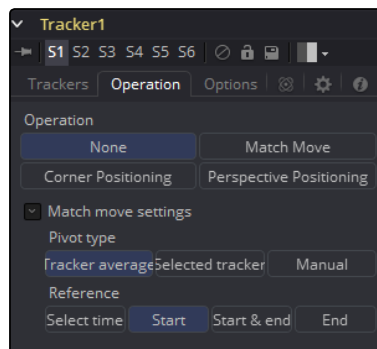
Operation Buttons

These four buttons select the exact function performed by the Tracker. The remaining controls in this tab fine-tune the result of the Operation.

None

The Tracker performs no additional operation on the image beyond simply locating and tracking the chosen pattern. This is the default mode, used to create a path that will then drive another control in Fusion.

Match Move

This mode is used when stabilizing an image, or when matching the position, rotation and scaling of the layer for match moving another element into the scene. Stabilizing requires a minimum of one Tracker to determine position, and two or more to determine scaling and rotation in the sequence.
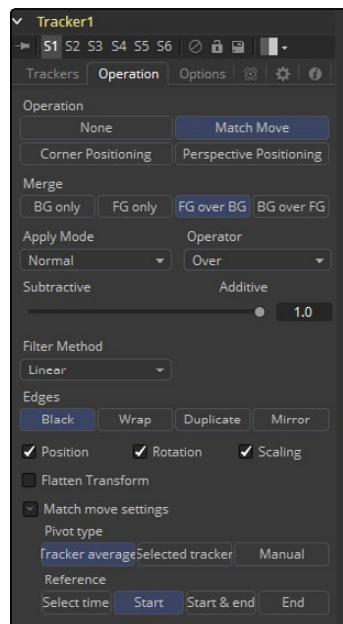
Corner Positioning

The Corner Positioning mode is used to track the four corners of a rectangular object and replace the contents with a new image. A minimum of four Trackers is required for this mode, and if there are not enough Trackers, new ones will be created until the total equals four.
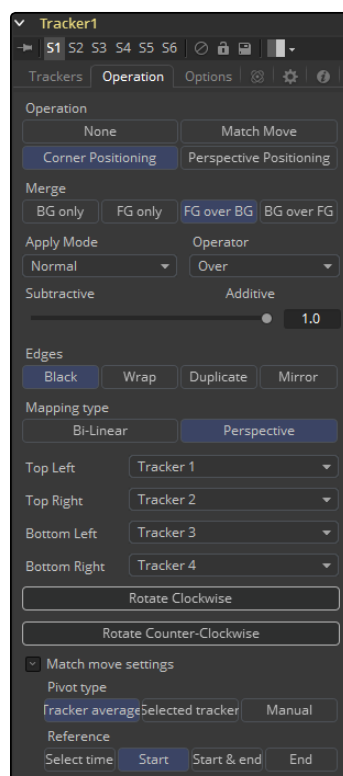
Perspective Positioning

This mode is similar to the Corner Positioner, but rather than replacing the contents of the rectangle, the four tracked corners are mapped to the four corners of the image. This is generally used to remove Perspective from an image. Like the Corner Positioner, this mode requires four Trackers, which will be created if there are not already that many.

Merge

The Merge control determines what is done (if anything) with the image provided to the Foreground input of the Tracker. This array of buttons appears when the operation is set to anything other than None.

BG Only

The Foreground input is ignored, only the Background is affected. This is used primarily when Stabilizing an image sequence.

FG Only

The Foreground input is transformed to match the movement in the background, and this transformed image is passed through the Tracker's output. This Merge technique is used when match moving one layer's motion to another layer's motion.

FG Over BG

The Foreground image is merged over the Background image, using the Merge method described by the Apply Mode control that appears.

BG Over FG

The Background is merged over the Foreground. This technique is often used when tracking a layer with an Alpha channel so that a more static background can be applied behind it.

Apply Mode

This drop-down menu provides a variety of options to determine how the two layers should be combined. The options in this menu are explained in more detail in the reference chapter for the Merge tool.

Subtractive - Additive

This determines whether the Foreground layer is placed over the Background in using Additive or Subtractive merging techniques. This control is explained in more detail in the documentation for the Merge tool.

Edges Match Move

This button array only appears if the Operation mode is set to Match Move. The various options select how the revealed edges are handled when the image is moved to match position and scaling.

Black Edges

Out of frame edges revealed by Stabilization are left black.

Wrap

Portions of the image moved off frame to one side are used to fill edges that are revealed on the opposite side.

Duplicate

The last valid pixel on an edge is repeated to the edge of the frame.

Position, Rotation and Scaling Checkboxes

The Position, Rotation and Scaling checkboxes only appear when the mode is set to Match Move. They determine what components of motion that Stabilization will attempt to correct in the image. For example, if only the Position checkbox is selected, no attempt will be made to correct for Rotation and Scaling in the image.

Flatten Transformation

This checkbox only appears when the mode is set to Match Move. Like most transformations in Fusion, Stabilization is concatenated with other sequential transformations by default. Selecting this checkbox will flatten the transform, breaking any concatenation taking place and applying the transform immediately.

Mapping Type

The Mapping Type control only appears in the Corner Positioning mode. There are two options in the button array.

Bi-Linear

The first method is Bi-Linear where the Foreground image is mapped into the Background without any attempt to correct for perspective distortion. This is identical to how previous versions of Fusion operated, and the Classic mode is included pretty much for compatibility reasons only.

Perspective

The preferred setting for this control is True Perspective.

Corner Selector

When the operation of the Tracker is set to either Corner or Perspective Positioner modes, these four drop-down menus appear. They are used to select which trackers map to each of the four corners of the rectangle used by these modes. This is useful when a Tracker has more than four patterns selected, and you must choose which the positioners use.

Rotate Buttons

These controls only appear when the operation of the Tracker is set to either Corner or Perspective Positioner modes. They are used to rotate the Foreground image by 90 degrees before it is applied to the Background.

Stabilize Settings

The Tracker tool automatically outputs several steady and unsteady position outputs to which other controls in the flow can be connected. The Stable Position output provides X and Y coordinates to match or reverse motion in a sequence. These controls are available even when the operation is not set to Match Move, since the Stable Position output is always available for connection to other tools.

Axis Type (Stabilize Setting)

Under virtually all circumstances, the Axis for any stabilization should be the average position of all Trackers on that frame, however, the rare occasion arises when the Tracker's axis must be elsewhere.

This array of buttons allows for the selection of an axis for the Stabilization based on the position of a single Tracker, or a manual position.

Reference (Stabilize Setting)

The Reference controls are used to set the `snapshot frame' for Stabilization. When you stabilize an image, there must be a position that is considered correct, to which all subsequent movement is detected and corrected.

Select Time

The Select Time Reference mode determines the `snapshot frame' based on the frame where the pattern is first selected. All Stabilization is intended to return the image back to that reference.

Start

The Snapshot Frame is determined to be the first frame in the tracked path. All Stabilization is intended to return the image back to that reference.

Start and End

The Start and End Reference mode is somewhat different from all other Reference modes. Where the others are intended to take a snapshot frame to which all stabilization returns, immobilizing the image, the Start and End mode is intended to smooth existing motion, without removing it. This mode averages the motion between the Start and End of the path, drawing a straight line between those points.

When this mode is Active, it reveals the Reference Intermediate Points control. Increasing the value of this control increases the number of points in the path used by the Reference, smoothing the motion from a straight line between Start and End without making it wholly linear.

End

The Snapshot Frame is determined to be the last frame in the tracked path. All Stabilization is intended to return the image back to that reference.

Onscreen Controls

Each pattern in the Tracker has its own set of onscreen controls, used to select the pixels in the image to be tracked.

These controls are visible in the Viewers whenever a tracker is selected in a flow.

→ The onscreen control is indicated by a red rectangle with a handle in the top left corner. This rectangle indicates the position of the pattern in the image. Every pixel within the rectangle is considered to be part of the pattern used for tracking. Resize the pattern by clicking and dragging on the rectangle's borders.

→ Whenever the mouse moves over the pattern rectangle, a second rectangle with a dashed outline appears. This represents the search area, which determines how far away from the current pattern the Tracker looks on the next frame. This should always be larger than the pattern, and it should be large enough to encompass the largest frame-to-frame movement in the scene. Faster moving objects require larger search areas and slower moving objects can get away with smaller search areas. The larger the search area, the longer it will take to track, so try not to make the search area larger than necessary.

→ Dragging on the handle repositions the pattern. While repositioning the pattern, a thumbnail window with an enlarged view of the pattern is displayed in the views, to assist with precise positioning of the pattern. This thumbnail disappears when the mouse button is released. The magnification ratio can be adjusted in the Options tab. If the selected Tracker has a custom name, the name of that Tracker will be displayed as a label at the bottom right of the search area rectangle.

There is no limit to the number of trackers that can be used in one flow, or in the number of connections that can be made to a tracker. This chapter serves as a reference for the various controls in the Tracker, but we strongly suggest you read the more general information about using the Tracker in the Tracking chapter.

The Tracker can be employed in two forms: as a tool in the Flow, or as a modifier attached to a control. When the Tracker is used as a tool in the Flow, the image tracked comes from the input to the Tracker tool. There is no limit to the number of patterns that can be tracked by a single Tracker tool.

When the Tracker is used as a modifier, its controls appear in the Modifier tab for any tool with a control connected to that modifier. Only one pattern can be tracked by a Tracker Modifier, but the image source can come from anywhere in the composition. This technique is generally used when tracking a quick position for a control.

X/Y Paths

By default the Tracker applies a Displacement Path to the tracked points. To apply an XY Path to the tracked points go to Preferences > Globals > Splines.

Options Tab
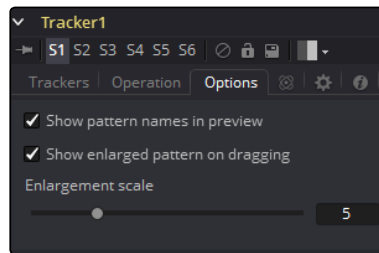
Show Pattern Names in Preview

This option defines if the Tracker's name will be displayed in the view. Switch it off to see just the Pattern Rectangle instead.

Show Enlarged Pattern on Dragging

This option defines if there is an enlarged view on positioning the Pattern Rectangle or not.

Enlargement Scale

The Zoom factor that is used on positioning the Pattern Rectangle when the above option is on. The outputs of a Tracker (seen in the Connect to... menu) can also be used by scripts. They are:

They are:

- → SteadyPosition: Steady Position

- → UnsteadyPosition: Unsteady Position

- → SteadyAxis: Steady Axis

- → SteadySize: Steady Size

- → UnsteadySize: Unsteady Size

- → SteadyAngle: Steady Angle

- → UnsteadyAngle: Unsteady Angle

- → Position1: Tracker 1 Offset position

- → PerspectivePosition1: Tracker 1 Perspective Offset position

- → PositionX1: Tracker 1 Offset X position (3D Space)

- → PositionY1: Tracker 1 Offset Y position (3D Space)

- → PerspectivePositionX1: Tracker 1 Perspective Offset X position (3D Space)

- → PerspectivePositionY1: Tracker 1 Perspective Offset Y position (3D Space)

- → SteadyPosition1: Tracker 1 Steady Position

- → UnsteadyPosition1: Tracker 1 Unsteady Position (similarly for the 2nd, 3rd and so on)

Transform Tools

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Transform Tools

Transform Tools

Camera Shake	Resize
Crop	Scale
DVE	Transform
Letterbox	
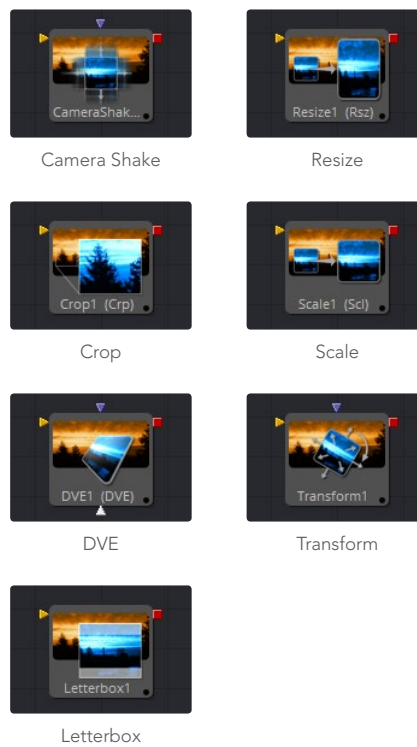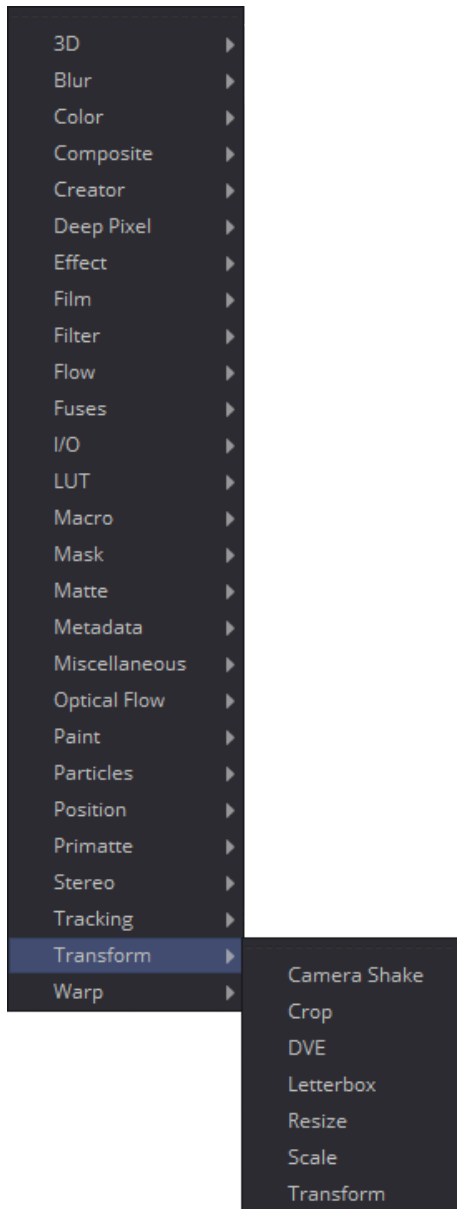
Camera Shake [CSн]

This tool can simulate a variety of Camera Shake style motions from organic to mechanical. It is not the same as the Shake Modifier, which generates random number values for tool controls. See the Connections and Modifiers chapter for more information about the Shake Modifier.

The Camera Shake tool concatenates its result with adjacent transformation tools. For more information on concatenation, consult the Transformations chapter.
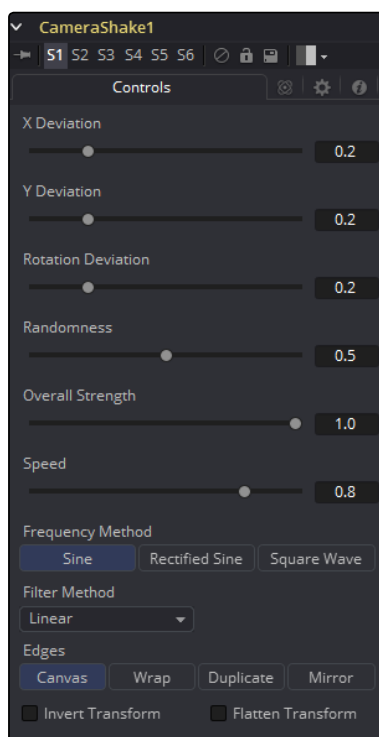
Controls Tab

Deviation X and Y

These controls determine the amount of shake that is applied to the image along the horizontal (X) and vertical (Y) axis. Values between 0.0 and 1.0 are permitted. A value of 1.0 generates shake positions anywhere within the boundaries of the image.

Rotation Deviation

This determines the amount of shake that is applied to the rotational axis. Values between 0.0 and 1.0 are permitted.

Randomness

Higher values in this control cause the movement of the shake to be more irregular or random. Smaller values cause the movement to be more predictable.

Overall Strength

This adjusts the general amplitude of all the parameters and blends that affect in and out. A value of 1.0 applies the effect as described by the remainder of the controls.

Speed

Speed controls the frequency, or rate, of the shake.

Frequency Method

This selects the overall shape of the shake. Available frequencies are Sine, Rectified Sine and Square Wave. A Square Wave will generate a much more mechanical looking motion than a Sine.

Edges

This determines how the Edges of the image are treated.

Black

This causes the edges that are revealed by the shake to be black.

Wrap

This causes the edges to wrap around (the top is wrapped to the bottom, the left is wrapped to the right, etc.).

Duplicate

This causes the Edges to be duplicated, causing a slight smearing effect at the edges.

Invert Transform

Select this control to Invert any position, rotation or scaling transformation. This option might be useful to exactly removing the motion produced in an upstream Camera Shake.

Flatten Transform

The Flatten Transform option prevents this tool from concatenating its transformation with adjacent tools. The tool may still concatenate transforms from its input, but it will not concatenate its transformation with the tool at its output.

Filter Modes

Nearest Neighbor

This skips or duplicates pixels as needed. This produces the fastest but crudest results.

Box

This is a simple interpolation resize of the image.

Linear

This uses a simplistic filter, which produces relatively clean and fast results.

Quadratic

This filter produces a nominal result. It offers a good compromise between speed and quality.

Cubic

This produces better results with continuous tone images but is slower than Bi-Cubic. If the images have fine detail in them, the results may be blurrier than desired.

Catmull-Rom

This produces good results with continuous tone images that are resized down. Produces sharp results with finely detailed images.

Gaussian

This is very similar in speed and quality to Bi-Cubic.

Mitchell

This is similar to Catmull-Rom but produces better results with finely detailed images. It is slower than Catmull-Rom.

Lanczos

This is very similar to Mitchell and Catmull-Rom but is a little cleaner and also slower.

Sinc

This is an advanced filter that produces very sharp, detailed results, however, it may produce visible 'ringing' in some situations.

Bessel

This is similar to the Sinc filter but may be slightly faster.

Window Method

Some filters, such as Sinc and Bessel, require an infinite number of pixels to calculate exactly. To speed up this operation, a windowing function is used to approximate the filter and limit the number of pixels required. This control appears when a filter that requires windowing is selected.

Hanning

This is a simple tapered window.

Hamming

Hamming is a slightly tweaked version of Hanning.

Blackman

A window with a more sharply tapered falloff.

Kaiser

A more complex window, with results between Hamming and Blackman.

Most of these filters are useful only when making an image larger. When shrinking images, it is common to use the Bi-Linear filter, however, the Catmull-Rom filter will apply some sharpening to the results and may be useful for preserving detail when scaling down an image.

Example

Different Resize Filters. From left to right: Nearest Neighbor, Box, Linear, Quadratic, Cubic, Catmull-Rom, Gaussian, Mitchell, Lanczos, Sinc, Bessel

Crop [CRP]

The Crop tool can be used to cut out a portion of an image or to offset the image into a larger image area. This tool actually changes the resolution of the image and should not be animated under normal circumstances.

It is possible to crop an image in the view by viewing the upstream tool and selecting a region with the mouse. To do so, first activate Allow Box Selection by clicking on the icon next to your view, then dragging a rectangle to perform the operation.
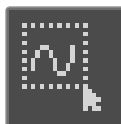
Crop Tab
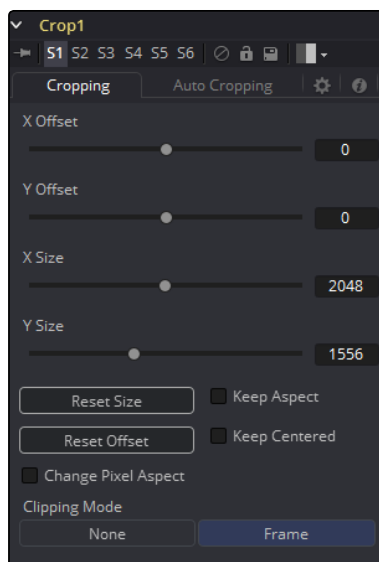
Offset X and Y

These controls position the top left corner of the Cropping window. Values larger than the actual resolution of the cropped image cause it to disappear off the edges of the output image. Values below 0 will push the input image toward the bottom right of the result. The values of these controls are measured in pixels.

Size X and Y

Use this control to set the vertical and horizontal resolution of the image output by the Crop tool. The values of these controls are measured in pixels.

Keep Aspect

When toggled on, the Crop tool maintains the aspect of the input image.

Keep Centered

When toggled on, the Crop tool automatically adjusts the X and Y Offset controls to keep the image centered.

Reset Size

This resets the image dimensions to the Size of the input image.

Reset Offset

This resets the X and Y Offsets to their defaults.

Change Pixel Aspect

Enable this checkbox to reveal a Pixel Aspect control that can be used to change the pixel aspect that the image is considered to have. See the Frame Formats section for details on how Pixel Aspect operates in Fusion.

Clipping Mode

This option sets the mode used to handle the edges of the image when performing Domain of Definition rendering. This is profoundly important for tools like Blur, which may require samples from portions of the image outside the current domain.

Frame

The default option is Frame, which automatically sets the tool's Domain of Definition to use the full frame of the image, effectively ignoring the current Domain of Definition. If the upstream DoD is smaller than the frame, the remaining area in the frame will be treated as black/transparent.

Domain

Setting this option to Domain will respect the upstream Domain of Definition when applying the tool's effect. This can have adverse clipping effects in situations where the tool employs a large filter.

None

Setting this option to None will not perform any source image clipping at all. This means that any data required to process the tool's effect which would normally be outside the upstream DoD will be treated as black/transparent.

Auto Crop Tab
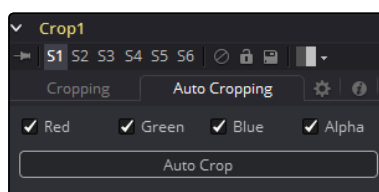
RGBA Color Channels

Select which channels are examined for an Auto Crop. This is useful for auto cropping images with non-solid backgrounds in a specific color channel, like a blue color gradient. Toggling the channel off causes Auto Crop to ignore it when evaluating the image.

Auto Crop

This evaluates the image and attempts to determine the background color. It then crops each side of the image to the first pixel that is not this color.

DVE [DVE]

The DVE tool is a 3D-image transformation similar to tools found in an online edit suite. The tool encompasses image rotations, perspective changes and Z moves. The axis can be defined for all transformations.

Settings Tab
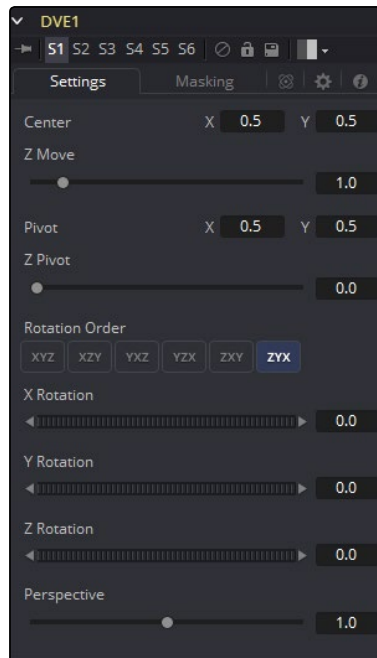
Pivot X, Y and Z

Position the axis of rotation and scaling. The default is 0.5, 0.5 for X and Y, which is in the center of the image, and 0 for Z, which is at the center of Z space.

Rotation Order

Use these buttons to determine in what order Rotations are applied to the image.

XYZ Rotation

These controls are used to rotate the image around the pivot along the X-, Y- and Z-axis.

Center X and Y

This positions the Center of the DVE image on screen. The default is 0.5, 0.5, which positions the DVE in the center of the image.

Z Move

This zooms the image in and out along the Z-axis. Visually, when this control is animated, the effect is similar to watching an object approach from a distance.

Perspective

This adds additional Perspective to an image rotated along the X- or Y-axis, similar to changing the Field of View and zoom of a camera.

Masking Tab
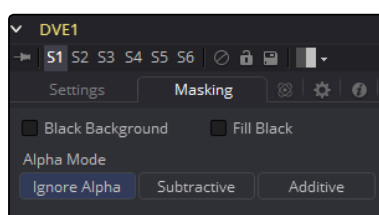
The DVE tool allows pre-masking of its input image. This offers the ability to create transformations from the masked area of the image while leaving the remainder of the image unaffected.

Unlike regular effect masking, the masking process occurs before the transformation. To use this feature, connect a mask to the DVE tool's DVE Mask input. Alternatively, select the DVE tool, right-click on the view and select DVE Mask from the contextual menu. All of the usual mask types can be applied to the DVE mask.

Black Background

Toggle this on to erase the area outside the mask from the transformed image.

Fill Black

Toggle this on to erase the area within the mask (before transformation) from the DVE's input, effectively cutting the masked area out of the image. Enabling both Black Background and Fill Black will show only the masked, transformed area.

Alpha Mode

This determines how the DVE will handle the alpha channel of the image, when merging the transformed image areas over the untransformed image.

Ignore Alpha

This causes the input image's alpha channel to be ignored, so all masked areas will be opaque.

Subtractive/Additive

These cause the internal merge of the pre-masked image over the input image to be either Subtractive or Additive. For more information on Subtractive and Additive merges, see the Merge tool.
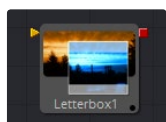
Letterbox [LBX]

Use the Letterbox Tool to adapt existing images to the frame size and aspect ratios of any other format. The most common use of this tool is to adapt film resolution images to NTSC or PAL sized frames for viewing on an external television monitor. Horizontal or vertical black edges are automatically added where necessary to compensate for aspect ratio differences.

Controls Tab
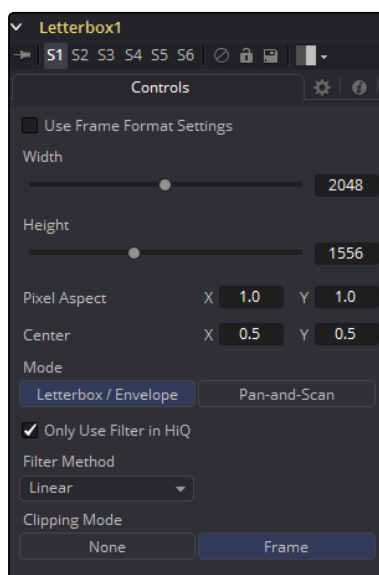
Formats Contextual Menu

Place the pointer on the Aspect X or Y control and press the right mouse button to display a menu with available frame formats. Select any one of the choices from the menu to set the Height, Width and Aspect controls automatically, or enter the required information manually.

Width and Height

The values of these controls determine the size of the output image as measured in pixels.

Pixel Aspect X and Y

The controls determine the Pixel Aspect Ratio of the output image.

Center X and Y

This Center control repositions the image window when used in conjunction with Pan-And-Scan mode. It has no effect on the image when the tool is set to Letterbox mode.

Mode

This control is used to determine the Letterbox tool's mode of operation.

Letterbox/Envelope

This corrects the aspect of the input image and resizes it to match the specified width.

Pan-And-Scan

This corrects the aspect of the input image and resizes it to match the specified height. If the resized input image is wider than the specified width, the center control can be used to animate the visible portion of the resized input.

Filter Modes

Nearest Neighbor

This skips or duplicates pixels as needed. This produces the fastest but crudest results.

Box

This is a simple interpolation resize of the image.

Linear

This uses a simplistic filter, which produces relatively clean and fast results.

Quadratic

This filter produces a nominal result. It offers a good compromise between speed and quality.

Cubic

This produces better results with continuous tone images but is slower than Bi-Cubic. If the images have fine detail in them, the results may be blurrier than desired.

Catmull-Rom

This produces good results with continuous tone images that are resized down. Produces sharp results with finely detailed images.

Gaussian

This is very similar in speed and quality to Bi-Cubic.

Mitchell

This is similar to Catmull-Rom but produces better results with finely detailed images. It is slower than Catmull-Rom.

Lanczos

This is very similar to Mitchell and Catmull-Rom but is a little cleaner and also slower.

Sinc

This is an advanced filter that produces very sharp, detailed results, however, it may produce visible 'ringing' in some situations.

Bessel

This is similar to the Sinc filter but may be slightly faster.

Window Method

Some filters, such as Sinc and Bessel, require an infinite number of pixels to calculate exactly. To speed up this operation, a Windowing function is used to approximate the filter and limit the number of pixels required. This control appears when a filter that requires windowing is selected.

Hanning

This is a simple tapered window.

Hamming

Hamming is a slightly tweaked version of Hanning.

Blackman

A window with a more sharply tapered falloff.

Kaiser

A more complex window, with results between Hamming and Blackman. Most of these filters are useful only when making an image larger. When shrinking images, it is common to use the Bi-Linear filter, however, the Catmull-Rom filter will apply some sharpening to the results and may be useful for preserving detail when scaling down an image.

Example

Different Resize Filters. From left to right: Nearest Neighbor, Box, Linear, Quadratic,
Cubic, Catmull-Rom, Gaussian, Mitchell, Lanczos, Sinc, Bessel

Resize [Rsz]

Use the Resize tool to increase or decrease the resolution of an input image. This is useful for converting images from one format to another (for example, from film to video resolution).

Controls Tab

Width
This controls the new resolution for the image along the X-axis.

Height
This controls the new resolution for the image along the Y-axis.

Keep Frame Aspect
When toggled on, the Resize tool maintains the aspect of the original image, preserving the original ratio between width and height.

Reset Size
Reset the image dimensions to the original size of the image.

Only Use Filter in HiQ
The Resize tool will normally use the fast Nearest Neighbor filter for any non-HiQ renders, where speed is more important than full accuracy. Disable this checkbox to force Resize to always use the selected filter for all renders.

Change Pixel Aspect
Enable this checkbox to reveal a Pixel Aspect control that can be used to change the pixel aspect that the image is considered to have. See the Frame Formats chapter for details on how pixel aspect operates in Fusion.

Filter Method

When rescaling a pixel, surrounding pixels are often used to give a more realistic result. There are various algorithms for combining these pixels, called filters. More complex filters can give better results but are usually slower to calculate. The best filter for the job will often depend on the amount of scaling and on the contents of the image itself.

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Window Method

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Note: Because this tool changes the physical resolution of the image, we do not normally advise animating the controls.

Example

Different Resize Filters. From left to right: Nearest Neighbor, Box, Linear, Quadratic, Cubic, Catmull-Rom, Gaussian, Mitchell, Lanczos, Sinc, Bessel

Scale [Scl]

The Scale tool is almost identical to the Resize tool, except that Resize uses exact dimensions where the Scale tool uses relative dimensions to describe the change to the source image's resolution.
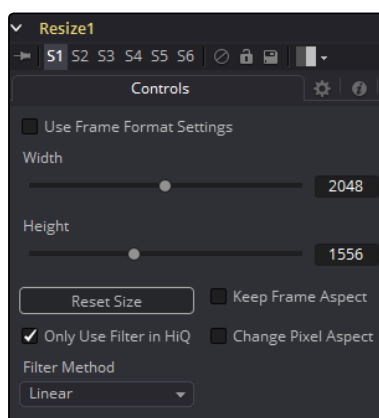
Controls Tab
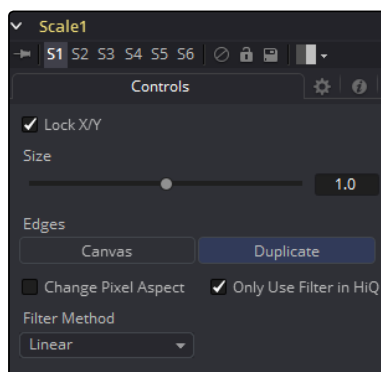
Lock X/Y

When selected, only a Size control is shown and changes to the image's scale are applied to both axes equally. If the checkbox is cleared, individual size controls appear for both X and Y Size.

Size X/Y

The Size control is used to set the scale used to adjust the resolution of the source image. A value of 1.0 would have no affect on the image, while 2.0 would scale the image to twice its current resolution. A value of 0.5 would halve the image's resolution.

Change Pixel Aspect

Enable this checkbox to reveal a Pixel Aspect control that can be used to change the Pixel Aspect that the image is considered to have. See the Frame Formats chapter for details on how Pixel Aspect operates in Fusion.

Only Use Filter in HiQ

The Scale tool will normally use the fast Nearest Neighbor filter for any non-HiQ renders, where speed is more important than full accuracy. Disable this checkbox to force Scale to always use the selected filter for all renders.

Filter Method

When rescaling a pixel, surrounding pixels are often used to give a more realistic result. There are various algorithms for combining these pixels, called Filters. More complex filters can give better results, but are usually slower to calculate. The best filter for the job will often depend on the amount of scaling and on the contents of the image itself.

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Note: Because this tool changes the physical resolution of the image, we do not normally advise animating the controls.

Example

Different Resize Filters. From left to right: Nearest Neighbor, Box, Linear,
Quadratic, Cubic, Catmull-Rom, Gaussian, Mitchell, Lanczos, Sinc, Besse

Transform [X$_F$]

The Transform tool can be used for simple 2D Transformations of the image, such as moving, rotating and scaling. The image's aspect can also be modified using the Transform tool.

The Transform tool concatenates its result with adjacent Transformation tools. For more information on concatenation, consult the Transformations chapter.

Controls Tab

Flip Horizontally and Vertically

Toggle this control on to flip the image along the X- or Y-axis.

Edges

Edges determines how the edges of the image will be treated.

Canvas

This causes the edges of the image that are revealed to show the current Canvas Color. This defaults to black with no Alpha and can be set using the Set Canvas Color tool.

Wrap

This wraps the edges of the image around the borders of the image. This is useful for seamless images to be panned, creating an endless moving background image.

Duplicate

This causes the edges of the image to be duplicated as best as possible, continuing the image beyond its original size.

Center X and Y

This sets the position of the image on the screen. The default is 0.5, 0.5, which places the image in the center of the screen. The value shown is always the actual position multiplied by the reference size. See below for a description of the reference size.

Pivot X and Y

This positions the axis of rotation and scaling. The default is 0.5, 0.5, which is the center of the image.

Use Size and Aspect

This checkbox determines whether the Transform tool provides independent Size controls for the X and Y scale, or if Size and Aspect controls are used instead.

Size

This modifies the Size, or scale, of the image. Values range from 0 to 5, but any value greater than zero can be entered into the edit box. If the Use Size and Aspect checkbox is selected, this control will scale the image equally along both axes. If the Use Size and Aspect option is off, independent control is provided for X and Y.

Aspect

This control changes the Aspect Ratio of an image. Setting the value above 1.0 stretches the image along the X-axis. Values between 0.0 and 1.0 stretch the image along the Y-axis. This control is available only when the Use Size And Aspect checkbox is enabled.

Angle

This control rotates the image around the axis. Increasing the Angle rotates the image in a counter-clockwise direction. Decreasing the Angle rotates the image in a clockwise direction.

Invert Transform

Select this control to Invert any position, rotation or scaling transformation. This option is useful when connecting the Transform to the position of a tracker for the purpose of re-introducing motion back into a stabilized image.

Flatten Transform

The Flatten Transform option prevents this tool from concatenating its transformation with adjacent tools. The tool may still concatenate transforms from its input but it will not concatenate its transformation with the tool at its output. See the Transformations chapter earlier in this manual for details on concatenated transformation.

Reference Size

The controls under the Reference Size reveal do not directly affect the image. Instead they allow you to control how Fusion represents the position of the Transform tool's center.

Normally, coordinates are represented as values between 0 and 1, where 1 is a distance equal to the full width or height of the image. This allows for resolution independence, because you can change the size of the image without having to change the value of the center.

One disadvantage to this approach is that it complicates making pixel accurate adjustments to an image. To demonstrate, imagine an image that is 100 by 100 pixels in size. To move the center of the image to the right by 5 pixels, we would change the X value of the transform center from 0.5, 0.5 to

0.55, 0.5. We know the change must be 0.05 because 5/100 = 0.05.

The Reference Size controls allow you to specify the dimensions of the image. This changes the way the control values are displayed, so that the Center shows the actual pixel positions in the X and Y fields of the Center control. Extending our example, if you set the Width and Height to 100 each, the Center would now be shown as 50, 50, and we would move it 5 pixels toward the right by entering 55, 50.

Internally, the Transform tool still stores this value as a number between 0 to 1, and if you were to query the Center controls value via scripting, or publish the Center control for use by other tools, then you would retrieve the original normalized value. The change is only visible in the value shown for Transform Center in the tool control.

Use Frame Format Settings
Select this to force the Merge to use the composition's current frame format settings to set the Reference Width and Reference Height values.

Reference Width and Height Sliders
Set these to the width and height of the image to change the way that Fusion displays the values of the Transform tool's Center control.

Filter Method

Nearest Neighbor
This skips or duplicates pixels as needed. This produces the fastest but crudest results.

Box
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Window Method

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Example

Different Resize Filters. From left to right: Nearest Neighbor, Box, Linear, Quadratic,
Cubic, Catmull-Rom, Gaussian, Mitchell, Lanczos, Sinc, Bessel

Warp Tools

30

Warp Tools

Warp Tools

Menu	
3D	▶
Blur	▶
Color	▶
Composite	▶
Creator	▶
Deep Pixel	▶
Effect	▶
Film	▶
Filter	▶
Flow	▶
Fuses	▶
I/O	▶
LUT	▶
Macro	▶
Mask	▶
Matte	▶
Metadata	▶
Miscellaneous	▶
Optical Flow	▶
Paint	▶
Particles	▶
Position	▶
Primatte	▶
Stereo	▶
Tracking	▶
Transform	▶
Warp	▶

Coordinate Space
Corner Positioner
Dent
Displace
Drip
Grid Warp
Lens Distort
Perspective Positioner
Vector Distortion
Vortex
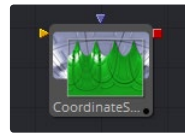
Coordinate Space

Grid Warp
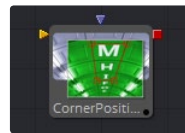
Corner Positioner

Lens Distort

Dent
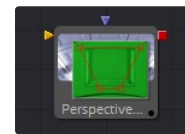
Perspective Positioner

Displace
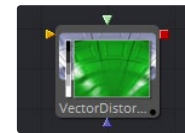
Vector Distort
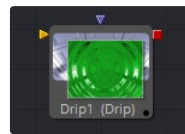
Drip
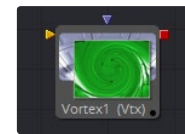
Vortex

Coordinate Space [C**D**S]

The Coordinate Space tool changes the coordinate space of the image at its input from Rectangular to Polar or from Polar to Rectangular.

Controls Tab

Select between Rectangular to Polar and Polar to Rectangular. Consider the following example to demonstrate the two coordinate spaces.
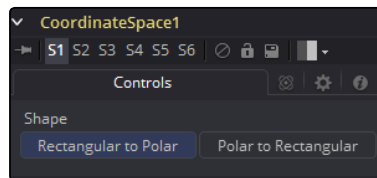
Example

To demonstrate a basic tunnel effect that can be achieved with this tool:

→ Create some text and animate it to move along a path from the top of the frame to the bottom.

→ Connect the output of the Text+ tool to a Coordinate Space tool.

→ Select Polar to Rectangular from the Shape menu.

As the text moves from top to bottom along the original path, it will appear to move from an infinite distance in the Coordinate Space tool. It may be necessary to flip the text using the Transform (Xf) tool to make it appear the correct way in the Coordinate Space tool. Another common use for the Coordinate Space tool is to use it in pairs; two of them set to different Shape settings with a Drip or Transform tool in between. When used in this way, the effect gets modified while the image remains the same.

Corner Positioner [CP$_N$]

The Corner Positioner can be used to interactively position the four corners of an image. This would typically be used to replace a sign or other rectangular portion of a scene. Connect all corners to Paths or Trackers for animation purposes.

Controls Tab

Mapping Type

This determines the method used to project the image caused by the Corner Positioner. In Bi-Linear mode, a straight 2D warping takes place. In Perspective mode, the image is calculated with the offsets in 2D space and then mapped into a 3D perspective.

Corners X and Y

There are four points in the Corner Positioner. Drag these around to position each corner of the image interactively. Attach these control points to any of the usual modifiers.

The image input will be deformed and perspective corrected to match the position of the four corners.

Offset X and Y

These controls can be used to offset the position of the corners slightly. Useful when the corners are attached to Trackers with patterns that may not be positioned exactly where they are needed.

Dent [Dɴᴛ]

The Dent function creates a circular deformation of an image similar to a Fish Eye Lens effect, with the choice of six different Dent filters.

Controls Tab
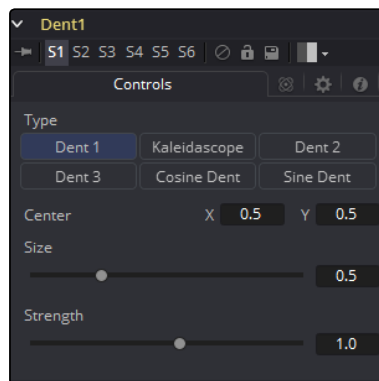
Type

Select the type of Dent filter to use from this menu. All parameters for Dent are animatable.

Dent 1

This creates a bulge dent.

Kaleidoscope

This creates a dent, mirrors, and inverts it.

Dent 2

This creates a displacement dent.

Dent 3

This creates a deform dent.

Cosine Dent

This creates a fracture to a center point.

Sine Dent

This creates a smooth rounded dent.

Center X and Y

This positions the Center of the Dent effect on the image. The default values are 0.5, 0.5, which center the effect in the image.

Size

This changes the Size of the area affected by the dent. Animate this slider to make the Dent grow.

Strength

This changes the overall Strength of the Dent.

Displace [DSP]

This tool uses a map image to displace or refract another image. This is useful for creating a vast range of effects from bevels and heat distortion to glass and water effects.

Controls Tab
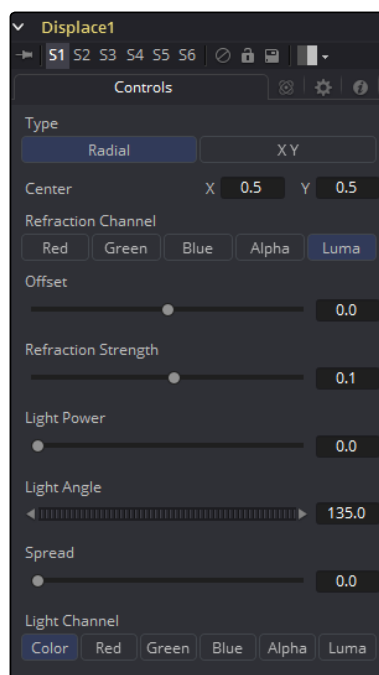
Type

The Type buttons can choose in what mode the Displace tool operates. The Radial mode uses the map image that refracts each pixel out from the center, while X/Y mode provides control over the amount of displacement along each axis individually.

Note: There is one set of Refraction controls while in Radial mode, and two sets in XY mode, one for each of the X and Y channels.

Center (Radial Only)

The Center control defines the point from which pixels are displaced toward or away from.

Refraction Channel

This array of buttons controls which Channel from the foreground image is used to displace the image. Select from Red, Green, Blue, Alpha or Luminance channels. In XY mode, this control appears twice, once for the X displacement and once for the Y displacement.

Refraction Strength (Radial)

Controls the strength of the refraction. Higher values cause stronger or more pronounced refraction.

X and Y Refraction (X/Y)

Two separate sliders appear to control the Refraction strength along the X- and Y-axis separately. Otherwise, this is exactly like Refraction Strength.

Light Power

This controls the intensity or strength of the simulated light, causing bright and dim areas to form according to the contour of the refraction image. Higher values cause the bright and dim areas to be more pronounced.

Light Angle

This sets the angle of the simulated light source.

Spread

This widens the Displacement effect and takes the edge off the Refraction map. Higher values cause the ridges or edges spread out.

Light Channel

Select the channel from the refraction image that will be used as the simulated light source. Select from Color, Red, Green, Blue, Alpha or Luminance channels.

Note: The Radial mode pushes pixels inwards or outwards from a center point, based on pixel values from the Displacement map. The XY mode uses two different channels from the map to displace pixels horizontally and vertically, allowing more precise results. Using the XY mode, the Displace tool can even accomplish simple morphing effects. The Light controls allow directional highlighting of refracted pixels for simulating a beveled look.

Drip [Drp]

The Drip function creates a ripple effect over the entire image, which has the potential to animate outward from a central source. There are a variety of different Drip effects from which to choose.

Controls Tab
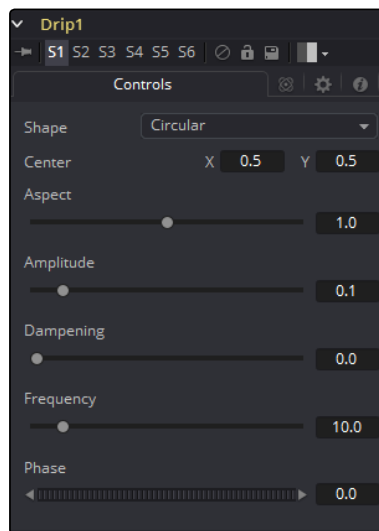
Shape
Use this control to select the shape of the Drip.

Circular
This creates circular ripples. This is the default Drip mode.

Square
This creates even-sided quadrilateral drips.

Random
This creates randomly dispersed noise that distorts your image. Similar to a particle effect.

Horizontal
This creates horizontal waves that move in one direction.

Vertical
This creates vertical waves that move in one direction.

Exponential
This creates a Drip effect that looks like a diamond shape with inverted, curved sides (an exponential curve flipped and mirrored).

Star

This creates an eight-way symmetrical star-shaped ripple that acts like a kaleidoscope when the phase is animated.

Radial

This creates a star-shaped ripple that emits from a fixed pattern.

Center X and Y

Use this control to position the Center of the Drip effect in the image. The default is 0.5, 0.5, which centers the effect in the image.

Aspect

Control the Aspect Ratio of the various drip shapes. A value of 1.0 causes the shapes to be symmetrical. Smaller values cause the shape to be taller and narrower, while larger values cause shorter and wider shapes.

Amplitude

The Amplitude of the Drip effect refers to the peak height of each ripple. Use the slider to change the amount of distortion the Drip applies to the image. A value of 0.0 gives all ripples no height and, therefore, makes the effect transparent. A maximum amplitude of 10 makes each ripple extremely visible and completely distorts the image. Higher numbers can be entered via the text entry boxes.

Dampening

Controls the Dampening, or falloff, of the Amplitude as it moves away from the center of the effect. It can be used to limit the size or area affected by Drip.

Frequency

This changes the number of ripples emanating from the center of the Drip effect. A value of 0.0 indicates that there will be no ripples. Move the slider up to a value of 100, to correspond with the density of desired ripples.

Phase

This controls the offset of the frequencies from the center. Animate the Phase value to make the ripple emanate from the center of the effect.

Grid Warp [GRD]

The Grid Warp tool is a simple 2D deformation grid with flexible vertices. The image will be deformed so that the Source grid matches the Destination grid.

Controls Tab
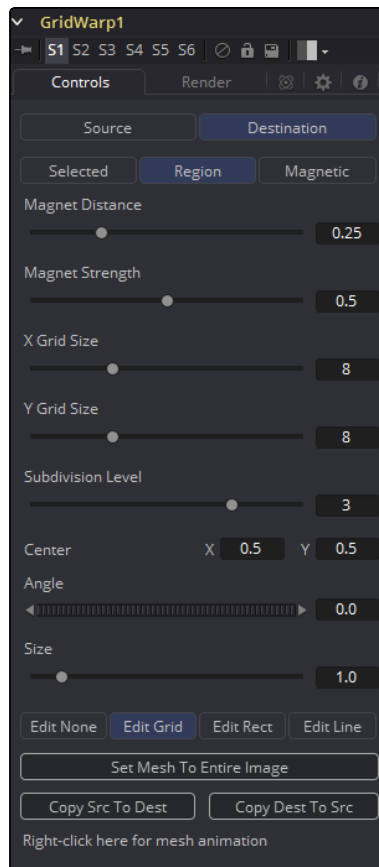
Source and Destination

The Source and Destination buttons determine whether the Source grid or Destination grid is currently active. Only one grid can be displayed or manipulated at a time. The selected button will be highlighted to indicate that is the active grid at the moment.

All of the other controls in this tab affect the grid selected by this control.

Selection Type

These three buttons determine the selection types used for manipulating the points. There are three options available.

Selected

When in Selected mode, adjustments to the grid will be applied only to the currently selected points. This mode is identical to normal polyline operation.

Region

In Region mode, all points within the area around the mouse pointer, when the left mouse button is clicked, will move. New points that enter the region during the move will be ignored. Choosing this option will expose Magnet Distance and Magnet Strength controls to determine the size and falloff of the area.

Magnetic

In Magnetic mode, all points within the area around the mouse pointer when the left mouse button is clicked will move. New points that enter the region during the move will be affected as well. Choosing this option will expose Magnet Distance and Magnet Strength controls to determine the size and falloff of the area.

Magnet Distance

The default tool for selecting and manipulating the grid is a Magnet tool. The magnet is represented in the Viewer by a circle around the mouse pointer. The Magnet Distance slider controls how large the region of affect for the magnet is, as in the size of the circle. Drag on the grid and any vertex within the range of the slider will move.

To increase the size of the magnet, increase the value of this slider. Alternately, adjust the size of the magnet by holding down the D key while dragging the mouse.

Magnet Strength

The Magnet Strength slider will increase or decrease the falloff of the magnet cursor's effect. At a setting of 0.0, the magnetic cursor has no effect, and vertices will not move at all. As the values increase, the magnet causes a greater range of motion in the selected vertices. Use smaller values for a more sensitive adjustment and larger values for broad-sweeping changes to the grid.

X and Y Grid Size

The X and Y Grid Size sliders control the number of divisions in the grid. Where the X and Y divisions intersect, a control vertex is created.

Be aware that changing either of these controls after applying changes in the grid will reset the entire grid. Set the X and Y grid sizes to the appropriate resolution before making serious detailed adjustments to the grid.

Subdivision Level

The Subdivision Level determines how many subdivisions there are between each set of divisions. Subdivisions do not generate vertices at intersections. The more subdivisions there are, the smoother the deformation is likely to be (and the slower it will be to render the deformation).

Center

The Center coordinates determine the exact center of the grid. The onscreen Center control is invisible while editing the grid. Select the Edit Rect mode and the grid center becomes visible and available for editing.

Use the Center control to move the grid through a scene without affecting the animation applied to the individual vertices. For example, while deforming lips on a face, track the motion of the face with a Tracker and connect the grid center to the Tracker. This matches the grid with slight movements of the head while focusing on the deformation of the lips.

Angle

This Angle control rotates the entire grid.

Size

The Size control increases or decreases the scale of the grid.

Edit Buttons

There are four edit modes available, each of which can be selected by clicking on the appropriate button.

Edit None

Set the grid to Edit None mode to disable the display of all onscreen controls.

Edit Grid

The Edit Grid mode is the default mode. While this mode is enabled, the grid is drawn in the Viewer and the control vertices of the grid can be manipulated directly.

Edit Rectangle

When the grid is in Edit Rectangle mode, the onscreen controls display a rectangle that determines the dimensions of the grid. The sides of the rectangle can be adjusted to increase or decrease the grid's dimension. This mode also reveals the onscreen Center control for the grid.

Edit Line

The Edit Line mode is extremely useful for creating grids around organic shapes. When this mode is enabled, all onscreen controls will disappear and a spline can be drawn around the shape or object to be deformed. While drawing the spline, a grid is automatically created that best represents that object. Additional controls for Tolerance, Over Size and Snap Distance appear when this mode is enabled. These controls are documented below.

Set Mesh to Entire Image

The Set Mesh to Entire Image button automatically resets the size of the grid to the exact dimensions of the image. Any adjustments to vertices within the grid will be reset.

Copy Buttons

These two buttons provide a technique for copying the exact shape and dimensions of the Source grid to the Destination, or the Destination grid to the Source. This is particularly useful after setting the Source grid to ensure that the Destination grid's initial state matches the Source grid before beginning a deformation.

Point Tolerance

This control is only visible when the Edit Line mode is enabled. The Point Tolerance slider determines how much tessellation the grid will apply to closely match the density of points in the spline. The lower this value, the fewer vertices there will be in the resulting grid and the more uniform the grid will appear. Higher values will start applying denser grids with variations to account for regions in the spline that require more detail.

Oversize Amount

This control is only visible when the Edit Line mode is enabled. The Oversize Amount slider is used to set how large an area around the spline should be included in the grid. Higher values create a larger border, which can be useful when blending a deformation back into the source image.

Snap Distance

This control is only visible when the Edit Line mode is enabled. The Snap Distance slider dictates how strongly the drawn spline will attract surrounding vertices. If a vertex is close enough to a spline's edge, the vertex will move to line up with the spline. The higher the value, the further the reach of the spline.

Right-Click Here for Mesh Animation

The grids are static by default. Right-clicking on the Right-Click Here for Mesh Animation label will provide a contextual menu with options for animating the grid or connecting it to another grid in the composition.

The grid uses a Polychange spline. Any adjustment to any of the control points will add or modify the keyframe for all points to the Polychange spline.

Right-Click Here for Shape Animation

This label only appears in the Edit Line mode. Right-clicking on the Right-Click Here for Shape Animation label will reveal a contextual menu that can be used to animate the shaping polyline or to connect it to other polylines in the composition.

Render Tab
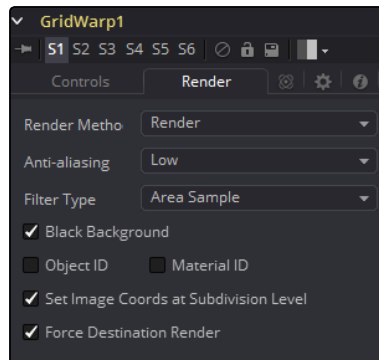
Render Method

The Render Method drop-down menu is used to select the rendering technique and quality applied to the mesh. The three settings are arranged in order of quality, with the first (Wireframe) as the fastest and lowest of quality. The default mode is Render, which produces final resolution, full quality results.

Anti-Aliasing

The Anti-aliasing control is a checkbox in Wireframe Render mode.

It is otherwise a drop-down menu with three levels of quality. Higher degrees of anti-aliasing improve image quality dramatically but vastly increase render times. The Low setting may be an appropriate option while setting up a large dense grid, or previewing a flow, but almost never for a final render.

Filter Type

The Area Sample control is only visible when the Render Method is not set to Wireframe. Checked by default, disabling this checkbox prevents the grid from calculating area samples for each vertex in the grid. Area sampling vastly improves render quality at the cost of speed.

Wireframe Width

This control only appears when the Render Method is set to Wireframe. It determines the width of the lines that make up the wireframe.

Anti-Aliased

This control only appears when the Render Method is set to Wireframe. Use this checkbox to enable/disable antialiasing for the lines that make up the wireframe.

Black Background

The Black Background checkbox determines whether pixels outside of the grid in the source image will be set to black or if they will be preserved.

Object ID and Material ID

Enable the Object ID or Material ID checkboxes to have the grid output the proper ID channel in the final render.

Set Image Coordinates at Subdivision Level

Checkbox that defaults to On.

Force Destination Render

Checkbox that defaults to On.

Right Click Menu

The Grid Warp tool places a submenu for both Source and Destination grids in the Viewer's contextual menu. Both menus have the exact same name, where only the menu for the active grid is populated with options. The other menu is empty. The contextual menu options are all available from the toolbar that appears in the Viewer.
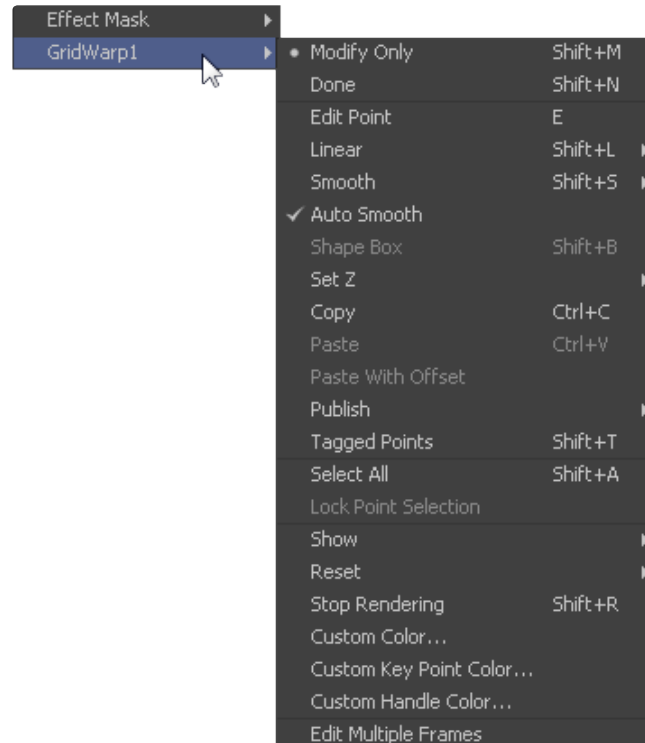
Modify Only/Done

These two options set the mesh to modify only and done modes, respectively. Select Modify Only to edit the mesh or Modify Done to prevent any further changes to a mesh.

Smooth/Linear

Use Smooth and Linear to apply or remove smoothing from selected vertices.

Auto Smooth Points

When Auto Smooth Points is enabled, the vertices in the grid will automatically be smoothed whenever they are moved. This is generally on by default.

Z Under/Z Same/Z Over

When two vertices in a grid overlap, one ends up getting clipped by the other. Z Under, Z Same and Z Over are used to select which vertices are rendered on top and which are rendered behind.

Select All

This option will Select All points in the mesh.

Show Key Points, Handles, Grid and Subdivisions

Use these four options to enable or disable the display of the grid, key points (vertices), Bezier handles and subdivisions in the Viewers.

Reset Selected Points

Reset Selected Points (vertices) to their default positions.

Reset All Points

This will Reset All Points (vertices) in the mesh to their default positions.

Stop Rendering

This option will enable Stop Rendering, which disables all rendering of the Grid Warp tool until the mode is turned off. This is frequently useful when making a series of fine adjustments to a complex grid.

Screen Controls

Whenever the Grid Warp tool is selected and is in Edit Grid mode, the Grid Warp toolbar is displayed in the views. This toolbar provides a variety of options for manipulating and adjusting the grid. The toolbar buttons in this toolbar are described above in the contextual menu.
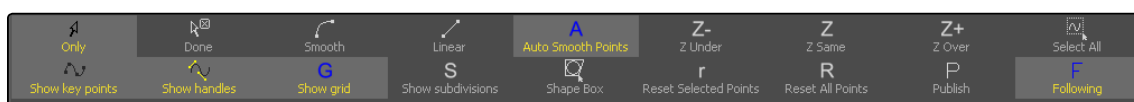
Lens Distort [Lens]

This tool can be used to remove or add lens distortion in an image. The amount and type of lens distortion in an image depends on a variety of factors such as the actual lens that has been used, the quality and amount of lensgroups in that lens, adjustments like shift lenses and much more.

One reason to remove lens distortion is to comp an undistorted layer as, for example, a 3D rendering, on top of a distorted layer as, for example, a real world camera shoot. When combining the layers without removing the lens distortion, unwanted effects like straight lines not matching up on foreground and background will occur. The resulting composite will not look believable.

In a typical workflow one would apply the LensDistort in Undistort mode to the original layer, add the 3D elements, do all other compositing work and finally apply LensDistort again with exactly the same settings, but this time in Distort mode to get the original look and distortion back into the image.

Controls Tab
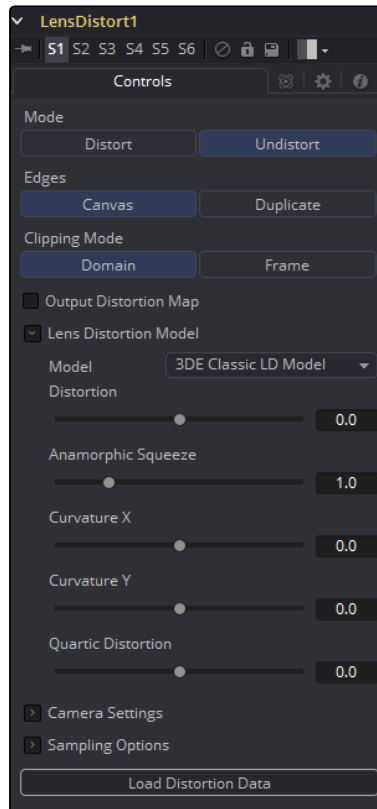
Mode

Undistort removes the lens distortion to create a flattened image. Distort brings the original lens distortion back into the image.

Edges

Determines how samples that fall outside the frame are treated.

→ **Canvas:** Pixels outside the frame are set to the default canvas color. In most cases this is black with no alpha.

→ **Duplicate:** Pixels outside the frame are duplicated. This results in "smeared" edges but is useful when, for example, applying a blur, because black pixels would in that case result in unwanted blurring between the actual image and the black canvas.

Clipping Mode

→ **Domain:** Retains all pixels that might be moved out of the frame for later re-distorting.

→ **Frame:** Pixels moved outside the frame will be discarded.

Output Distortion Map

Outputs the location of pixels as a warped screen-coordinate map.

Camera Settings

The options known from the Camera3D are duplicated here. They can either be set manually or connected to an already existing Camera3D.

Lens Distortion Model

Select the appropriate 3D Equalizer Lens Distortion model here: 3DE Classic Model, 3DE4 Anamorphic, 3DE4 Radial Fisheye or 3DE4 Radial. Please consult the 3D Equalizer manual for further explanation. The sliders in the 3DE Classic LD Model are most likely best suited for manually applying (un)distortion, without having imported lens data.

Supersampling [HiQ]

Sets the number of samples used to determine each destination pixel. As always, higher supersampling leads to higher render times. 1×1 bilinear is usually of sufficient quality, but with high lens distortion near the edges of the lens there will be noticeable differences to higher settings.

Supersampling Mode [HiQ]

The type of sample done for each supersample. Nearest will lead to a crisper but more aliased image. Bilinear will give a blurrier result.

Load Distortion Data

Allows the user to load a Lens Distortion profile created, for example, by the 3D Equalizer.

How to Manually Determine Lens Distortion

In the ideal world, one would have exact lens-parameters from each lens that was used during the shoot, and one could use those values to undistort the image. However, in the real world, those parameters have not been taken on set or don't match. Another approach is to use a software like 3DEqualizer which analyzes the footage and delivers a dataset that can be imported into the LensDistort tool right away.

And finally, one could try to manually eyeball the amount of lens distortion using the control sliders. To do that, one could either look out for horizontal or vertical lines in the footage that are supposed to be straight and straighten them out using the controls, or shoot a full frame checkerboard pattern on set as a reference.

Perspective Positioner [PPN]

The Perspective Positioner is the complementary tool to the Corner Positioner tool. By positioning corner points on an image and moving them, it is possible to remove the perspective from an image. This function can also be used to wobble and warp the image by animating the points over time.

Controls Tab
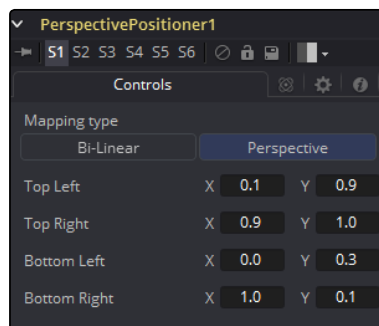
Corners X and Y

There are the four control points of the Perspective Positioner. Interactively drag these in the views to position each corner of the image.

Vector Distortion [Dst]

The Vector Distortion tool distorts the main source image along the X- and Y-axis separately, based on the vector channel data in the source image, or a channel from a second image or reference image.

Controls Tab
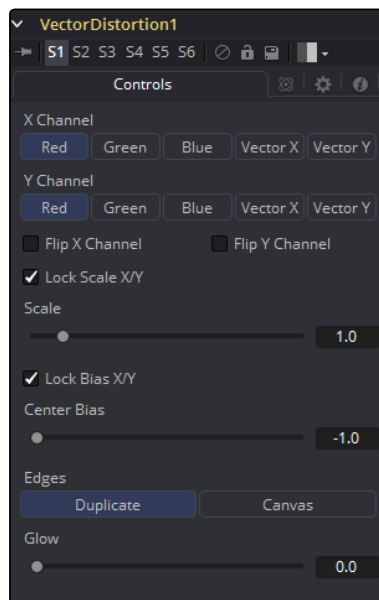
X Channel and Y Channel

Use these buttons to select which channel of the reference image will be used to distort the X and Y channels. If no Distort reference image is connected to the second (green) input of the tool, then channels from the main input are used instead.

Flip X and Flip Y Channel

Use these checkboxes to flip the direction of the distortion along the specified axis.

Lock Scale X/Y

Select this checkbox to separate the Scale slider into separate Scale X and Scale Y sliders.

Scale

Use the Scale slider to apply a multiplication to the values of the distortion reference image.

Lock Bias X/Y

Select this checkbox to separate the Bias slider into separate Bias X and Bias Y sliders.

Center Bias

Use the Center Bias slider to shift or nudge the distortion along a given axis.

Edges

The Edges buttons are used to set how the tool deals with pixels that reach the edge of the screen.

Glow

Use this slider to add a glow to the result of the vector distortion.

Vortex [Vᴛx]

The Vortex effect appears as a swirling whirlpool in specified regions of the image. The Vortex can be made to move and grow by animating the various controls.

Controls Tab
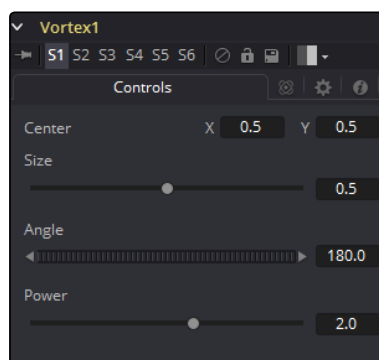
Center X and Y

This control is used to position the Center of the Vortex effect on the image. The default is 0.5, 0.5, which positions the effect in the center of the image.

Size

Change the area affected by the Vortex in the display window by dragging the circumference of the effect or by using the Size slider.

Angle

Drag the rotation handle in the Viewer or use the thumbwheel control to change the amount of rotation in the Vortex. The higher the angle value, the greater the swirling effect.

Power

Increasing the Power slider makes the Vortex smaller but tighter. It effectively concentrates it inside the given image area.

Modifiers

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Modifiers

Bezier Spline

The BezierSpline is one of the animation modifiers in Fusion and normally is applied to numerical values rather than point values. It is applied by default each time you right-click on a numerical control and select Animate.

It can also be applied by right-clicking on a numerical control and selecting Modify with > BezierSpline.

Usage

Being an animation spline, this modifier has no actual Controls tab. However, its effect can be seen and influenced in the Spline Editor. The Bezier Spline offers individual control over each point's smoothness by means of handles. The smoothness can be applied by multiple ways.
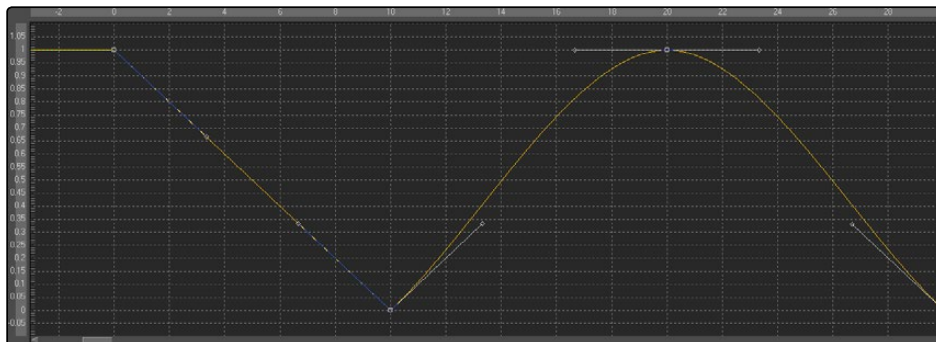
→ To make the keys smooth, select them and press Shift-S. The handles can then be used to further modify the behavior of in and out.

→ To make the keys linear, select them and press Shift-L. These operations can also be performed using the contextual menu.

→ Select the keyframe(s), right click and select Smooth or Linear. The menu also allows the user to apply smoothing using a Savitzky-Golay filter. Select the keyframe(s), right-click and select Smooth Points -Y Dialog.

Ease In/Out Can Also Be Modified by Using the Control Slider

→ Select the keyframe you want to modify, right-click and select Ease In/Out... from the contextual menu. Then use the sliders to individually control the Ease In/Out numerically.
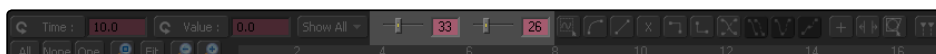
B-Spline

The B-spline is one of the animation modifiers in Fusion and normally is applied to numerical values rather than point values.

It can be applied by right-clicking on a numerical control and selecting Modify with > B-Spline.

Usage
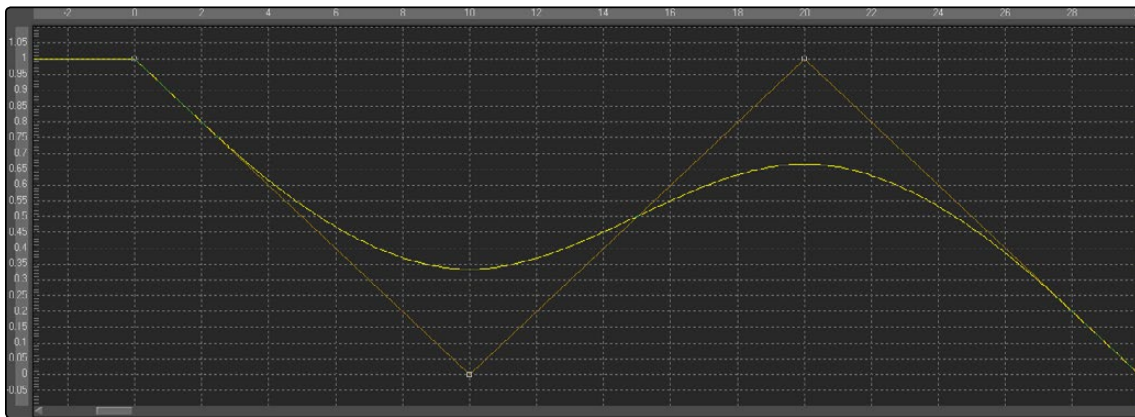
Being an animation spline, this modifier has no actual Controls tab. However its effect can be seen and influenced in the Spline Editor. Notice that, though the actual value of the second keyframe is 0, the value of the resulting spline is 0.33 due to the unique smoothing and weighing algorithms of a B-spline.

The weight can be modified by left-clicking on the keyframe to select it, holding down W as well as the left mouse button, and moving the mouse to the left to lower the tension and to the right to increase the tension. This also can be done with multiple selected keyframes simultaneously.

Calculation

Calculations are used to create indirect connections between value controls. A calculation can perform a mathematical expression based on two operands, where each operand can be connected to another control or set manually by the user.

Additionally, the Calculation control can access the values of a connected control at times other than the current time, using Time offsets and Time Scale controls built into the Calculation Modifier.

The most common use for a calculation is when two controls need to be connected to each other, but the range or scope of the value's output by one control is inappropriate for the other control.

Note: The Expression modifier is essentially a more flexible version of the Calculation modifier, with a single exception. It is far easier to manipulate the timing of the operands provided to a Calculation than it is to do so with an Expression.

Calc Tab
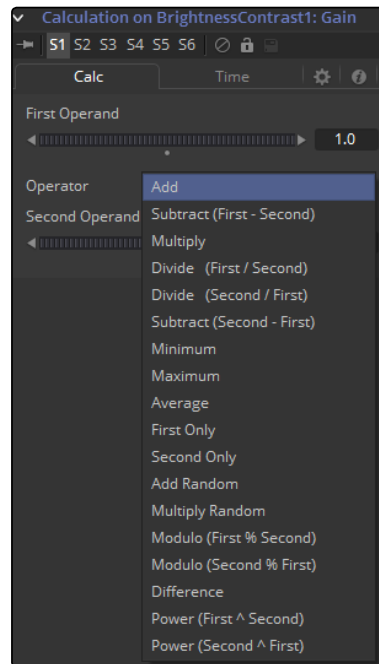
First and Second Operand

These sliders are either connected to published or animated controls from other tools in the composition or manually set to the desired values for the calculation.

Operator

Select from the mathematical operations listed in this menu to determine how the two operands are combined. Clicking on the down arrow opens the menu with the following options:

Time Tab
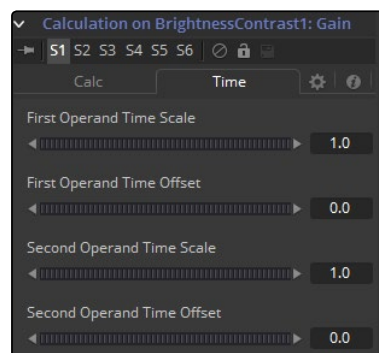
First and Second Operand Time Scale

These sliders cause the frame used to read the values of the Operands specified in the Calc tab to be scaled. A value of 1 returns the value of the operand at frame x when the composition is set to frame x. For example, if the first operand is animated with a value of 1 to 10 from frame 0 to 10, then a scale of 0.5 would cause the calculation to return a value of 5 at frame 10 (effectively slowing the animation by half for the purposes of the calculation).

First Operand and Second Operand Time Offset

These sliders return the value of the Operand at the Time Offset specified. A value of 10 would return the value of the operand 10 frames forward in time and -10 would return the value of the operand 10 frames back in time. See the example below for a practical example.

Example

The following example uses a calculation to apply blur to a text in inverse proportion to the size of the text.

→ Create a new composition, and set the Global Start and Render Start to 1. Set the Global End and Render End to 100.

→ Add a Text Plus tool to the composition.

→ Enter a small amount of text in the StyledText input.

→ Make sure the current frame is 0

→ Set the Size parameter of the Text tool to a value of 0.06 at frame 0.

→ Right-click on the Size slider and animate the slider by setting a key.

→ Advance to frame 100 and set the value of the Size control to 0.50.

→ Add a Blur tool immediately after the Text tool. Connect the Blur input to the Text tool's output.

→ View the Blur tool in one of the Viewers.

→ We want the blur to decrease in strength as the text gets bigger. The controls cannot be directly connected together because the values of the Text Size control are getting bigger instead of smaller.

→ Right-click on the Blur size and select Modify With Calculation from the contextual menu. A new set of controls will appear in the Modifiers tab while the Blur tool is selected.

→ Switch to the Modifier tab (F11)

→ Right-click on the First Operand slider. Select Connect To > Text 1 > Size from the contextual menu. This connection isn't very useful, though; the maximum value of the Blur Size control is 0.5, which is hardly noticeable as a blur.

→ Set the Operator drop-down menu to Multiply.

→ Set the Second Operand slider to 100.

→ Switch to the Time tab of the modifier and set the First Operand Time Scale to -1.0. Normally, the First Operand will get the value of the control it is connected to from the same frame as the current time. So at frame 10, the first operand will be set to the same value as the Text size at frame 10. By setting this value to -1, the value is read from one frame back in time whenever the current time of the composition advances by 1 frame.

→ However, this means that the Calculation would be reading the value of the Text size at frame -10 when we are at frame 10 in the composition. To correct for this, set the First Operand Time Offset slider to 100.

→ Return to the Tools tab of the Tool Control Area (F9). Press play (spacebar) and watch how the value of the Blur Size relates to the value of the Text Size.

Character Level Styling

The Character Level Styling modifier only works on Text+ tools. You can then select individual characters directly in your view and apply different text attributes to them. Think of larger capitals at the beginning of each line, different fonts in one word, colored highlighting and more.

It can be applied by right-clicking into the Styled Text field of a Text+ tool and selecting Character Level Styling.

Character Level Styling can only be directly applied to Text+ tools, not to Text 3D tools. However, styled text from a Text+ tool can be applied to a Text 3D tool by means of copying the Text+, right-clicking on the Text 3D and choosing Paste Settings.

Text Tab
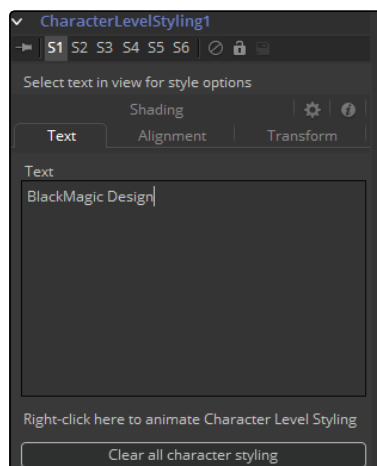
Text Controls, Alignment, Transform and Shading Tab
For details see the Text+ tool documentation.

Clear Character Styling on Selection

All changes made to the currently selected Characters will be reset.

Clear all Character Styling

All character attributes will be reset to their original values.

Circle

The Circle only works on Paint tools. Creates a circular shape with animatable control over radius and center. It can be applied by clicking on Circle in the Paint tool's Stroke menu.
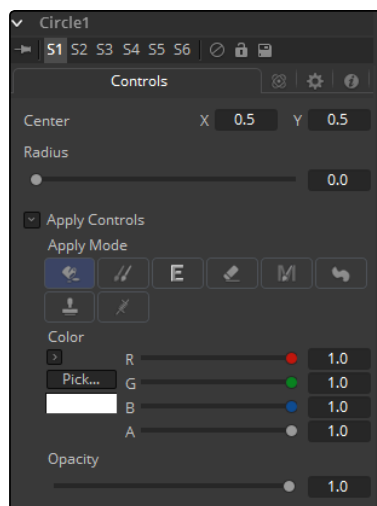
Controls

Center

The Center of the circle.

Radius

The Radius of the circle.

Apply Mode

For details see the Apply Controls of the Paint tool.

Color

The Color of the circle.

Opacity

The Opacity of the circle.

CloneMultistroke

The CloneMultistroke is pretty much like the normal Multistroke, but specifically meant to clone areas from one image to the other. In addition to the Multistroke, it has a Source Tool input, described later in this manual.

→ Perfect for those 100-strokes-per-frame retouching paint jobs like removing tracking markers.

→ Much faster than the Stroke, but not editable later on.

→ It can be applied by clicking on the CloneMultistroke button in the Paint tool's Stroke menu.

Controls Tab

Not all of the controls described here appear in all modes. Certain controls are only useful in a specific paint mode and are hidden when they are not applicable. Additionally, several of the controls are considered to be self-explanatory; the purpose of a Center control, Angle or Size control should be relatively straightforward to determine.

To reduce complexity, these controls are not all described. For further details on the functionality of the Controls Tab, see the Working with Paint Strokes - Animating Strokes section in this chapter.

Brush Shape
- → Soft Brush: The Soft Brush type is a circular brush with soft edges. Modify the size of the brush in the Viewer by holding the Command or Ctrl key down while dragging the mouse.

- → Circular Brush: A Circular Brush is a brush shape with hard edges. Resize this brush interactively.

- → Image Brush: The Image Brush allows images from any tool in the flow, or from a file system, to be used as a brush. See Creating Custom Brushes later in this chapter.

- → Single Pixel Brush: The Single Pixel Brush is perfect for fine detail work, creating a brush exactly one pixel in size. No anti-aliasing is applied to the single pixel brush.

- → Square Brush: A Square Brush is a brush shape with hard edges.

Vary Size
- → Constant: The brush will be a constant size over the stroke.

- → With Pressure: The stroke size will vary with the actual applied pressure.

- → With Velocity: The stroke size will vary with the speed of painting. The faster the stroke, the thinner it is.

Vary Opacity
- → Constant: The Constant brush will be a constant transparency over the entire stroke.

- → With Pressure: The stroke transparency will vary with the applied Pressure.

- → With Velocity: The stroke transparency will vary with the speed of painting. The faster the stroke, the more transparent it is.

Softness
Use this control to increase or decrease the Softness of a soft brush.

Image Source
When using the Image Source brush type, select between three possible sources brush images.

- → Tool: The image source is derived from the output of a tool on the flow. Drag the tool into the Source Tool input to set the source.

- → Clip: The image source is derived from an image or sequence on disk. Any file supported by Fusion's Loader can be used. Locate the file using the filename Clip browser that appears to set the clip used as a source.

- → Brush: Images stored in the Fusion > Brushes directory are used as a brush for the Paint tool. Select the brush from the the menu that appears.

Apply Controls

Apply Mode

→ **Color:** The Color apply mode paints simple colored strokes on the screen. When used in conjunction with an image brush, it can also be used to tint the brush.

→ **Clone:** The Clone apply mode copies portions of one image into another image, or clones from the same image using adjustable positions and time offsets. Any image from the flow can be used as the source image.

→ **Emboss:** The Emboss apply mode embosses the portions of the image covered by the brush stroke.

→ **Erase:** Erase reveals the underlying image through all other strokes, effectively erasing portions of the strokes beneath it without actually destroying the strokes.

→ **Merge:** This apply mode effectively Merges the brush onto the image. This mode behaves in much the same way as the Color apply mode but has no color controls. It is best suited for use with the image brush type.

→ **Smear:** Smear the image using the direction and strength of the brush stroke as a guide.

→ **Stamp:** Stamp the brush onto the image, completely ignoring any alpha channel or transparency information. This mode is best suited for applying decals to the target image.

→ **Wire:** This Wire Removal mode is used to remove wires, rigging and other small elements in the frame by sampling adjacent pixels and drawing them in toward the stroke.

→ **Source Tool:** Shows which tool's image output is used to clone from.

Stroke Controls

Size

This control adjusts the Size of the brush when the brush type is set to either Soft Brush or Circle. The diameter of the brush is drawn in the Viewer as a small circle surrounding the mouse pointer. The size can also be adjusted interactively in the Viewer by holding the Command or Ctrl key while click-dragging the mouse pointer.

Spacing

The Spacing slider determines the distance between dabs (samples used to draw a straight line along the underlying vector shape that composes a stroke or polyline stroke). Increasing the value of this slider increases the density of the stroke, whereas decreasing the value is likely to cause the stroke to assume the appearance of a dotted line.

Stroke Animation

The Stroke Animation menu control provides several pre-built animation effects that can be applied to a paint stroke. This menu only appears for Vector strokes.

→ **All Frames:** This default displays the stroke for All Frames of the project where a valid target image is available to the paint tool.

→ **Limited Duration:** This exists on the number of frames specified by the Duration slider.

→ **Write On:** When Write On is selected, an animation spline will be added to the paint stroke that precisely duplicates the timing of the paint stroke's creation. The stroke will be written on the image exactly as it was drawn. To adjust the timing of the Write On effect, switch to the Spline Editor and use the Time Stretcher mode to adjust the overall length of the animation spline. To smooth or manually adjust the motion, try reducing the points in the animation spline.

→ **Write Off:** Write Off will perform the reverse of Write On, drawing the stroke starting from the end and working backward to the start of the stroke.

→ **Write On Then Off:** This mode will apply a Write On and then a Write Off animation mode to the stroke.

→ **Trail:** Selecting the Trail mode will cause both the start and end points of the stroke to be animated simultaneously, offset from each other by the amount specified in the duration control. This has the effect of creating a segment of the stroke that follows the stroke as if it were a path. As with the Write On and Off effects, this will start at the frame that is current when the animation mode is selected. The timing of the animation can be adjusted manually using the Spline or Timeline Editors.

Duration

Duration sets the duration of each stroke in frames. This control is only present for Multistrokes or when the stroke animation mode is set to Limited Duration. It is most commonly employed for frame-by-frame rotoscoping through a scene.

Note: Each Vector stroke applied to a scene will have a duration in the Timeline that can be trimmed independently from one stroke to the next. The duration can be set to 0.5, which will allow each stroke to last for a single field only when the flow is processing in Fields mode.

Write On and Write Off

This range slider appears when the Stroke Animation is set to one of the Write On and Write Off methods. The range represents the beginning and end points of the stroke. Drag the low value upward to give the impression that the stroke is being erased, or drag the high value from 0.0 to 1.0 to give the impression that the stroke is being drawn on the screen. This control can be animated to good effect. It works most effectively when automatically animated through the use of the Write On, Write Off modes of the stroke animation menu.

Make Editable

This button only appears for Vector strokes. Clicking on 'Make Editable' turns the current stroke into a polyline spline so that the shape can be adjusted or animated.

Comp Name

The Comp Name only works on Text+ tools. It sets the Styled text to become the current Composition Name. This is quite useful to automate burn-ins for daily renderings. See also the TimeCode modifier. It can be applied by right-clicking into the Styled text field of a Text+ tool and selecting Comp Name.

Controls

This Modifier Has No Controls

For further details see the Text+ Tool documentation.

Coordinate Transform 3D

Because of the hierarchical nature of the Fusion 3D flow, the original position of an object in the 3D scene often fails to indicate the current position of the object. For example, an image plane might initially have a position at 1, 2, 1, but then be scaled, offset, and rotated by other tools further downstream in the 3D scene, ending up with an absolute location of 10, 20, 5.

This can complicate connecting an object further downstream in the composition directly to the position of an upstream object. The Coordinate Transform modifier can be added to any set of XYZ coordinate controls, and will calculate the current position of a given object at any point in the scene hierarchy.

To add a Coordinate Transform modifier, simply right-click on the a numeric input on any tool, and select Modify With/CoordTransform Position from the Controls contextual menu.
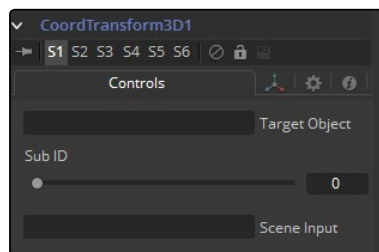
Controls Tab

Target Object

This control should be connected to the 3D tool that produces the original coordinates to be transformed. To connect a tool, drag and drop a tool tile from the flow into the Text Edit control, or right-click on the control and select the tool from the contextual menu. It is also possible to type the tools name directly into the control.

Sub-Id

The SubID slider can be used to target an individual sub-element of certain types of geometry, such as an individual character produced by a Text 3D tool or a specific copy created by a Duplicate 3D tool.

Scene Input

This control should be connected to the 3D tool that outputs the scene containing the object at the new location. To connect a tool, drag and drop a tool tile from the flow into the Text Edit control, or right-click on the control and select an object from the Connect To pop-up menu.

Copy Ellipse

The Copy Ellipse only works on Paint tools. It creates an elliptical shape to clone elements from one area of the image to the other. It can be applied by clicking on the Copy Ellipse button in the Paint tool's Stroke menu.
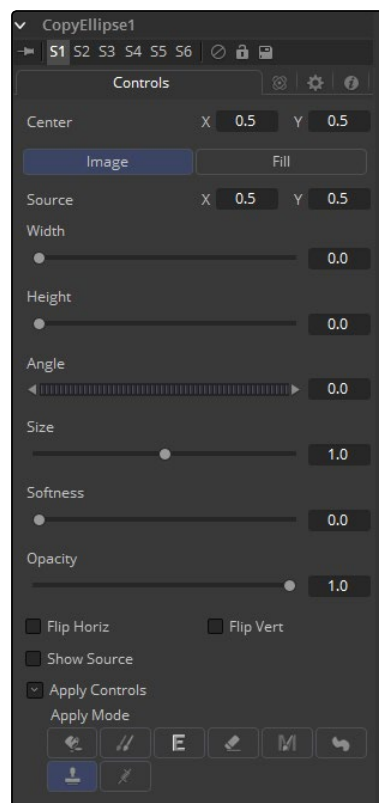
Controls

Center X Y

The Center of the Ellipse. Move this control to determine where the content will be copied to.

Image

The Source will be used to copy content to the destination.

Fill

The Fill color will be used to create a plain fill on the destination.

Source Center X Y

The Center of the Source Ellipse. Move this control to determine where the content will be copied from. Activate Show Source to see the on screen controls.

Width/Height Sliders

The Width and Height of the ellipse. This can also be modified with the on screen controls.

Angle

The Rotation of the ellipse. This can also be modified with the on screen controls.

Size

The overall Size of the ellipse. This is a multiplier to the Width and Height settings.

Softness

The Softness of the edge of the ellipse.

Opacity

The overall opacity of the output.

Flip Horiz/Flip Vert

The area inside the ellipse will be flipped horizontally and/or vertically.

Show Source

Show the on screen controls to adjust the position of the Source Ellipse.

Apply Mode

For more details see the Apply Controls of the Paint tool section.

Copy Polyline

The Copy Polyline only works on Paint tools. It creates a user-definable Polyline to clone elements from one area of the image to the other. See the Polylines and Rotoscoping chapter of this manual. It can be applied by clicking on the Copy Polyline button in the Paint tool's Stroke menu.
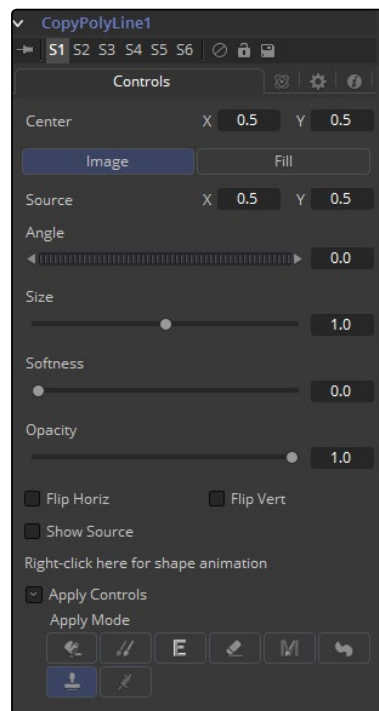
Controls

Center X Y

The Center of the Polyline. Move this control to determine where the content will be copied to.

Image

The Source will be used to copy content to the Destination.

Fill

The Fill color will be used to create a plain fill on the Destination.

Source Center X Y

The Center of the Source Polyline. Move this control to determine where the content will be copied from. Activate Show Source to see the on screen controls.

Width/Height Sliders

The Width and Height of the Polyline. This can also be modified with the on screen controls.

Angle

The Rotation of the Polyline. This can also be modified with the on screen controls.

Size

The overall Size of the Polyline. This is a multiplier to the Width and Height settings.

Softness

The Softness of the edge of the Polyline.

Opacity

The overall Opacity of the output.

Flip Horiz/Flip Vert

The area inside the Polyline will be flipped horizontally and/or vertically.

Show Source

Show the on screen controls to adjust the position of the source Polyline.

Apply Mode

For more details see the Apply Controls of the Paint tool section.

Copy Rectangle

The Copy Rectangle only works on Paint tools. It creates a user-definable Rectangle to clone elements from one area of the image to the other. It can be applied by clicking on the Copy Rectangle button in the Paint tool's Stroke menu.
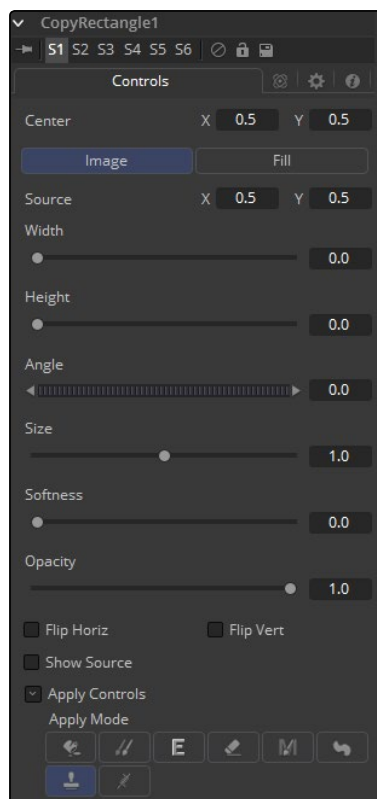
Controls

Center X Y

The Center of the Rectangle. Move this control to determine where the content will be copied to.

Image

The Source will be used to copy content to the Destination.

Fill

The Fill color will be used to create a plain fill on the Destination.

Source Center X Y

The Center of the Source Rectangle. Move this control to determine where the content will be copied from. Activate Show Source to see the on screen controls.

Width/Height Sliders

The Width and Height of the Rectangle. This can also be modified with the on screen controls.

Angle

The Rotation of the Rectangle. This can also be modified with the on screen controls.

Size

The overall Size of the Rectangle. This is a multiplier to the Width and Height settings.

Softness

The Softness of the edge of the Rectangle.

Opacity

The overall Opacity of the output.

Flip Horiz/Flip Vert

The area inside the Rectangle will be flipped horizontally and/or vertically.

Show Source

Show the on screen controls to adjust the position of the source Rectangle.

Apply Mode

For more details see the Apply Controls of the Paint tool section.

Cubic Spline

The Cubic Spline is one of the animation modifiers in Fusion and normally is applied to numerical values rather than point values. It can be applied by right-clicking on a numerical control and selecting Modify with > Natural Cubic Spline.

Usage

Being an animation spline, this modifier has no actual Controls tab. However its effect can be seen and influenced in the Spline Editor.
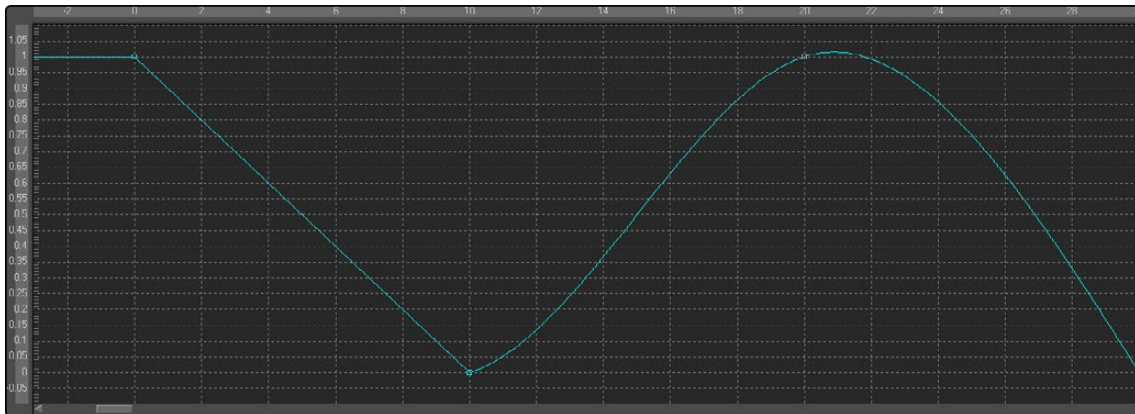
Expression

Adding an Expression modifier to a control will add the ability to control and manipulate either position or value controls based on any number of controls, either positional or value-based. This modifier offers exceptional flexibility compared to the more limited Calculation or Offset modifiers, but it is unable to access values from frames other than the current time.

An Expression will accept up to nine value inputs and nine position inputs that are used as part of a user-defined mathematical expression to output a value.

To add an Expression to a control, right-click on the control and choose Modify With > Expression from the contextual menu. The type of value that will be returned by the Expression entirely depends on the type of control it is modifying.

When used with a value control (like a slider), the Expression in the Number Out tab will be evaluated to create the result. When used to modify a positional control (like a tool's center), the Point Out tab will control the result.

The Modifiers view contains the controls for the Expression modifier. Its controls are described below.
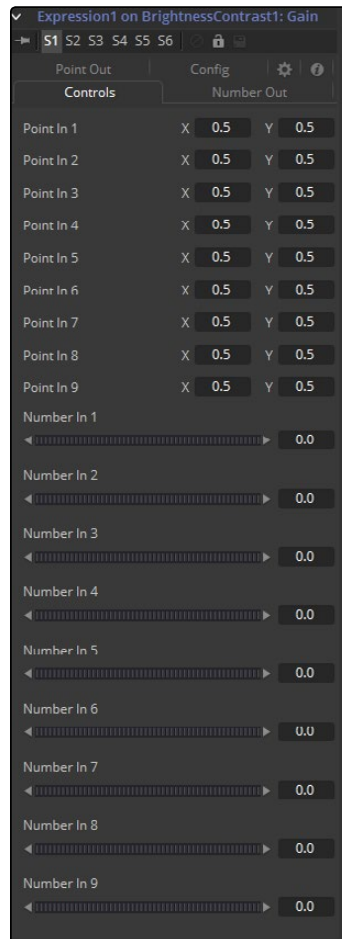
Controls Tab

This tab provides nine number controls and nine point controls. The values of the number controls can be referred to in an expression as n1 through n9. The X-coordinate of each point control can be referred to as p1x through p9x, while the Y-coordinate is p1y through p9y.

These values can be set manually by the user, connected to other parameters, animated and even connected to other Expressions or Calculations.

Number Out Tab
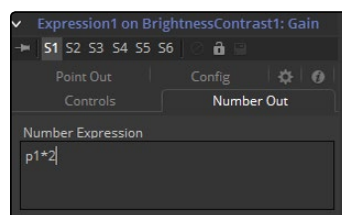
This enables a mathematical formula to be entered, which can access the values from both the Number In and the Point In tabs and output a value used to modify the control to which the expression was applied. See below for the syntax to use in this field.

Point Out Tab
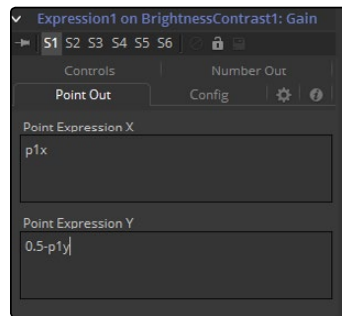
Each one of the text boxes in this tab can contain a mathematical formula that can access the values from both the Number In and the Point In tabs and output a value used to modify the control to which the Expression was applied. The Expression in the top text box control is used to calculate the X-axis value and the bottom text box is used to calculate the Y-axis control. See below for the syntax to use in this field.

Config Tab
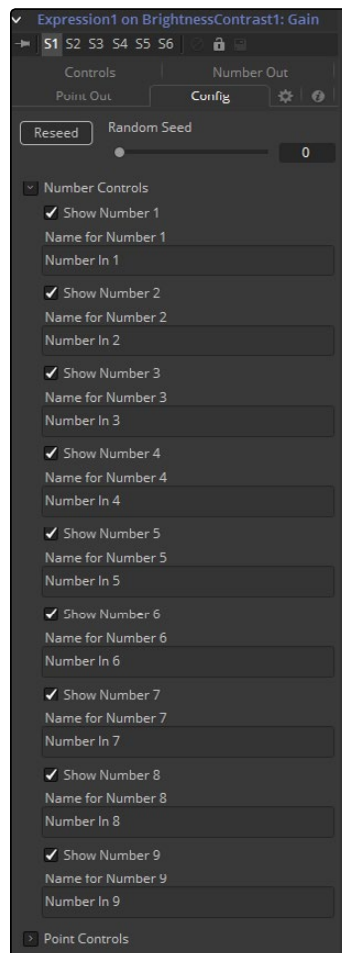
A good expression can be re-used over and over again. As a result, it can be useful to provide more descriptive names for each input and to hide the ones that are unused. The Config Tab of the Expressions modifier is used to customize visibility and name for each of the nine point and number inputs.

Random Seed

The Random Seed control is used to seed the Rand() function. The rand(x, y) function produces a random value between X and Y, producing a new value for every frame. As long as the setting of this Random Seed slider remains the same, the values produced at frame x will always be the same. Adjust the seed slider to a new value to get a different value for that frame.

Show Number or Point X

There are eighteen of these checkbox controls, one for each of the nine Number and Point inputs. Enable this checkbox to display the control for Number x or Point x in the Controls tab.

Name for Number or Point X

There are eighteen of these edit controls, one for each of the nine Number and Point inputs. Type a new name for the input into this edit control to assign a new name for the Input's label in the Controls tab.

Expression Syntax Formulas

Formulas are entered into the Number Out or Point Out tabs as part of an expression. They can be made up of the following functions:

n1..n9	The value of Number Input 1..9.
p1x..p9x	The X of Positional Control 1..9.
p1y..p9y	The Y of Positional Control 1..9.
time	The current time (frame number).
pi	The value of pi.
e	The value of e.
log(x)	The base-10 log of x.
ln(x)	The natural (base-e) log of x.
sin(x)	The sine of x (x is degrees).
cos(x)	The cosine of x (x is degrees).
tan(x)	The tangent of x (x is degrees).
asin(x)	The arcsine of x, in degrees.
acos(x)	The arccosine of x, in degrees.
atan(x)	The arctangent of x, in degrees.
atan2(x, y)	The arctangent of x,y, in degrees.
abs(x)	The absolute (positive) value of x.
int(x)	The integer (whole) value of x.
frac(x)	The fractional value of x.
sqrt(x)	The Square Root of x.
rand(x, y)	A random value between x and y.
rands(x, y, s)	A random value between x and y, based on seed s.
min(x, y)	The minimum (lowest) of x and y.
max(x, y)	The maximum (highest) of x and y.
dist(x1, y1, x2, y2)	The distance between point x1,y2 and x2,y2.
dist3d(x1,y1,z1,x2,y2,z2)	The distance between 3D points x1,y2,z1 and x2,y2,z2
noise(x)	A smoothly varying Perlin noise value based on x
noise2(x, y)	A smoothly varying Perlin noise value based on x and y
noise3(x, y, z)	A smoothly varying Perlin noise value based on x, y and z
if(c, x, y)	Returns x if c not 0, otherwise y.

Expression Syntax Operators

Operators are used to evaluate statements. They are combined with functions to perform logical and mathematical calculations in the Number Out and Point Out tabs.

x + y	x plus y.
x - y	x minus y.
x > = y	1.0 if x is less than y, otherwise 0.0.
x > y	1.0 if x is greater than y, otherwise 0.0.
!x	1.0 if x = 0, otherwise 0.0.
-x	(0.0 - x).
+x	(0.0 + x) (effectively does nothing).
x ^ y	x raised to the power of y.
x y	x multiplied by y.
x y	x divided by y.
x % y	x modulo y, (remainder of (x divided by y)).
x > = y	1.0 if x is less than or equal to y, otherwise 0.0.
x > = y	1.0 if x is greater than or equal to y, otherwise 0.0.
x = y	1.0 if x is exactly equal to y, otherwise 0.0.
x == y	1.0 if x is exactly equal to y, otherwise 0.0 (identical to above).
x < > y	1.0 if x is not equal to y, otherwise 0.0.
x != y	1.0 if x is not equal to y, otherwise 0.0 (identical to above).
x & y	1.0 if both x and y are not 0.0, otherwise 0.0.
x && y	1.0 if both x and y are not 0.0, otherwise 0.0 (identical to above).
x | y	1.0 if either x or y (or both) are not 0.0, otherwise 0.0.
x || y	1.0 if either x or y (or both) are not 0.0, otherwise 0.0 (identical to above).

Examples

Example 1

To make a numeric control equal to the Y value of a motion path, add an expression to the desired target control and connect the Path to Point In 1. Enter the formula:

```
p1y
```

into the Number Out field.

Example 2

To make the result of the Expression's Number Out be the largest of Number In 1 and Number In 2, multiplied by the cosine of Number In 3, plus the X coordinate of Point In 1, enter the formula:

```
max(n1, n2) * cos(n3) + p1x
```

into the Number Out field.

Example 3

Add a Background tool set to solid black and a Hotspot tool. Set the Hotspot size to 0.08 and set the Strength to maximum. Modify the Hotspot center with an expression. Change the current frame to 0.

Set n1 to 0.0 and add a Bezier spline. At frame 29, set the value of n1 to 1.0. Select both points and loop the spline using the Spline Editor. Now enter the following equations into the Point Out tab of the expression.

```
X-Axis Expression

n1

Y-Axis Expression

0.5 + sin(time*50) 4
```

Render out a preview and have a look at the results. (Try this one with motion blur.)

Fill

The Fill only works on Paint tools. It fills an area of the image with a user-definable color. From the way it works, it can be compared with the Wand mask. It can be applied by clicking on the Fill button in the Paint tool's Stroke menu.
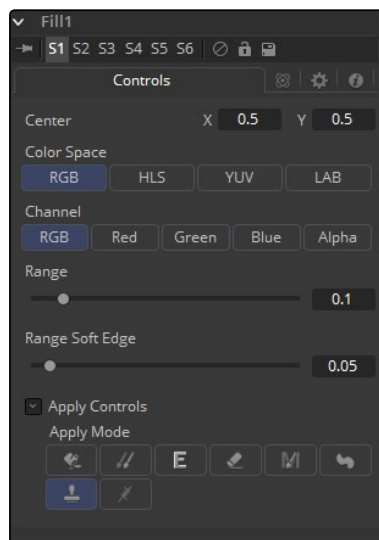
Controls

Selection Point

The Selection Point is a pair of X and Y coordinates that determine from where in the source image the fill derives its initial color sample. This control is also seen as a crosshair in the Viewers. The selection point can be positioned manually, connected to a Tracker, Path or other expressions.

Color Space

The Color Space button group determines the color space used when selecting the source color for the mask. The fill can operate in RGB, YUV, HLS or LAB color spaces.

Channel

The Channel button group is used to select whether the color that is masked comes from all three color channels of the image, the alpha channel, or from an individual channel only.

The exact labels of the buttons will depend on the Color Space selected for the fill operation. If the color space is RGB, the options will be R, G or B. If YUV is the color space, the options will be Y, U or V.

Range

The Range slider controls the range of colors around the source color that will be included in the fill. If the value is left at 0.0, only pixels of exactly the same color as the source will be considered part of the file. The higher the value, the more similar colors in the source will be considered to be wholly part of the fill.

Range Soft Edge

The Range Soft Edge determines the falloff range of the colors selected. Any pixel within the range defined above will be treated as 100% for the fill. If the soft range is set to 0.0, no other pixels will be considered for the fill. Increasing the soft range will increase the number of colors close to, but not quite within, the range that will be included in the fill. These pixels will be semi-transparent in the fill.

Apply Mode

For more details see the Apply Controls of the Paint tool section.

Follower

The Follower only works on Text and Text3D tools. This tool allows for a plethora of cool motion graphics effects. The basic idea is that you animate the parameters of a single character and the other characters will follow that animation with a delay. It can be applied by right-clicking into the Styled Text field of a Text tool and selecting Follower.

Timing Tab
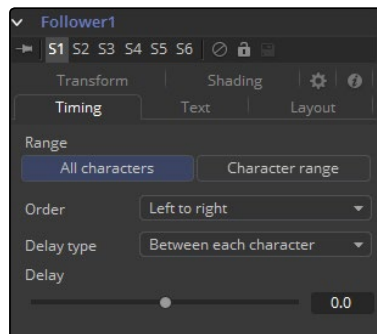
Range

Allows the user to select if all characters should be influenced or only a selected range. You can drag-select a range of characters directly on the screen.

Order

Determines in which order the Characters are influenced. Notice that empty spaces are counted as characters as well. Available options are:

- → Left to right: The animation ripples from left to right through all characters.
- → Right to left: The animation ripples from right to left through all characters.
- → Inside out: The animation ripples symmetrically from the center point of the characters toward the margin.
- → Outside in: The animation ripples symmetrically from the margin toward the center point of the characters.

→ **Random but one by one:** The animation is applied to randomly selected characters but only influences one character at a time.

→ **Completely random:** The animation is applied to randomly selected characters, influencing multiple characters at a time.

→ **Manual curve:** The affected characters can be specified by sliders.

Delay Type

Determines what sort of delay is applied to the animation. Available options are:

→ **Between Each Character:** The more characters there are in your text, the longer the animation will take to the end.

→ **Between First and Last Character:** No matter how many characters are in your text, the animation will always be completed in the selected amount of time.

Clear all Character Styling

All character attributes will be reset to their original values.

Text Controls, Alignement, Transform and Shading Tab

In these tabs, the actual animation for the characters is done. Observe that simply changing a value in these tabs will have no influence at all. The value needs to be animated for the effect to show.

For a detailed description on the various parameters, see the Text+ tool documentation.

From Image

The From Image only works on gradients, like the gradient on a Background tool. It takes samples of an image along a user-definable line and creates a gradient from those samples.

It can be applied by right-clicking on a Gradient control and selecting From Image.

Controls
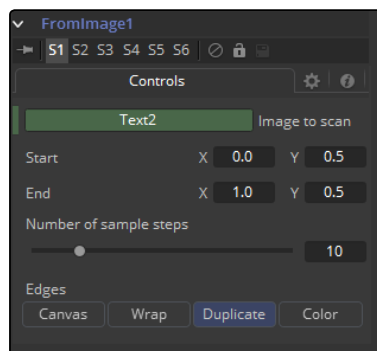
Image to Scan

Drop the tool you want to be examined into this box.

Start X/Y, End X/Y

These two point controls define the Start and End points of the line along which the samples are taken from the image defined in the Image to scan box.

The points can also be moved directly in the view.

Number of Sample Steps

Defines how many individual color samples are taken along the line. You can also see the result of this setting when you look at the actual tool's Gradient control. The more sample steps you define here, the more individual points you will see on the Gradient control. It is also possible to first create a gradient using the From Image modifier and then remove that modifier from the Gradient control again. The created gradient will stay intact and can then be fine tuned by hand.

Edges

Edges determines how the edges of the image will be treated when the sample line extends over the actual frame of the image to be sampled.

Black

This outputs black for every point on the sample line outside of the image bounds.

Wrap

This wraps the edges of the line around the borders of the image.

Duplicate

This causes the edges of the image to be duplicated as best as possible, continuing the image beyond its original size.

Color

Outputs a user-definable color instead of black for every point on the sample line outside of the image bounds.

Example
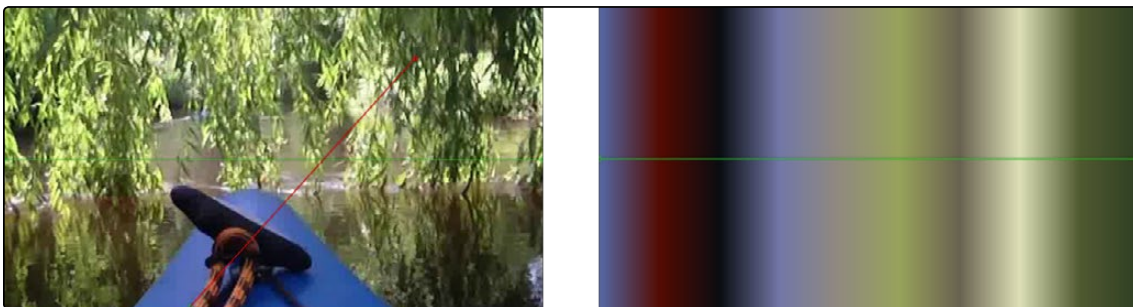
The source image on the left shows the color selection line in red.
The image on the right shows the resulting gradient from that selection.

GradientColorModifier

The Gradient Color modifier allows the user to control the value of a parameter. A gradient with customized values is mapped into a specific time range to control the value. If both time values are set to 0, then the modifier returns the value at the starting point of the gradient. You can use the Offset control to animate the gradient manually.

It can be applied by right-clicking onto a control and selecting Modify with > GradientColorModifier.

Controls Tab
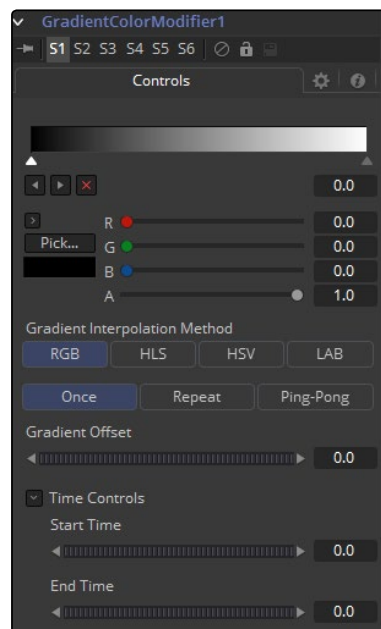
Gradient
The Gradient control consists of a bar where it is possible to add, modify and remove points of the gradient. Each point has its own color. It is possible to animate the color as well as the position of the point. Furthermore, a From Image modifier can be applied to the gradient to evaluate it from an image.

Gradient Interpolation Method
The gradient is linearly interpolated from point to point in RGB color space by default. This can sometimes result in unwanted colors. Choosing another color space may provide a better result.

Repeat

Defines how the left and right borders of the gradient are treated.

Gradients set to Once, Repeat and Ping Pong from top to bottom respectively and shifting the gradient to the left.

→ **Once:** When using the Gradient Offset control to shift the gradient, the border colors will keep their values. Shifting the default gradient to the left will result in a white border on the left, shifting it to the right will result in a black border on the right.

→ **Repeat:** When using the Gradient Offset control to shift the gradient, the border colors will be wrapped around. Shifting the default gradient to the left will result in a sharp jump from white to black, shifting it to the right will result in a sharp jump from black to white.

→ **Ping Pong:** When using the Gradient Offset control to shift the gradient, the border colors ping-pong back and forth. Shifting the default gradient to the left will result in the edge fading from white back to black, shifting it to the right will result in the edge fading from black back to white.

Gradient Offset

Allows you to pan through the gradient.

Time Controls

The Start Time and End Time thumbwheels determine the time range the gradient is mapped into. This is set in frames. The same effect can be achieved by setting the Gradient to Once and animating the offset thumbwheel.

MIDI Extractor

The MIDI Extractor Modifier provides the ability to modify the value of a control using the values stored in a MIDI file. Using the modifier relies on some knowledge of MIDI, which is outside of the scope of this manual to describe in detail.

The value produced by the modifier is extracted from the MIDI event selected in the Mode menu. Each mode can be trimmed so only specific messages for that event are processed. For example, only some notes are processed, while others are ignored. The value of the event can be further scaled or modified by additional factors, such as Scale, Velocity, Attack and Decay.

It can be applied by right-clicking on a control and selecting Modify with > Midi Extractor.

Controls Tab
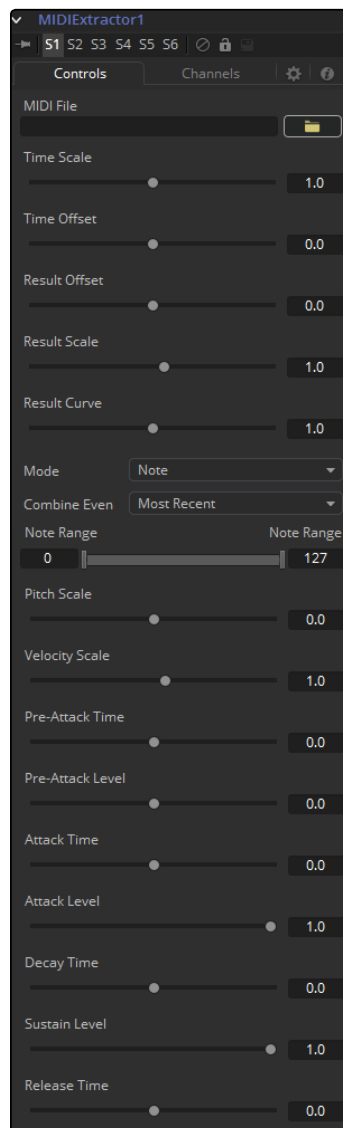
MIDI File

This browser control is used to specify the MIDI file that will be used as the input for the modifier.

Time Scale

Time Scale is used to specify the relationship between time as the MIDI file defines it and time as Fusion defines it. A value of 1.0 will play back the MIDI events at normal speed, 2.0 at double speed, etc.

Time Offset

Time Offset adjusts the sync between the MIDI file's timing and Fusion's timing. If there is an unexpected delay or if the MIDI file should start part way into or before some animation in Fusion, this control can be used to offset the MIDI data as required.

Result Offset, Result Scale

These sliders adjust the range of values produced by the modifier. By default, values between 0 and 1 (or -1 and 1 for PitchBend mode) are generated. This will not always suit the tool/parameter and scale can be used to make this range larger (such as * 0.0 - 2.0). Offset is used to provide some constant value as a base.

Result Curve

The Result Curve can also be used to adjust the output, however, this adjusts the curve of the result. By default, for any input MIDI data, the result will fall linearly between 0.1 and 1.0 (for example, a velocity 127 note will generate 1.0, where 63 will generate approximately 0.5).

Result curve applies a gamma-like curve so that middle values can produce higher or lower results while still maintaining the full scale.

Mode

This menu provides Beat, Note, Control Change, Poly AfterTouch, Channel AfterTouch or Pitch Bend, indicating from which MIDI event the values are being read. Beat mode is slightly different in that it produces regular pulses based on the tempo of the MIDI file (including any tempo maps).

The Beat mode does not actually use any specific messages. It bases its event timing on the tempo map contained in the MIDI file.

Combine Events

This menu selects what will happen when multiple events occur at the same time. In Notes mode, this can happen easily. For other events, this can happen if Multiple Channels are selected.

Use this to take the result from the most recent event to occur, the oldest event still happening, the highest or lowest valued event, the average, sum or the median of all events currently occurring.

Beat (Quarters) Beat Mode Only

This defines how often a beat will occur when in Beat mode. This is in Quarter notes so a value of 1.0 will give a beat every quarter.

Note Range Note and Poly Aftertouch Modes Only

This defines what range of notes will cause a value to be generated. For example, use this to pick out the kick drum from a GM drum track by setting the note range between 35-36.

Pitch Scale Note Mode Only

Pitch Scale defines how much the result changes with pitch. A value of 1.0 will cause the result to vary from 0.0 to 1.0 over the entire range.

Velocity Scale Note Mode Only

This defines how much the result changes with velocity. A value of 1.0 will cause the result to vary from 0.0 to 1.0 over the entire range. This is added to the result from pitch scale for the final result.

Control Number Control Change Mode Only

This specifies the MIDI controller number from which to extract events.

Envelope Controls Note and Beat Modes Only

These define an Envelope to follow for values before, during and after the note or beat. Pre-Attack Time defines how long before the event it will start ramping up to the pre-attack level. Attack is the Time/Level to ramp to once the event has occurred, followed by the Decay ramp and Sustain, until the event stops. This stage is for Notes only. Beats have an instantaneous duration, so it goes straight to Release. Release is the ramp down time after the event finishes. When trying to do a Beat, set Release to some value, or there likely will not be much on the beats.

These values can be used to follow actual sounds in the MIDI sequence, or just to create interesting effects. All time values used in the MIDI Extractor are in seconds.

Channels Tab
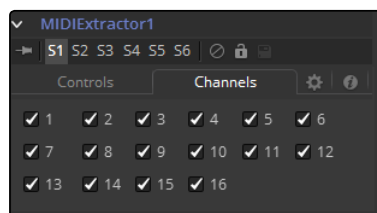
Channels

Channels checkboxes select which of the 16 channels in the MIDI file are actually considered for events. This is a good way to single out a specific instrument from an arrangement.

More About MIDI

A single MIDI interface allows 16 channels. Typically, these will be assigned to different instruments within a device or different devices.

Usually, MIDI data is 7-bits, ranging from 0..127. This is represented as a value between 0..1 to be more consistent with the way data is handled throughout the rest of Fusion.

There are quite a number of different MIDI messages and events but the ones that are particularly useful with this modifier are detailed below.

MIDI Messages

→ Note On: This indicates that a note (on a specific channel) is being turned on, has a pitch (0..127, with middle C being 60) and a Velocity (0..127, how fast the key was or whatever was hit).

→ Note Off: This indicates that a note (on a specific channel) is being turned off, has a pitch (0..127, with middle C being 60) and a Velocity (0..127, how fast the key was or whatever was released).

→ Control Change: This message indicates that some controller has changed. There are 128 controllers (0..127), each of which has data from 0..127. Controllers are used to set things such as Volume, Pan, amount of Reverb or Chorus, and generic things like foot controllers or breath controllers.

Midi Events

→ Channel Aftertouch: This event defines that pressure is being applied to the keys (or whatever) during a note. It is general, overall pressure for this channel so it simply uses a pressure value (0..127).

→ Poly Aftertouch: This event defines that pressure is being applied to the keys (or strings, or whatever) during a note. It is specific to each particular note and, therefore, contains a note number as well as a pressure value (0..127).

General

Pitch Bend

The Pitch Bend controller generally specifies the degree of pitch bending or variation applied to the note. Because pitch bend values are transmitted as a 14-bit value, this control has a range between -1 and 1, and a correspondingly finer degree of resolution.

For a resource on how MIDI works, have a look at http://www.harmony-central.com/MIDI/Doc/doc.html.

Multistroke

The Multistroke is the standard stroke in the Paint tool. Perfect for those 100-strokes-per-frame retouching paint jobs like removing tracking-markers. Much faster than the Stroke, but not editable later on.

While Multistrokes aren't directly editable, they can be grouped with the PaintGroup modifier, then tracked, moved and rotated by animating the PaintGroup instead. Alternatively, the Edit Multistrokes and Combine Strokes tool scripts can be used to convert multistrokes into ordinary, editable strokes, and vice versa.

It can be applied by clicking on the Multi Stroke button in the Paint tool's Stroke menu.

Controls Tab

Not all of the controls described here appear in all modes. Certain controls are only useful in a specific paint mode and are hidden when they are not applicable. Additionally, several of the controls are considered to be self-explanatory the purpose of a Center control, Angle or Size control should be relatively straightforward to determine.

To reduce complexity, these controls are not all described. For further details on the functionality of the Controls Tab, see the Working With Paint Strokes - Animating Strokes section in this chapter.

Brush Controls

Brush Shape

→ Soft Brush: The Soft Brush type is a circular brush with soft edges. Modify the size of the brush in the Viewer by holding Command or Ctrl down while dragging the mouse.

→ Circular Brush: A Circular Brush is a brush shape with hard edges. Resize this brush interactively.

→ Image Brush: The Image Brush allows images from any tool in the flow, or from a file system, to be used as a brush. See Creating Custom Brushes later in this chapter.

→ Single Pixel Brush: The Single Pixel Brush is perfect for fine detail work, creating a brush exactly one pixel in size. No anti-aliasing is applied to the single pixel brush.

→ Square Brush: A Square Brush is a brush shape with hard edges.

Vary Size

→ Constant: The brush will be a constant size over the stroke.

→ With Pressure: The stroke size will vary with the actual applied pressure.

→ With Velocity: The stroke size will vary with the speed of painting. The faster the stroke, the thinner it is.

Vary Opacity

→ Constant: The Constant brush will be a constant transparency over the entire stroke.

→ With Pressure: The stroke transparency will vary with the applied pressure.

→ With Velocity: The stroke transparency will vary with the speed of painting. The faster the stroke, the more transparent it is.

Softness

Use this control to increase or decrease the Softness of a soft brush.

Image Source

When using the Image Source brush type, select between three possible sources brush images.

→ Tool: The image source is derived from the output of a tool on the flow. Drag the tool into the Source Tool input to set the source.

→ Clip: The image source is derived from an image or sequence on disk. Any file supported by Fusion's Loader can be used. Locate the file using the filename Clip browser that appears to set the clip used as a source.

→ Brush: Images stored in the Fusion > Brushes directory are used as a brush for the paint tool. Select the brush from the menu that appears.

Apply Controls

Apply Mode

→ **Color:** The Color apply mode paints simple colored strokes on the screen. When used in conjunction with an Image brush, it can also be used to tint the brush.

→ **Clone:** The Clone apply mode copies portions of one image into another image, or to clones from the same image using adjustable positions and time offsets. Any image from the flow can be used as the source image.

→ **Emboss:** The Emboss apply mode embosses the portions of the image covered by the brush stroke.

→ **Erase:** Erase reveals the underlying image through all other strokes, effectively erasing portions of the strokes beneath it with out actually destroying the strokes.

→ **Merge:** This apply mode effectively Merges the brush onto the image. This mode behaves in much the same way as the Color apply mode but has no color controls. It is best suited for use with the image brush type.

→ **Smear:** Smear the image using the direction and strength of the brush stroke as a guide.

→ **Stamp:** Stamp the brush onto the image, completely ignoring any alpha channel or transparency information. This mode is best suited for applying decals to the target image.

→ **Wire:** This Wire Removal mode is used to remove wires, rigging and other small elements in the frame by sampling adjacent pixels and drawing them in toward the stroke.

Stroke Controls

Size

This control adjusts the Size of the brush when the brush type is set to either soft brush or circle. The diameter of the brush is drawn in the Viewer as a small circle surrounding the mouse pointer. The size can also be adjusted interactively in the Viewer by holding the Command or Ctrl key while click-dragging the mouse pointer.

Spacing

The Spacing slider determines the distance between dabs (samples used to draw a straight line along the underlying vector shape that composes a stroke or polyline stroke). Increasing the value of this slider increases the density of the stroke, whereas decreasing the value is likely to cause the stroke to assume the appearance of a dotted line.

Stroke Animation

The Stroke Animation menu control provides several pre-built animation effects that can be applied to a paint stroke. This menu only appears for Vector strokes.

All Frames

This default displays the stroke for All Frames of the project where a valid target image is available to the paint tool.

Limited Duration

This exists on the number of frames specified by the Duration slider.

Write On

When Write On is selected, an animation spline will be added to the paint stroke that precisely duplicates the timing of the paint stroke's creation. The stroke will be written on the image exactly as it was drawn. To adjust the timing of the Write On effect, switch to the Spline Editor and use the Time Stretcher mode to adjust the overall length of the animation spline. To smooth or manually adjust the motion, try reducing the points in the animation spline.

Write Off

Write Off will perform the reverse of Write On, drawing the stroke starting from the end and working backward to the start of the stroke.

Write On Then Off

This mode will apply a Write On and then a Write Off animation mode to the stroke.

Trail

Selecting the Trail mode will cause both the start and end points of the stroke to be animated simultaneously, offset from each other by the amount specified in the duration control. This has the effect of creating a segment of the stroke that follows the stroke as if it were a path. As with the Write On and Off effects, this will start at the frame that is current when the Animation mode is selected. The timing of the animation can be adjusted manually using the Spline or Timeline Editors.

Duration

Duration sets the duration of each stroke in frames. This control is only present for Multistrokes or when the Stroke Animation mode is set to Limited Duration. It is most commonly employed for frame-by-frame rotoscoping through a scene.

> Each Vector stroke applied to a scene will have a duration in the Timeline that can be trimmed independently from one stroke to the next. The duration can be set to 0.5, which will allow each stroke to last for a single field only when the flow is processing in Fields mode.

Write On and Write Off

This range slider appears when the Stroke Animation is set to one of the Write On and Write Off methods. The range represents the beginning and end points of the stroke. Drag the low value upward to give the impression that the stroke is being erased, or drag the high value from 0.0 to 1.0 to give the impression that the stroke is being drawn on the screen. This control can be animated to good effect. It works most effectively when automatically animated through the use of the Write On/Write Off modes of the Stroke animation menu.

Make Editable

This button only appears for Vector strokes. Clicking on 'Make Editable' turns the current stroke into a polyline spline so that the shape can be adjusted or animated.

Natural Cubic Spline

The Natural Cubic Spline is one of the animation modifiers in Fusion and normally is applied to numerical values rather than point values. It can be applied by right-clicking on a numerical control and selecting Modify with > Natural Cubic Spline.

Note: Unlike other spline types, Cubic splines have no control handles and attempt to automatically provide a smooth curve through the keypoints.

Usage

Being an animation spline, this modifier has no actual Controls tab, however, its effect can be seen and influenced in the Spline Editor.
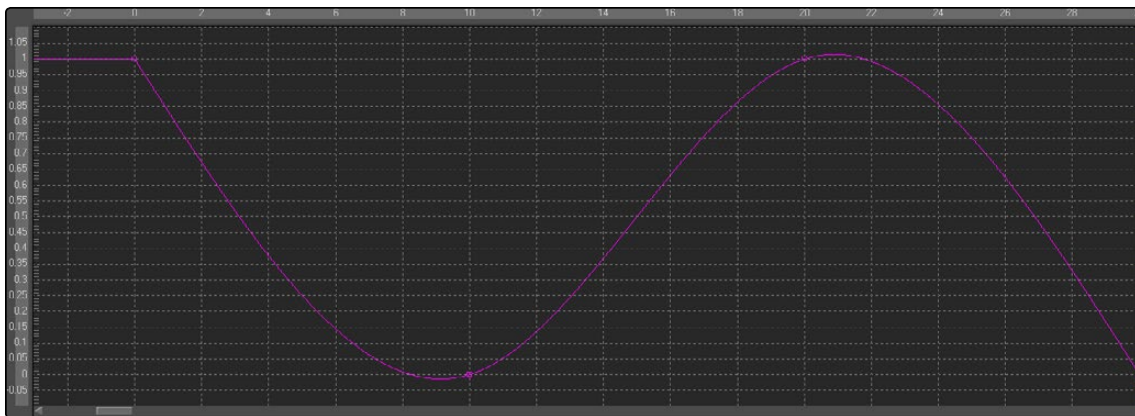
Offset

Offsets are useful for creating constant or animated variances between values, relating to various controls, paths and points. There are three types of offsets available in Fusion:

→ Offset Distance

→ Offset Angle

→ Offset Position

Offset Angle

The Offset Angle Modifier outputs a value between 0 and 360 that is based on the angle between two positional controls. The Position and Offset parameters may be static, connected to other positional parameters or connected to paths of their own. All of the offsets use the same set of controls, which behave differently depending on the offset type used. These controls are described below.

Offset Distance

The Offset Distance modifier outputs a value that is based on the distance between two positional controls. This modifier is the first one discussed that is capable of outputting a value based on a mathematical expression applied to a position.

Offset Position

The Offset Position modifier outputs a position (X and Y coordinate) that is based on the relationship between positional controls. This modifier is the equivalent of a calculation control except that it outputs X and Y coordinates instead of a value.

It can be applied by right-clicking on a control and selecting Modify with > Offset.

Offset Tab
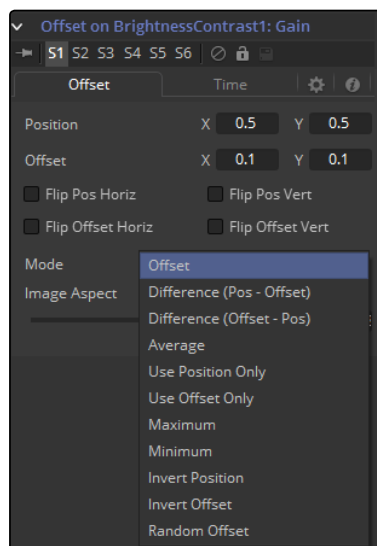
Position X and Y

The first position value is used by the Position to generate the calculation.

Offset X and Y

The first position value is used by the Offset to generate the calculation.

Flip Position Horizontal and Vertical

When these controls are selected, the Position will be mirrored along the vertical or horizontal axis of the image.

Flip Offset Horizontal and Vertical

When these controls are selected, the Offset position will be mirrored along the vertical or horizontal axis of the image.

Mode

Select an option from the Mode menu to choose the mathematical operation performed by the offset control.

Available options are:

- → Offset
- → Difference (Position - Offset)
- → Difference (Offset - Position)
- → Average
- → Use Position Only
- → Use Offset Only
- → Maximum
- → Minimum
- → Invert Position
- → Invert Offset
- → Invert Sugar
- → Random Offset

Image Aspect

Adjust the modifier's output to compensate for the Image Aspect (not pixel aspect) of the project. A square image of 500 x 500 would use an Image Aspect value of 1 and a rectangular image of 500 x 1000 would use an Aspect value of 2. The default value is always based on the current frame format selected in the preferences. To calculate Image Aspect, divide the width by the height. This control can also be used to create the illusion of aspect.

Time Tab
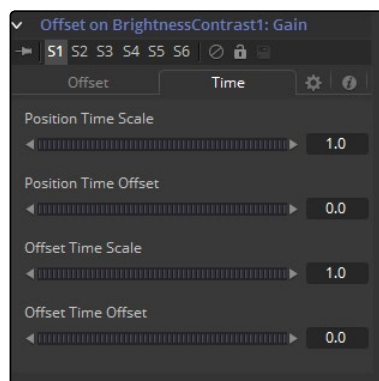
Position Time Scale

This returns the value of the Position at the Time Scale specified (for example, 0.5 is the value at half the current frame time).

Position Time Offset

This returns the value of Position at the Time Offset specified (for example, 10 is 10 frames back).

Offset Time Scale

This returns the value of the Offset at the Time Scale specified.

Offset Time Offset

This returns the value of Offset at the Time Offset specified.

Example

→ Let's continue the Text banking example at the beginning of this chapter to illustrate one potential use of offsets.

→ Select and view the Merge tool in this flow. Right-click on the Merge Size control and select Modify With > Offset Distance from the contextual menu. This will add two new crosshairs and Offset controls in the Modifier tab.

→ The size of the text will now be determined by the distance or offset between the two new cross hairs. These points are animatable and can be connected to other controls.

→ Connect the position value of the offset to the existing path by right-clicking on the Position control and selecting Connect To > Path on Merge 1 Center Value. Manually place the Offset crosshair at the bottom of the screen between the two path points.

→ Now, the text should shrink near the ends of the path (when the distance between the offset and the path is at its minimum) and grow at its ends (where the distance between the offset and the path is at its maximum).

Paint Group

The Paint Group only works on Paint strokes and objects. It groups all currently selected paint strokes together, making it easier to handle them all together.

Multistroke modifiers can be grouped as well, which includes all the multistrokes contained within that modifier. By animating the Paint Group, it is thus possible to move, track and rotate a collection of multistrokes.

It can be applied by clicking on the Paint Group button in the Paint tool's Stroke menu.
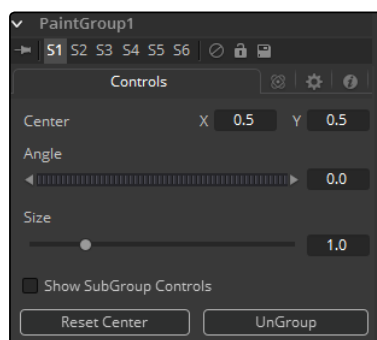
Controls

Center X Y

The Center of the Group. Modify this control to move the group around.

Angle

The entire group can be rotated using this control.

Size

Scales the entire group.

Show Subgroup Controls

Displays the controls of the individual strokes in the group and allows the user to modify them.

Reset Center

Puts the Center back to the position where it was when the group was created.

Ungroup

Disassembles the group back into individual strokes and deletes the Group modifier. For temporary opening of the group, use the Show Subgroup controls switch instead.

Path

The Path uses two splines to control the animation of Points. An onscreen motion path (spacial) and a Time spline visible in the Spline Editor (temporal). To animate a Coordinate control using a Path, right-click on the control and select Path from the contextual menu.

Controls Tab

For an in-depth explanation, see the chapter Working with Motion Paths in this documentation.
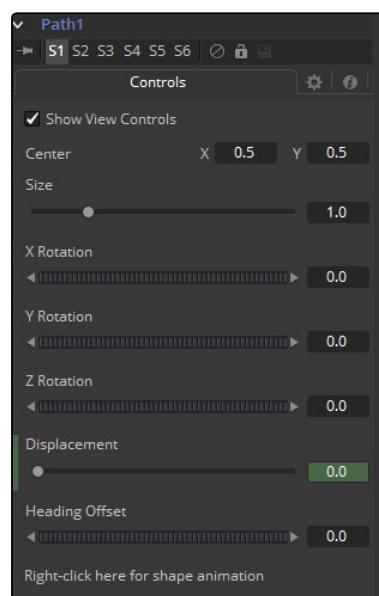
Center

The actual Center of the path. This can be modified and animated as well to move the entire path around.

Size

The Size of the path. Again this allows for later modification of the animation.

X Y Z Rotation

The Path can be rotated in all three dimensions to allow for sophisticated controls.

Displacement

Every motion path has an associated Displacement spline in the Spline Editor. The Displacement spline represents the position of the animated control along its path, represented as a value between 0.0 and 1.0. Displacement splines are used to control the speed of a control's movement along its path.

To slow down, speed up, stop or even reverse the motion of the control along the path, adjust the values of the points for the path's displacement in the Spline Editor.

> → A Displacement value of 0.0 in the Spline Editor indicates that the control is at the very beginning of a path.

> → A value of 1.0 indicates that the control is positioned at the end of the path.

> → Each locked point on the motion path will have an associated point on the Displacement spline.

> → Unlocked points will not have a corresponding point on the Displacement spline.

For an in-depth explanation, see the chapter Working with Motion Paths in this documentation.

Heading Offset

If another control, for example a mask's Angle, is connected to the path's heading, this control allows for adding or subtracting from the calculated angle.

Right Click Here for Shape Animation

It is possible to animate the shape of the path as well, or to connect it to other path controls like Polyline Masks or Paint Strokes.

Switching Default Paths

Change the Default Path type used when animating a Coordinate control to Path (if this is the preferred type of animation). Open the Global preferences and look under the Default tab for the drop-down list in the default animate section labeled Point With. Change this from the current value to Path. The next time Animate is selected from a Coordinate control's contextual menu, a Path will be used.
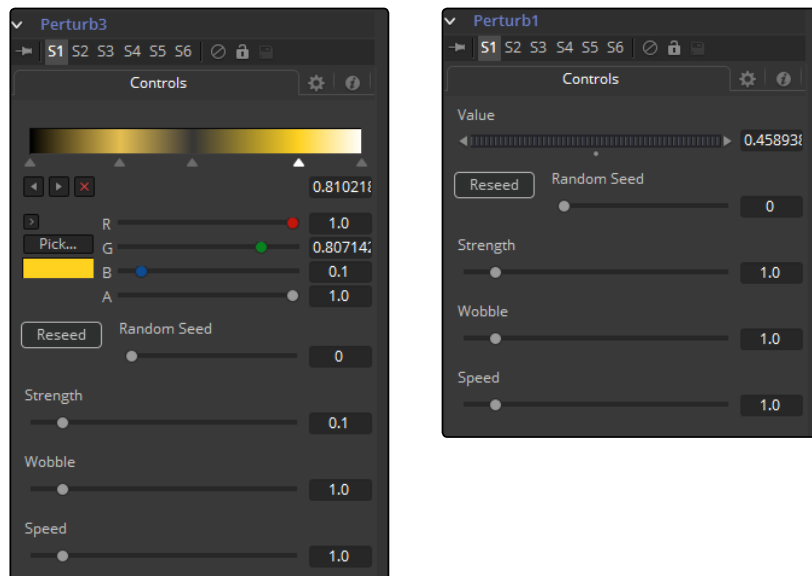
Perturb

The Perturb modifier generates smoothly varying random values for several input types, based on Perlin noise. It can be used to add jitter, shake or wobble to any animatable control, even if the control is already animated. Its results are similar to those of the Shake modifier, though it uses a different set of controls that may be more suitable to your needs. Unlike other random modifiers, the Perturb modifier can also be applied to polylines, shapes, grid meshes and even color gradients.

For example, to add camera shake to an existing path, right-click on the crosshair and choose Insert > Perturb, then adjust the Strength down to suit. Alternatively, right-click on the path's Shape Animation control, and apply the wobble to the path's polyline itself (this works best if the polyline has many points, for example, if it has been tracked, or hand-drawn with the Draw Append pencil tool). A third option is to insert the modifier onto the Displacement control, which will cause the motion along the path to jitter back and forth without actually leaving the line of the path.

Note: Perturb can only add jitter it cannot smooth out existing animation curves.

Controls Tab

Value

The actual contents of this control will depend on what type of control the modifier was applied to. If the Perturb modifier was added to a basic Slider control, the Value will be a slider. If it was added to a Gradient control, then a Gradient control will be displayed here. Use the control to set the default, or center value, for the Perturb modifier to work on.

Jaggedness

(Polylines, Meshes only) This allows you to increase the amount of variation along the length of the polyline or mesh, rather than over time. Increasing this will give a squigglier polyline or more tangled mesh, independent of its movement.

Phase

(Polylines, Meshes only) Animating this can be used to move the ripple of a polyline or mesh along itself, from end to end. The effect can be most clearly seen when Speed is set to 0.0.

Random Seed Randomize

The Random Seed is used to 'seed' the amount of jitter applied by the modifier. Two Perturb modifiers with identical settings, but different random seeds, will produce two completely different results. Click on the Randomize button to assign a random seed value.

Strength

Use this control to adjust the Strength of the Perturb modifier's output, or its maximum variation from the primary value specified above.

Wobble

Use the Wobble control to determine how smooth the resulting values are. Less wobble implies a smoother transition between values, while more wobble produces less predictable results.

Speed

Increasing the Speed slider value will speed up the rate at which the value changes. This can increase the apparent wobbliness in a more predictable fashion than the Wobble control and make the jitter more frantic or languorous in nature.

Polyline Stroke

Fusion offers a Polyline Stroke mode. This provides the ability to create and manipulate a stroke in the same way that a path or mask might be created. To add a polyline stroke to the flow, select the Polyline button from the Paint tool's Stroke toolbar and click in the view to add the first point. Continue clicking to add additional points to the polyline.

Notice that the usual Polyline toolbar buttons will appear in the Viewer toolbar. Polyline strokes are created in Click Append mode by default, but they can also be created in Draw Append mode.

Controls Tab

Not all of the controls described here appear in all modes. Certain controls are only useful in a specific paint mode and are hidden when they are not applicable. Additionally, several of the controls are considered to be self-explanatory; the purpose of a center control, angle or size control should be relatively straightforward to determine.

To reduce complexity, these controls are not all described. For further details on the functionality of the Controls Tab, see the Working With Paint Strokes - Animating Strokes section in this chapter.

Brush Controls

Brush Shape

→ Soft Brush: The Soft Brush type is a circular brush with soft edges. Modify the size of the brush in the Viewer by holding Command or Ctrl down while dragging the mouse.

→ Circular Brush: A Circular Brush is a brush shape with hard edges. Resize this brush interactively.

→ Image Brush: The Image Brush allows images from any tool in the flow, or from a file system, to be used as a brush. See Creating Custom Brushes later in this chapter.

→ Single Pixel Brush: The Single Pixel Brush is perfect for fine detail work, creating a brush exactly one pixel in size. No anti-aliasing is applied to the single pixel brush.

→ Square Brush: A Square Brush is a brush shape with hard edges.

Vary Size
→ **Constant:** The brush will be a constant size over the stroke.

→ **With Pressure:** The stroke size will vary with the actual applied pressure.

→ **With Velocity:** The stroke size will vary with the speed of painting. The faster the stroke, the thinner it is.

Vary Opacity
→ **Constant:** The Constant brush will be a constant transparency over the entire stroke.

→ **With Pressure:** The stroke transparency will vary with the applied Pressure.

→ **With Velocity:** The stroke transparency will vary with the speed of painting. The faster the stroke, the more transparent it is.

Softness
Use this control to increase or decrease the Softness of a soft brush.

Image Source
When using the Image Source brush type, select between three possible sources brush images.

→ **Tool:** The image source is derived from the output of a tool on the flow. Drag the tool into the Source Tool input to set the source.

→ **Clip:** The image source is derived from an image or sequence on disk. Any file supported by Fusion's Loader can be used. Locate the file using the filename Clip browser that appears to set the clip used as a source.

→ **Brush:** Images stored in the Fusion > Brushes directory are used as a brush for the paint tool. Select the brush from a the menu that appears.

Apply Controls

Apply Mode
→ **Color:** The Color apply mode paints simple colored strokes on the screen. When used in conjunction with an image brush, it can also be used to tint the brush.

→ **Clone:** The Clone apply mode copies portions of one image into another image, or to clones from the same image using adjustable positions and time offsets. Any image from the flow can be used as the source image.

→ **Emboss:** The Emboss apply mode embosses the portions of the image covered by the brush stroke.

→ **Erase:** Erase reveals the underlying image through all other strokes, effectively erasing portions of the strokes beneath it with out actually destroying the strokes.

→ **Merge:** This apply mode effectively Merges the brush onto the image. This mode behaves in much the same way as the color apply mode but has no color controls. It is best suited for use with the image brush type.

→ **Smear:** Smear the image using the direction and strength of the brush stroke as a guide.

→ **Stamp:** Stamp the brush onto the image, completely ignoring any alpha channel or transparency information. This mode is best suited for applying decals to the target image.

→ **Wire:** This Wire Removal mode is used to remove wires, rigging and other small elements in the frame by sampling adjacent pixels and drawing them in toward the stroke.

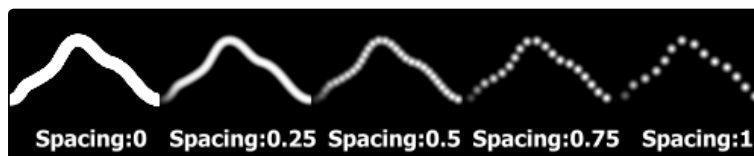→ **Source Tool:** Shows which tool's image output is used to clone from.

Stroke Controls

Size

This control adjusts the Size of the brush when the brush type is set to either soft brush or circle. The diameter of the brush is drawn in the Viewer as a small circle surrounding the mouse pointer. The size can also be adjusted interactively in the Viewer by holding the Command or Ctrl key while click-dragging the mouse pointer.

Spacing

The Spacing slider determines the distance between dabs (samples used to draw a straight line along the underlying vector shape that composes a stroke or polyline stroke). Increasing the value of this slider increases the density of the stroke, whereas decreasing the value is likely to cause the stroke to assume the appearance of a dotted line.

Stroke Animation

The Stroke Animation menu control provides several pre-built animation effects that can be applied to a paint stroke. This menu only appears for Vector strokes.

→ **All Frames:** This default displays the stroke for All Frames of the project where a valid target image is available to the Paint tool.

→ **Limited Duration:** This exists on the number of frames specified by the Duration slider.

→ **Write On:** When Write On is selected, an Animation spline will be added to the paint stroke that precisely duplicates the timing of the paint stroke's creation. The stroke will be written on the image exactly as it was drawn. To adjust the timing of the Write On effect, switch to the Spline Editor and use the Time Stretcher mode to adjust the overall length of the Animation spline. To smooth or manually adjust the motion, try reducing the points in the Animation spline.

→ **Write Off:** Write Off will perform the reverse of Write On, drawing the stroke starting from the end and working backward to the start of the stroke.

→ **Write On Then Off:** This mode will apply a Write On and then a Write Off animation mode to the stroke.

→ **Trail:** Selecting the Trail mode will cause both the start and end points of the stroke to be animated simultaneously, offset from each other by the amount specified in the duration control. This has the effect of creating a segment of the stroke that follows the stroke as if it were a path. As with the Write On and Off effects, this will start at the frame that is current when the Animation mode is selected. The timing of the animation can be adjusted manually using the Spline or Timeline Editors.

Duration

Duration sets the duration of each stroke in frames. This control is only present for Multistrokes or when the stroke animation mode is set to Limited Duration. It is most commonly employed for frame-by-frame rotoscoping through a scene.

Note: Each Vector stroke applied to a scene will have a duration in the Timeline that can be trimmed independently from one stroke to the next. The duration can be set to 0.5, which will allow each stroke to last for a single field only when the flow is processing in Fields mode.

Write On and Write Off

This range slider appears when the Stroke Animation is set to one of the Write On and Write Off methods. The range represents the beginning and end points of the stroke. Drag the low value upward to give the impression that the stroke is being erased, or drag the high value from 0.0 to 1.0 to give the impression that the stroke is being drawn on the screen. This control can be animated to good effect. It works most effectively when automatically animated through the use of the Write On/Write Off modes of the stroke animation menu.

Right Click Here for Shape Animation

To animate the Polyline shape like Polyline Masks, right click on this control and choose animate.

Probe

The Probe Modifier is one of the most versatile modifiers in Fusion. It allows you to control any numeric parameter by the pixel color or luminosity at a certain position or rectangular region of an image. Think of driving values by the presence or absence of an image or by color values of an image, using colors to create X Y positions on other controls, or measuring graded LUTs to compare values.

It can be applied by right-clicking on a control and selecting Modify with > Probe.

Probe Tab
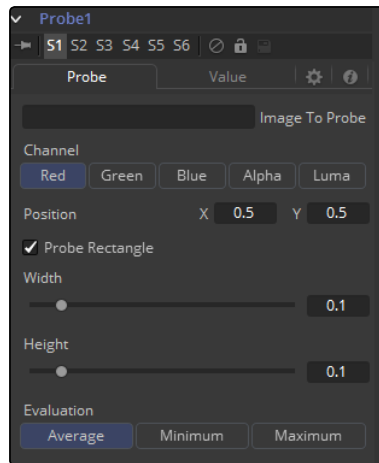
Image to Probe
Drop the tool of the image you want to probe into this field.

Channel
Select the Channel you want to probe. The usual options are:

- → Red
- → Green
- → Blue
- → Alpha
- → Luma

Once a Probe modifier is present somewhere in your comp you can connect other tool's values to its outputs as well. The Probe allows to connect to its values individually:

- → Result
- → Red
- → Green
- → Blue
- → Alpha

Position X Y
The position in the image from where the probe samples the values.

Probe Rectangle
By default the Probe only samples the value of a single pixel at its position. By using the Probe Rectangle mode you can sample from a larger area of pixels based on the Evaluation method.

Width Height Controls

These determine the size of the area to be probed.

Evaluation

Sets how the pixels inside the rectangle are computed to generate the output value.

Options are:

→ Average (all pixel values inside the rectangle are averaged).

→ Minimum (The smallest value of all pixels inside the rectangle is used).

→ Maximum (The highest value of all pixels inside the rectangle is used).

Value Tab
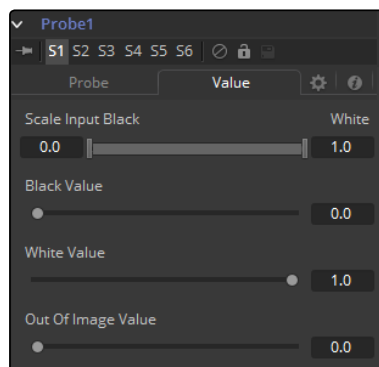
Scale Input Black White

By default, the Probe generates the Black Value when the probed area results in a value of 0 (i.e., Black) and it generates its White Value when the probed area results in a value of 1 (i.e., White). By using this range control you can modify the sensitivity of the Probe.

Black Value

The value that is generated by the Probe if the probed area delivers the result set in Scale Input Black.

White Value

The value that is generated by the Probe if the probed area delivers the result set in Scale Input White.

Out of Image Value

The value that is generated by the Probe if the probed area is outside the frame boundaries of the probed image. If probing a rectangle, this value will not be generated before the entire rectangle is outside the frame boundaries of the image to be probed.

Publish

Only controls that are animated can be available from the Connect To menu option. A non-animated control (static) must be published before it can be connected. Animated controls are automatically published, whereas static controls have to be manually published.

To publish a control, right-click on the control and select Publish from the contextual menu.
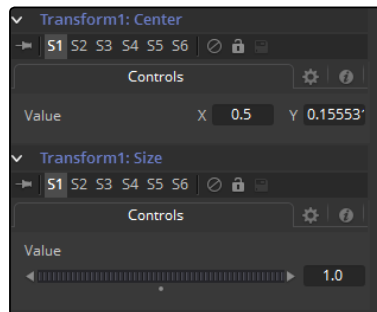
Publish

Published Value
This is obviously dependent on which value is published from which tool.

Shake

The Shake modifier is used to randomize a position or value control to create semi-random numeric inputs. The resulting shake can be entirely random. The motion can also be smoothed for a more gentle, organic feel.

To add the Shake modifier to a control, select Modify With > Shake from the Control's contextual menu. The Shake modifier uses the following controls to achieve its effect. It can be applied by right-clicking on a control and selecting Modify with > Shake.

Shake Tab
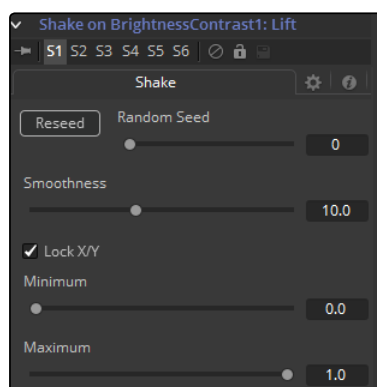
Random Seed

The Random Seed control contains the value used to seed the random number generator. Given the same seed, a random number generator will always produce the same results. Change the seed if the results from the randomizer are not satisfying.

Smoothness

This control is used to smooth the overall randomness of the shake. The higher the value is set, the smoother the motion will appear. A value of zero will generate completely random results, with no smoothing applied.

Lock X and Y

This checkbox is used to Unlock the X- and Y-axis, revealing independent slider controls for each axis.

Min and Max

This control is used to determine the overall strength of the shake. The low values represent the lowest value that can be generated by the randomizer and the high values represent the highest values. To create a shake that moves a center crosshair anywhere within the image, set the low to 0.0 and the high to 1.0. To restrict the motion to a smaller shake in the bottom right corner of the image, set the Min to 0.70 and the Max to 0.90.

Example

→ Create a new comp and add a Text tool.

→ Type something in the Text tool and view it in the large display.

→ Add a shake modifier by selecting Modify With > Shake Position from the contextual menu for the Text Center control.

→ Switch to the Modifier tab and set the smoothing to 5.0.

→ Set the Low to 0.1 and the High to 0.9.

→ Go to frame 0 and add a Bezier spline to both the Low and the High controls.

→ Advance to frame 90 and set the Low to 0.45 and the High to 0.55.

→ Render out a preview and view the results.

→ The text should start out by flying all over the screen and then tighten in toward the center of the screen.

Stroke

When the Paint tool is first added to the flow, the brush type is set to a medium sized soft, circular brush with a white Color apply mode.
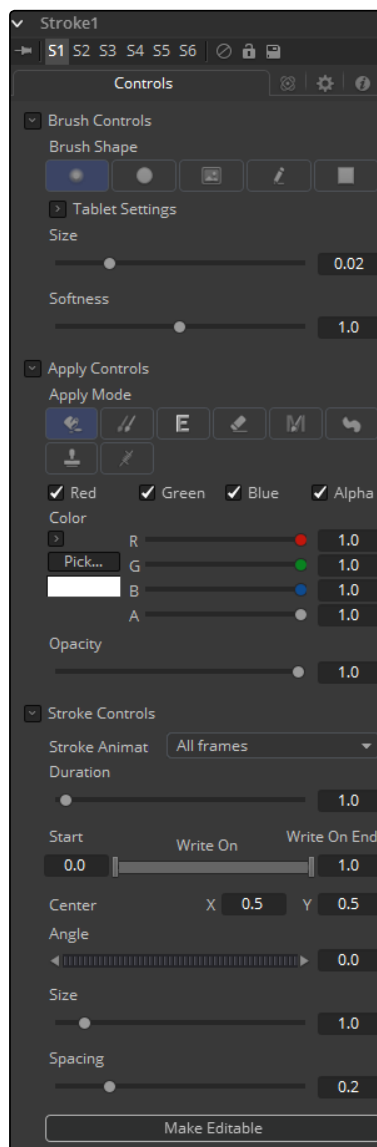
Release the mouse button to end the creation of the stroke. To draw another stroke, simply click again and continue. A new stroke will be added to the image with the same settings as the last applied stroke. When the painting is complete, choose the Select button in the Paint toolbar to avoid accidentally adding new strokes.

While in Brush or Polyline modes, the controls displayed in the Tool tab affect the next stroke created, not the strokes that are already created. To adjust the settings of an existing stroke, switch to Select mode using the Paint toolbar and select the stroke.

To add a stroke to the flow, select the Polyline Button from the Paint tool's Stroke toolbar, place the mouse or pen over the image, click-hold the left mouse button and start drawing.

Controls Tab

Not all of the controls described here appear in all modes. Certain controls are only useful in a specific paint mode and are hidden when they are not applicable. Additionally, several of the controls are considered to be self-explanatory; the purpose of a center control, angle or size control should be relatively straightforward to determine. To reduce complexity, these controls are not all described. For further details on the functionality of the Controls Tab, see the Working With Paint Strokes - Animating Strokes section in this chapter.

Brush Controls

Brush Shape

→ Soft Brush: The Soft Brush type is a circular brush with soft edges. Modify the size of the brush in the Viewer by holding Command or Ctrl down while dragging the mouse.

→ Circular Brush: A Circular Brush is a brush shape with hard edges. Resize this brush interactively.

→ Image Brush: The Image Brush allows images from any tool in the flow, or from a file system, to be used as a brush. See Creating Custom Brushes later in this chapter.

→ Single Pixel Brush: The Single Pixel Brush is perfect for fine detail work, creating a brush exactly one pixel in size. No anti-aliasing is applied to the single pixel brush.

→ Square Brush: A Square Brush is a brush shape with hard edges.

Vary Size

→ Constant: The brush will be a constant size over the stroke.

→ With Pressure: The stroke size will vary with the actual applied pressure.

→ With Velocity: The stroke size will vary with the speed of painting. The faster the stroke, the thinner it is.

Vary Opacity

→ Constant: The Constant brush will be a constant transparency over the entire stroke.

→ With Pressure: The stroke transparency will vary with the applied Pressure.

→ With Velocity: The stroke transparency will vary with the speed of painting. The faster the stroke, the more transparent it is.

Softness

Use this control to increase or decrease the Softness of a soft brush.

Image Source

When using the Image Source brush type, select between three possible sources brush images.

→ Tool: The image source is derived from the output of a tool on the flow. Drag the tool into the source Tool input to set the source.

→ Clip: The image source is derived from an image or sequence on disk. Any file supported by Fusion's Loader can be used. Locate the file using the filename Clip browser that appears to set the clip used as a source.

→ Brush: Images stored in the Fusion > Brushes directory are used as a brush for the Paint tool. Select the brush from the menu that appears.

Apply Controls

Apply Mode

→ Color: The Color apply mode paints simple colored strokes on the screen. When used in conjunction with an image brush, it can also be used to tint the brush.

→ Clone: The Clone apply mode copies portions of one image into another image, or to clones from the same image using adjustable positions and time offsets. Any image from the flow can be used as the source image.

→ Emboss: The Emboss apply mode embosses the portions of the image covered by the brush stroke.

→ Erase: Erase reveals the underlying image through all other strokes, effectively erasing portions of the strokes beneath it with out actually destroying the strokes.

→ Merge: This apply mode effectively Merges the brush onto the image. This mode behaves in much the same way as the color apply mode but has no color controls. It is best suited for use with the image brush type.

→ Smear: Smear the image using the direction and strength of the brush stroke as a guide.

→ Stamp: Stamp the brush onto the image, completely ignoring any alpha channel or transparency information. This mode is best suited for applying decals to the target image.

→ Wire: This Wire removal mode is used to remove wires, rigging and other small elements in the frame by sampling adjacent pixels and drawing them in toward the stroke.

→ Source Tool: Shows which tool's image output is used to clone from.
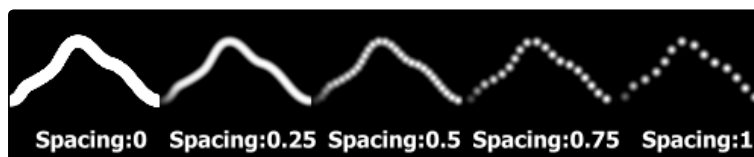
Stroke Controls

Size

This control adjusts the Size of the brush when the brush type is set to either soft brush or circle. The diameter of the brush is drawn in the Viewer as a small circle surrounding the mouse pointer. The size can also be adjusted interactively in the Viewer by holding the Command or Ctrl key while click-dragging the mouse pointer.

Spacing

The Spacing slider determines the distance between dabs (samples used to draw a straight line along the underlying vector shape that composes a stroke or polyline stroke). Increasing the value of this slider increases the density of the stroke, whereas decreasing the value is likely to cause the stroke to assume the appearance of a dotted line.

Spacing:0   Spacing:0.25   Spacing:0.5   Spacing:0.75   Spacing:1

Stroke Animation

The Stroke Animation menu control provides several pre-built animation effects that can be applied to a paint stroke. This menu only appears for Vector strokes.

→ **All Frames:** This default displays the stroke for All Frames of the project where a valid target image is available to the paint tool.

→ **Limited Duration:** This exists on the number of frames specified by the Duration slider.

→ **Write On:** When Write On is selected, an Animation spline will be added to the paint stroke that precisely duplicates the timing of the paint stroke's creation. The stroke will be written on the image exactly as it was drawn. To adjust the timing of the Write On effect, switch to the Spline Editor and use the Time Stretcher mode to adjust the overall length of the Animation spline. To smooth or manually adjust the motion, try reducing the points in the Animation spline.

→ **Write Off:** Write Off will perform the reverse of Write On, drawing the stroke starting from the end and working backward to the start of the stroke.

→ **Write On Then Off:** This mode will apply a Write On and then a Write Off animation mode to the stroke.

→ **Trail:** Selecting the Trail mode will cause both the start and end points of the stroke to be animated simultaneously, offset from each other by the amount specified in the duration control. This has the effect of creating a segment of the stroke that follows the stroke as if it were a path. As with the Write On and Off effects, this will start at the frame that is current when the Animation mode is selected. The timing of the animation can be adjusted manually using the Spline or Timeline Editors.

Duration

Duration sets the duration of each stroke in frames. This control is only present for Multistrokes or when the stroke Animation mode is set to Limited Duration. It is most commonly employed for frame-by-frame rotoscoping through a scene.

Note: Each Vector stroke applied to a scene will have a duration in the Timeline that can be trimmed independently from one stroke to the next. The duration can be set to 0.5, which will allow each stroke to last for a single field only when the flow is processing in Fields mode.

Write On and Write Off

This range slider appears when the Stroke Animation is set to one of the Write On and Write Off methods. The range represents the beginning and end points of the stroke. Drag the low value upward to give the impression that the stroke is being erased, or drag the high value from 0.0 to 1.0 to give the impression that the stroke is being drawn on the screen. This control can be animated to good effect. It works most effectively when automatically animated through the use of the Write On, Write Off modes of the stroke animation menu.

Right Click Here for Shape Animation

To animate the shape, like Polyline Masks, right-click on this control and choose animate.

Text Scramble

The Text Scramble only works on Text+ tools. It scrambles the Text around, randomly replacing the characters with others from a user definable set. It can be applied by right-clicking into the Styled text field of a Text+ tool and selecting TextScramble.

Controls
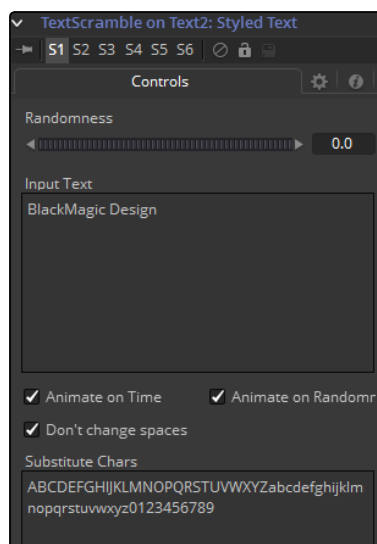
Randomness

Defines how many characters are exchanged randomly. A value of 0 will change no characters at all. A value of 1 will change all characters in the text. Animating this thumbwheel to go from 0 to 1 will gradually exchange all characters.

Input Text

This reflects the original Text in the Text+ Styled Text. Text can be entered either here on in the Text+.

Animate On Time

When set, the characters will get scrambled randomly on every new frame. This switch has no effect when Randomness is set to 0.

Animate On Randomness

When set, the characters will get scrambled randomly on every new frame, when the Randomness thumbwheel is animated.

This switch has no effect when Randomness is set to 0.

Don't Change Spaces

When set, the length of the single words will stay the same, though their characters get scrambled around.

Substitute Chars

Defines which characters are used to scramble the text.

Text Timer

The Text Timer only works on Text+ tools. It makes the Text+ tool either a Countdown, a Timer or a Clock. This is quite useful for on screen real-time displays or to burn in the creation time of a frame into the picture.

It can be applied by right-clicking into the Styled text field of a Text+ tool and selecting TextScramble.

Controls
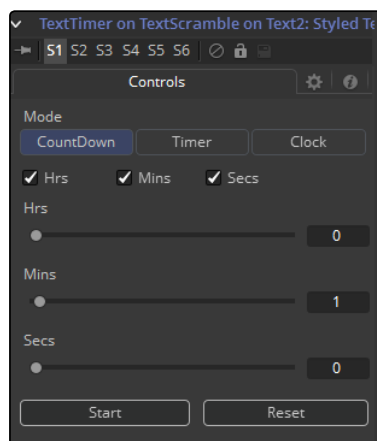
Mode

Sets the mode the timer is working in. In Clock mode the current system time will be displayed.

Hrs, Mins, Secs (Switches)

Defines which parts of the clock should be shown on screen.

Hrs, Mins, Secs (Sliders)

Set the start time for the Countdown and Timer mode.

Start

Starts the Counter or Timer. Toggles to Stop once the timer is running.
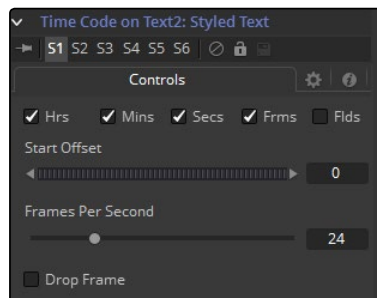
Reset

Resets the Counter and Timer to the values set by the sliders.

Time Code

The Time Code only works on Text+ tools. It sets the Styled text to become a counter based on the current frame. This is quite useful to automate burn-ins for daily renderings.

It can be applied by right-clicking into the Styled text field of a Text+ tool and selecting Time Code.

Controls

Hrs, Mins, Secs, Frms, Flds

Activate or de-activate these options to customize the time code display to show hours, minutes, seconds, frames and fields respectively. Activating Frames only will give you a plain frame counter

Start Offset

Introduce a positive or negative offset to Fusion's current time to match up with existing time codes.

Frames per Second

This should match with your Composition's FPS setting to provide accurate time measurement.

Drop Frame

Activate this checkbox to match the time code with footage that has drop frames, for example, certain NTSC formats.

Track

Another technique for adding a tracker directly to a control is to apply the Tracker as a modifier. Right-click on the center of the mask and select Ellipse x Center > Modify With > Tracker Position > Steady Position or Unsteady Position. This would add a modifier with a set of controls almost identical to those found in the Tracker tool itself.

Tracker Tab
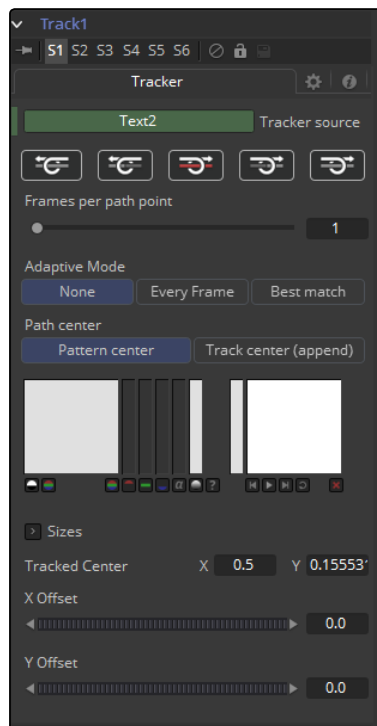
For an in-depth explanation of this tool, refer to the Tracker documentation in this manual.

The differences between a Tracker Modifier and a Tracker Tool are as follows:

→ The Tracker modifier can only track a single pattern.

→ A source image must be set for the Tracker modifier.

→ The Tracker modifier can only output a single value and cannot be used for complex stabilization procedures.

→ The default source image for the modifier is the tool immediately upstream of the tool that contains the modifier (i.e., when adding a Tracker modifier to a Glow tool with a Loader as its input, the Tracker Source input will default to the output of the Loader). Set a different source image for the Tracker modifier by typing in the name of the tool. Alternately, drag and drop the Source tool from the flow into the Text Box control.

Example

Imagine that you needed to track an actor's eyes so that an unearthly, alien glow could be applied to the eyes. Add a Glow tool and then create an Ellipse mask in the shape of the eye. Right-click on the center of that mask and select modify with > Track. Track the actor's eye.

Vector

The Vector Modifier is used to offset positional controls, such as crosshairs, by distance and angle. These can be static or animated values.

It can be applied by right-clicking on a control and selecting Modify with > Vector.

Controls Tab
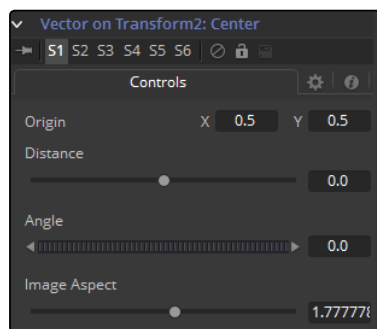
Origin

This control is used to represent the position from which the vector's distance and angle values originate.

Distance Slider Control

This control is used to determine the Distance of the vector from the origin.

Angle Thumbwheel Control

This control is used to determine the Angle of the vector relative to the origin.

Image Aspect Slider Control

This control is used primarily to compensate for image aspect differences. A square image of 500 x 500 would use an Image Aspect value of 1, while a rectangular image of 500 x 1000 would use an Aspect value of 2. The default for this value is taken from the current Frame Format preferences using width/height. It may be required to modify this control to match the current image.

Example

→ To illustrate, create a simple flow consisting of a black background, a Text tool and a Merge.

→ Right-click on the center of the merge and select Modify With > Vector. This will add a Vector Control header under the small view. Expand it by clicking on the gold triangle. Drag the Distance control to distance the text from the vector origin.

→ Drag the Angle thumbwheel to rotate the text around the vector origin.

→ Add a path to the vector origin by right-clicking on the Origin control and selecting the Path option from the contextual menu. Verify that the current frame is set to frame 0 (zero) and drag the Vector Origin crosshair to the bottom left corner of the screen.

→ Right-click on the Vector Angle thumbwheel and select Bezier Spline to animate this control.

→ Set the Angle thumbwheel to a value of 10.

→ Advance to frame 100 and click at the top left corner of the screen to move the vector origin crosshair.

→ Set the Vector Angle thumbwheel to a value of 1000. This will cause the text to orbit around the path just created.

XY Path

The XY Path type uses a separate spline for the position along the X-axis, as it does for the position along the Y-axis.

To animate a coordinate control using an XY path, right-click on the control and select Modify With > XY Path from the contextual menu.

At first glance, XY paths work like Displacement paths. To describe the path, change frames and position the control where it should be on that frame, then change frames again and move the control to its new position. Fusion automatically interpolates between the points. The difference is that no keyframes are created on the onscreen path.

Look in the Spline Editor to find the X and Y channel splines. Changes to the controls position will be keyframed on these splines. The advantage to the XY path is that it becomes very easy to work with motion along an individual axis.

Controls Tab
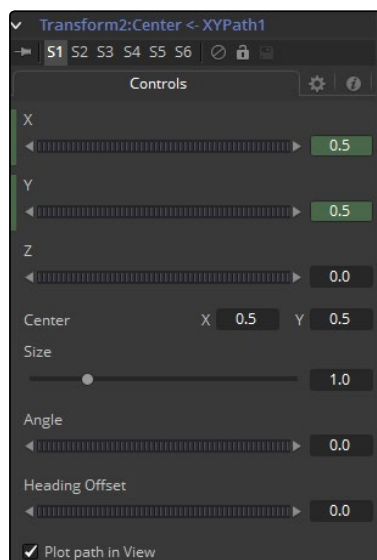
X Y Z Values

These reflect the position of the animated control.

Center

The actual Center of the path. This can be modified and animated as well to move the entire path around.

Size

The Size of the path. Again this allows for later modification of the animation.

Angle

The Angle of the path. Again this allows for later modification of the animation.

Heading Offset

If another control, for example a mask's Angle, is connected to the path's heading, this control allows for adding or subtracting from the calculated angle.

Plot Path In View

Toggles if or if not the actual path is displayed in the views.

Switching Default Paths

Change the Default Path type used when animating a coordinate control to XY path (if this is the preferred type of animation). Open the Global preferences and look under the default's tab for the drop-down list in the default animate section labeled Point With. Change this from the current value to XY Path. The next time Animate is selected from a Coordinate Control's contextual menu, an XY path will be used instead of a Displacement path.