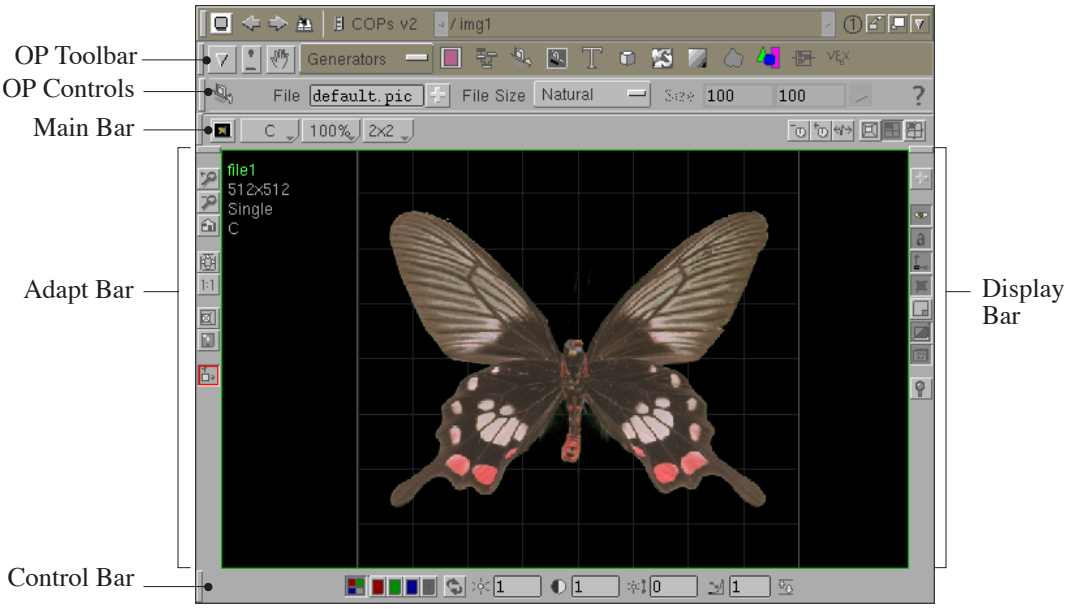
1 2D Viewport

The Image Viewer not only displays images, but also allows for two other modes for viewing sequences of images – the Timeline View p. 490 which shows the sequences in a time graph for timing analysis; and the Graph View p. 492 which displays a variety of different graph and histograms for data analysis of images (examination of quantization, dynamic range, errors, etc).

1 IMAGE VIEW



1.1 MANIPULATING THE VIEWPORTS

drag	Pan.
	Zoom
Shift drag	Select a region (Shift outside image to deselect)
Shift	Select a tile.
X	Make the Viewport current (in mPlay).
T	Toggle to occupy all Viewing Area.
Main Bar > Mode Select	Toggles between: *Image*, *TimeLine* or *Graph*.

1.2 DESCRIPTION

The Image viewer is capable of displaying a wide variety of images, including 8, 16 and 32 bit integer images, floating point images, and deep rasters. In addition, multiple sequences can be viewed simultaneously and compared.

The Image Viewer and the standalone *mPlay*, are very similar. Most of the functions are identical – differences are noted. Panning and zooming is consistant with Houdini's 3D viewport.

The Image View is the most common viewing mode, and it displays the image as a picture.

The top two bars are only seen in Houdini – the top bar is the State Controller, and the bar directly underneath it is the Toolbox (currently showing the File COP toolbox). The next bar underneath the toolbox is the main image control bar, which contains most of the global functions to all image modes. The bar underneath that is the Diff bar, used when comparing two images together.

Along the left side are the View Controls, which contains the size adapt, zoom, home and PI buttons. Along the right side is the Display Options, which contains the display item toggle buttons (guides, transparency, background image, etc.).

Along the bottom is the Image Controls, which contains the Component and Color correction controls. Above it is the Inspection bar, which shows information on the pixel under the mouse cursor.

Each of these bars can be stowed by clicking on the thin grey strip along the top (for vertical bars) or the left side (for horizontal bars).

1.3 CONTEXTUAL MENU (Ctrl)

mPlay Only – The viewport context menu can be popped up by using Ctrl . The functions of this menu are:

SAVE FRAME

Saves the current image.

SAVE SEQUENCE

Saves the current sequence.

ADD FRAME

If a frame was not initially loaded or was removed, this adds it back into the sequence.

REMOVE FRAME

Removes the current frame from the sequence. For rendered sequences and sequences loaded via Stdin, the frame is gone forever. For loaded files, it can be reloaded again using "Add Frame".

REMOVE SEQUENCE

Removes the current sequence from MPlay.

RELOAD SEQUENCE

Loads the sequence into MPlay again.

TOGGLE EXTRA UI

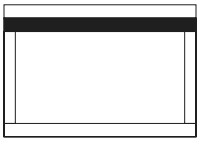
Toggles everything in the UI on/off except for the Viewports.
The individual UI options available are:

Menubar	Toggles the Menubar.
Main Bar	Toggles the *Main Bar* p. 479.
View Controls	Toggles the View Controls.
Display Options	Toggles the Display Options.
Image Controls	Toggles the Image Controls.
Playbar	Toggles the Playbar.
Diff	Toggles the Diff Bar (mPlay only).
Inspect	Toggles the Inspect Bar (mPlay only).

THE SEQUENCE LIST

A list of all the currently loaded sequences. The currently viewed sequence is checked. Selecting another sequence will replace the current sequence. Several viewports can view the same sequence if desired.

I.4 MAIN BAR



The Main bar contains the following controls, from left to right:

MODE SELECTION (Ctrl 1; Ctrl 2; Ctrl 3)

Sets the current View Mode to: *Image*, *TimeLine* or *Graph*. The *Image* View is discussed in the present section. For the others, see: *Graph View* p. 492 and *Timeline View* p. 490.

PLANE MENU

Selects the current image plane being display (i.e. Colour, Alpha, Point, etc).

RESOLUTION MENU

Sets the resolution zoom level of the image displayed, from 12.5% to 800%.

LAYOUT MENU

Sets the maximum viewport layout, from 1 × 1 (1 viewport only) to 4 × 4.

FRAME CONTROLS

These three buttons step allow you to easily move back and forward along the sequence.

Backwards 1 Frame — Moves backwards exactly 1 frame, even if the sequence's FPS does not match the playback FPS. If moving backward 1 frame would go beyond the start of the sequence, it jumps to the last frame of the sequence.

Forewards 1 Frame — Same as Backwards 1 Frame, except moving in the forwards direction.

Adapt Frame Range — Sets the global playback range to the sequence's frame range in the current Viewport.

ZOOM VIEWPORT TOGGLE

Zooms the current viewport to fill the entire viewing area, hiding any other viewports. Clicking again with restore the viewports' state.

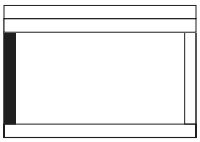
LINK VIEWPORTS TOGGLE

When on, all the viewports are "selected". Changing various controls, like the color correction and component controls or the display item toggles, will affect all the selected viewports. If off, only the current viewport is selected and thus affected by these controls.

LINK VIEWPORTS SCROLL TOGGLE

When on, zooming or panning in one viewport will zoom and pan all the viewports in the same fashion.

1.5 ADAPT BAR



The Adapt bar contains the controls for homing, zooming, clearing the selection, saving the current frame and adapting the image to the window. In mPlay, a button for fitting the viewer is visible. In Houdini, the toggle buttons for the current PIs are visible.

ZOOM IN / OUT] / [

Zooms in / out one level (×2 / ÷2).

HOME H / Shift H

Typing H or clicking this button homes the image to 100%.
Using Shift H scales the image to fill viewport.

SIZE ADAPT ?

If enabled, the viewer will fit the image to the viewport. If *Exact Pixel Size* is also on, this will ensure the image is centered in the view (no scaling will occur). This is automatically turned off if the image is manually panned.

EXACT PIXEL SIZE /

If enabled, the image will always be shown at 100% scale, regardless of viewport size. This is automatically turned off when the image is manually scaled.

CLEAR SELECTION C

If a portion of the image has been selected (by dragging a selection area on the image).

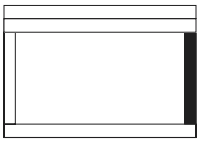
SAVE IMAGE

Launches a dialog to save the current viewport's current frame.

FIT VIEWPORT TO IMAGE (MPLAY ONLY)

Clicking this button will attempt to shrink or enlarge the Mplay window so that the displayed image fits exactly in the window. If more than one viewport is displayed, all viewports are sized to the size of the maximum viewport's dimensions.

1.6 DISPLAY BAR



The Display bar contains all the toggles for turning display items on and off.

DISPLAY OPTIONS (COMPOSITOR ONLY) D

Click to display the *Display Options* p. 485; click again to hide.

ENABLE VIEW (COMPOSITOR ONLY) Ctrl E

If off, the viewport will be temporarily disabled and thus black.

SHOW LABELS Ctrl L

Displays the information text in the upper left corner of the Viewport.

SHOW HANDLES (HOUDINI ONLY) Ctrl H

Displays all handles.

SHOW GUIDES Ctrl G

Shows all guides (gamuts and image border outline)

SHOW PREVIEW Ctrl P

Shows a small preview of the entire image in the lower left corner. In Mplay, left clicking on this preview will pan to that spot on the large image. Middle dragging on the preview selects the viewing region.

TOGGLE TRANSPARENCY

Toggles alpha transparency of the image. Most useful when used in conjunction with a background image.

TOGGLE BACKGROUND IMAGE

Toggles the background image on and off. Only has an effect if Transparency is on.

MAGNIFY WINDOW M

Toggles the Magnify window, which shows the area under the mouse cursor at a very high zoom level (10×), and also the Inspect and HSV Info.

I.7 CONTROL BAR

The Control bar contains the image component and colour controls.

COMPONENT TOGGLES ` 1 2 3 4

These five buttons allow you to determine which colour planes are displayed. The first shows all the planes (Red, Green, Blue, Alpha/Component 4). The next four allow you to individually toggle these planes on and off as desired.

The default hotkeys for these buttons are ~, 1, 2, 3 and 4. The Alpha/Component 4 button will show the Alpha plane if no fourth component exists in the current plane, or the fourth component of that plane if it does.

COLOR CORRECTION CONTROLS

The colour correction controls are split into two modes – Brightness/Contrast mode, and Black/White point mode. Clicking the UI toggle button (beside the RGBA buttons) will toggle between the two modes.

Type R to Reset them all to their defaults.

brightness reset & value

Clicking the brightness button will reset the brightness to 1. Enter a value in the number field for the brightness, or middle click the field to bring up an XCF slider. The button will turn red when the brightness is not 1.

contrast reset & value

The value for the image contrast, normally 1.

bright shift reset & value

This value is added to all pixels, effectively shifting the brightness of the entire image either up or down. Useful for looking through intensity ‘slices’ of the image.

IMAGE MODIFIER SWITCH

Click this button to swap the Bright/Contrast buttons with the Black/White Points.

black point reset & value

The black point of the image, normally 0. This is applied after any image-specific white and black points, so 0 is always black and 1 is always white, regardless of the image data format.

white point reset & value

The white point of the image, normally 1.

gamma button and value

Sets the gamma of the image, applied before the colour correction controls. Clicking the button will reset the gamma to its default value, specified in the Display Options dialog under the 'Correction' tab. The button will turn red when the gamma is not 1.

ADAPT TO FULL PIXEL RANGE R

Clicking this button will automatically adjust the black and white point color controls to fit the minimum and maximum pixel values of the current image.

I.8 DIFF BAR Ctrl D

The Diff bar (brought up with Ctrl D) allows you to compare frames, and contains all the controls for comparing images of two different sequences or frames.

The top line contains the comparison mode menu and the blend factor slider, while the bottom line contains the compare-to source and the frame offset control.

COMPARSION MODE

Selects the type of comparison to perform. Default is "None". The modes are:

Off	Display the image normally.
Compare	Subtract the compare-to image from the current image. This will potentially produce negative values (use the Adapt to Full Pixel Range button to view properly).
Split Horizontal/Vertical	Shows the current image and compare-to image side-by-side, with a blend factor to represent the amount of each shown. Left clicking on the image itself will split the image at that point (*mPlay* only).
Blend	Mixes the current and compared image together based on the blend factor. A blend factor of 0 shows the current image, 1 shows the compared image and values in between blend accordingly (0.3 will blend 70% of the current with 30% of the compared image).
Highlight Differences	Any pixel in the current image that differs from the compared image by more than the threshold (represent above by the Blend factor) will be highlighted. The default threshold is 0, so all differences will be highlighted. The threshold is given in normalized color space (1 unit = the range from black to white).

2 DISPLAY OPTIONS

2.1 DISPLAY PAGE

INTEGER IMAGE SCALING ONLY

If enabled, zooming will scale or shrink the images only by integer amounts (2, 3, 4, 1/2, 1/3, etc).

AUTO MIPMAP IMAGES

If enabled, mipmaps are generated on demand when the image is zoomed out beyond 3×. This may produce a slight delay during scaling as the mipmap is generated.

POP WINDOW WHEN RENDERING IMAGES

When rendering images, this option will pop mPlay to the front of the window stack whenever a render is started.

VIDEO CARD OPTIONS...

use color dithering

Dithers the images to approximate the image's full colour depth (when the display is not capable of showing the image's full colour depth). Dithering places adjacent pixels close to the actual colour next to each other in order to make it appear like the real colour – from a distance, the resulting 'speckled' pattern appears to resemble the actual colour. Dithering also helps break-up moiré patterns if they exist.

display images at 8bit pixel depth

If enabled, all images are compressed to an 8 bit pixel depth. Otherwise they are passed to OpenGL in their native format (floating point, 16 bit or 32bit).

use hardware accelerated colour functions

If your graphics card supports OpenGL hardware acceleration, enabling this option will use that capability to speed-up colour calculations. OpenGL colour functions affect the gamma, brightness, contrast and other functions.

Only disable this if your video card does not implement these functions properly, in which case, images will either not appear or the colour functions will have no effect.

use hardware accelerated lookup tables

Attempts to use hardware OpenGL features when the Gamma is set to a value other than 1, or a lookup table is applied to the image (using the -l command line option (mplay) or the Viewport Display LUT in the Display Options). If playback is much slower, or the LUT has no effect, turn this option off.

use luminance images for single frames

Uses a single monochrome 8 bit image to display 1 channel images such as Alpha, Masks and Z-Depth. Turn this option off if these types of images do not display, or if display of these images is substantially slower than normal colour images. These images will be promoted to greyscale RGB for better performance (but consuming three times the memory).

rgb component display mode

Sets the Component Selection Hardware mode viewing R, G, and B, individually. Hardware greyscale shows R, G and B as greyscale images. Hardware RGB shows R as red, G as green, and B as blue. Software greyscale shows R, G and B as greyscale, but does the conversion in software (some video cards cannot do this efficiently in hardware – long delays in panning or noticable colour flickering are symptoms).

2.2 VIEWPORT PAGE

MULTIPLE NODE DISPLAY

Specify a *Split View* or a *Single View* to be used for displaying multiple nodes.

LAYOUT HORIZONTALLY FIRST, THEN VERTICALLY

If enabled, images are added to Viewports with a horizontally preference.
If disabled, Viewports are added verically first. This only applies when more than one row and column are used in the viewport layout (ie 2×2, 4×2, 3×3).

SHOW ALL VIEWPORTS ALWAYS

If enabled, all the viewports specified by the layout will be visible, even if whole rows or columns of viewports are empty. If off, the viewer dynamically adapts the number of viewports up to the layout specified.

DEFAULT VIEWPORT LAYOUT

Specifies the default startup layout of the viewports, from 1×1 to 4×4.

DISPLAY VIEWPORT INFORMATION

Specifies the amount of information present in the viewport information labels, from Minimal (name only) to Verbose.

IMAGE GUIDE

The name of an image guide file. The guide file is a text file with a series of drawing commands which will overlay a guide on the image. All coordinates are expressed in pixels.

image guide commands

`box X Y Width Height` Draws a box at (X,Y) with the specified width and height.

`rect X1 Y1 X2 Y2` Draws a box with one corner at (X1, Y1) and the opposite corner at (X2, Y2).

`line X1 Y1 X2 Y2` Draws a line from (X1, Y1) to (X2, Y2).

`lines Num dX dY X1 Y1 X2 Y2`
Draws a series of lines from (X1, Y1) to (X2, Y2), offseting both coordinate pairs by (dX, dY) each time. *Num* lines are drawn.

`color R G B A` Sets the drawing colour to {R,G,B,A}.

BACKGROUND COLOUR

Specifies the background colour of the image viewer, normally black.
Click the colour preview to display a colour picker dialog.

2.3 BACKGROUND PAGE

Background images will always be stretched to fit the size of the currently displayed image. If the aspect ratio of the background image and the current image do not match, you will get distortion of the background image.

Note: Background images are only visible when Transparency is enabled.

FILENAME

The name of the background image to use.
If none is specified, then no background image will be displayed.

USE RES

Manually specify a resolution to use for the background image instead of using the natural size of the image.

FOREGROUND IMAGES ARE PREMULTIPLIED

Most rendered images are premultiplied, which means that the colour has already been multipled by the alpha plane.

However, if just place an arbitrary alpha plane without running it through a Premultiply COP, then the resulting image is not premultiplied, and your transparency will be wrong.

For example: Place a File COP, append a Shape COP and have it replace the Alpha plane with a star shape – then enable transparency. You'll need to turn off "Foreground Images are Premultiplied" in order to see the proper image.

2.4 CORRECTION PAGE

DISPLAY LUT

Applies a LUT file to the display images.

INSPECT LUT

When inspecting, the raw values of the image will be run backwards through the LUT file to produce the original values (i.e. Cineon values).

DEFAULT DISPLAY GAMMA

The default gamma applied to all images, which can be interactively changed using the color correction controls.

GAMMA CORRECT PLANES

The names of planes to gamma correct. Normally, this is just the colour plane (C).

2.5 HANDLES PAGE

RENDER WITH SMOOTH LINES

If enabled, the handle and guide lines will be anti-aliased.

RENDER WITH ALPHA BLENDING

If enabled, the handle and guide lines will be slightly transparent.

HANDLE COLOUR

The basic colour of all handles and guides. The default is bright grey. Specify an RGB for the handle colour, or click the colour preview to display a color picker.

HANDLE PICK SIZE

The size of the handle's pick region (in pixels). Larger values make the handles easier to pick, however, values above 10 should be used with caution, since handles may be unintentionally picked with such a forgiving value.

2.6 MEMORY PAGE

LIMIT VIEWER MEMORY USAGE

If enabled, the image cache has a maximum size specified by the Image Cache Size.

IMAGE CACHE SIZE

The size of the image cache, in Mb.

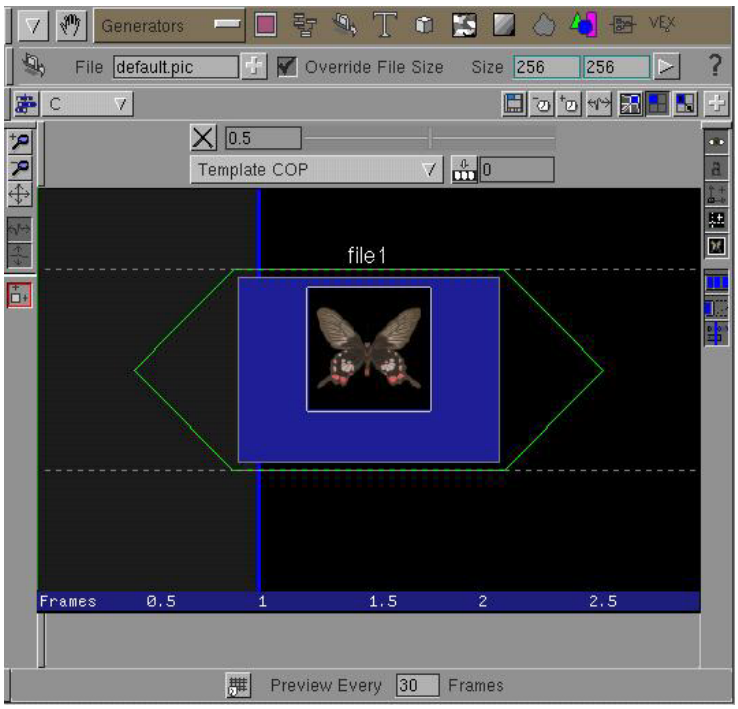
IMAGE COMPRESSION

If memory is short, you may want to apply lossless compression to images. This enables lossless compression on the cached images, with varying degrees of compression/CPU usage.

CLEAR IMAGES FROM MEMORY

Flushes the image cache, freeing all image memory, exception that used by the currently displayed image(s).

3 TIMELINE VIEW



The Timeline view layout is very similar to the Image view layout. However, the timeline only has 1 viewport, which displays all the sequences.

3.1 THE MAIN BAR

The Resolution and Layout menu selectors are not relavent, so they do not appear. There is one more button which is not found in the other views, the COP Filter button (which is not part of mplay) – it allows you to choose which COP nodes to show (Displayed, Time Sensitive, or All).

3.2 THE ADAPT BAR

The Zoom In, Zoom Out and Home buttons remain the same.

HORIZONTAL ADAPT TOGGLE

When on, the viewport will be horizontally adapted so that all sequence ranges can be seen.

VERTICAL ADAPT TOGGLE

When on, the viewport will be vertically adapted so that all the sequences can be seen.

3.3 THE CONTROL BAR

GRID MENU

Selects the display units, either Frames or Seconds, and the Grid density (none, low, medium, high).

PREVIEW

Sets the rate at which previews appear in the sequence. Previews must be on in order to make this have an effect (see Display Bar, below).

3.4 THE DISPLAY BAR

Additional display items in the TimeLine.

TOGGLE FRAME BOXES

If enabled, each frame gets its own box to represents the time it will be visible for.

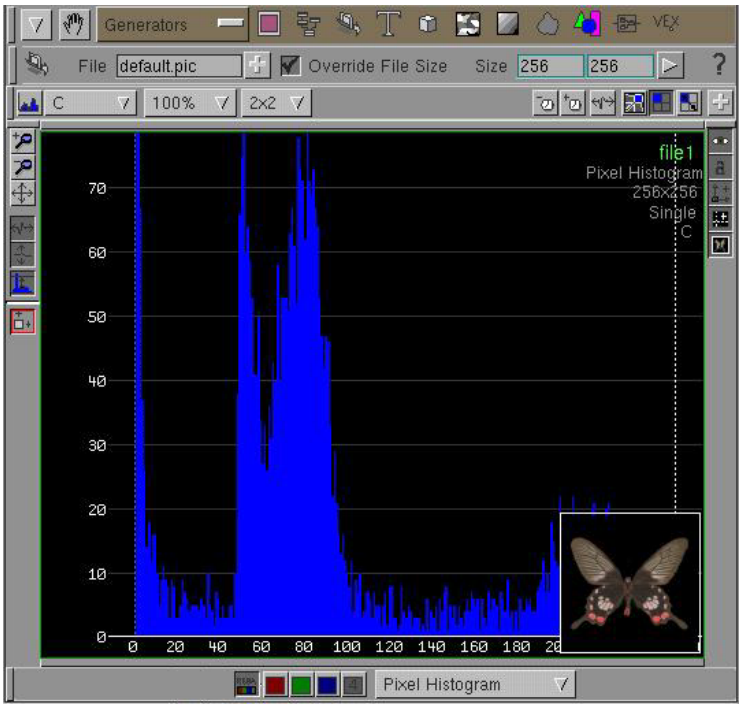
TOGGLE EXTEND GUIDES

If enabled, the extend conditions Cycle, Mirror, Hold and Hold for N Frames will be shown on the timeline.

TOGGLE FRAME BAR

Toggles the vertical blue line representing the current time on and off.

4 GRAPH VIEW



The Graph view displays a variety of graphs and histograms based on the pixel values of the image.

4.1 ADAPT BAR

In addition to the Zoom In, Zoom Out and Home buttons, the Graph view contains horizontal and vertical adapt toggle buttons.

HORIZONTAL ADAPT

If enabled, the full horizontal domain of the graph will be shown.

VERTICAL ADAPT

If enabled, the full or effective vertical range of the graph will be shown.

IGNORE SPIKES DURING ADAPT

If enabled, the effective vertical range of the graph is used. The top 2% of data points are ignored (the "spikes"). This often makes the graph easier to view when verically adapting. If off, the full range of the graph is shown.

4.2 CONTROL BAR

The control bar contains the same component selectors as the Image viewer. In addition, there is also a menu for the type of graph displayed.

PIXEL HISTOGRAM

Shows the frequency of occurance of a certain pixel value in the image as a bar graph.

HUE HISTOGRAM

Shows the frequency of occurance of a certain hue in the image as a bar graph (must be vector plane of 3 or 4 elements)

SATURATION HISTOGRAM

Shows the frequency of occurance of a certain saturation level in the image as a bar graph.

VALUE HISTOGRAM

Shows the frequency of occurance of a certain pixel value level in the image as a bar graph.

PIXEL/HUE/SATURATION/VALUE VS U/V

These 8 graphs show the pixel value, hue, saturation or value of pixel rows or columns in the image. The values are plotted as individual points. Dense regions of the graph will appear more white than blue.

HUE VS SATURATION

Shows the saturation range of the different hues in the image. Dense regions of the graph (ie, many occurances of the same hue-saturation pair) will appear whiter than the normal hue.

HUE VS VALUE

Shows the value range of different hues in the image. Dense regions of the graph (ie, many occurances of the same hue-saturation pair) will appear whiter than the normal hue.

5 DISPLAY OPTIONS

5.1 DISPLAY

USE COLOR DITHERING

If enabled, color dithering is enabled to approximate the actual color as accurately as possible (in the case where the display is not capable of showing the image's color resolution). Some video cards may not support dithering.

INTEGER IMAGE SCALING ONLY

If enabled, zooming will scale or shrink the images only by integer amounts (2, 3, 4, 1/2, 1/3, etc). This is faster on some video cards.

DISPLAY IMAGES AT 8BIT PIXEL DEPTH

If enabled, all images are compressed to 8bit pixel depth. Otherwise they are passed to OpenGL in their native format (floating point, 16 bit or 32bit). If non-8 bit images display improperly, toggle this option *On*.

AUTO MIPMAP IMAGES

If enabled, mipmaps are generated on demand when the image is zoomed out beyond 3×. This may produce a slight delay during scaling as the mipmap is generated.

USE HARDWARE ACCELERATED COLOR FUNCTIONS

If enabled, OpenGL color functions are used to affect the gamma, brightness, contrast and other color functions. Only turn this off if your video card does not implement these functions properly, in which case images will either not appear or the color functions will have no effect. Turn this *Off* to eliminate this delay, but Zooming out may cause viewing artifacts and display slower.

POP WINDOW WHEN RENDERING IMAGES

When rendering images, this will pop mPlay to the top of the window stack whenever another render is started.

5.2 VIEWPORT

LAYOUT HORIZONTALLY FIRST, THEN VERICALLY

If enabled, images are added to viewports horizontally first. If off, viewports are added verically first. This only applies when more than one row and column are used in the viewport layout (ie 2x2, 4x2, 3x3).

SHOW ALL VIEWPORTS ALWAYS

If enabled, all the viewports specified by the layout will be visible, even if whole rows or columns of viewports are empty. If off, the viewer dynamically adapts the number of viewports up to the layout specified.

BACKGROUND COLOR

Specifies the background color of the image viewer, normally black. Click the color preview region to launch a color picker dialog.

DEFAULT VIEWPORT LAYOUT

Specifies the default startup layout of the viewports, from 1 × 1 to 4 × 4.

DISPLAY VIEWPORT INFORMATION

Specifies the amount of information present in the viewport information labels, from Minimal (name only) to Verbose.

IMAGE GUIDE

The name of an image guide file. The guide file is a text file with series of drawing commands which will overlay the guide on the image. All coordinates are expressed in pixels. The commands are (bold is required text, italics represents numeric values):

`box` *`X Y Width Height`* — Draws a box at (X,Y) with the specified width and height.

`rect` *`X1 Y1 X2 Y2`* — Draws a box with one corner at (X1, Y1) and the opposite corner at (X2, Y2).

`line` *`X1 Y1 X2 Y2`* — Draws a line from (X1, Y1) to (X2, Y2).

`lines` *`Num dX dY X1 Y1 X2 Y2`* — Draws a series of lines from (X1, Y1) to (X2, Y2), offseting both coordinate pairs by (dX, dY) each time. Num lines are drawn.

`color` *`R G B A`* — Sets the drawing color to {R,G,B,A}.

5.3 BACKGROUND

Background images will always be stretched to fit the size of the currently displayed image. If the aspect ratio of the background image and the current image do not match, you will get distortion of the background image.

Background images are only visible when Transparency is enabled.

FILENAME

The filename of the background image(s). If blank, no image will be shown. If invalid, a pink texture will appear as a background image.

USE RES

If enabled, a specific resolution can be used for the background images.

5.4 CORRECTION

DISPLAY LUT

Applies a LUT file to the display images.

INSPECT LUT

When inspecting, the raw values of the image will be run backwards through the LUT file to produce the original values (ie, Cineon values).

DEFAULT DISPLAY GAMMA

The default gamma applied to all images, which can be interactively changed using the color correction controls.

GAMMA CORRECT PLANES

The plane names to gamma correct, normally just the color plane.

5.5 HANDLES (HOUDINI ONLY)

RENDER WITH SMOOTH LINES

If enabled, the handle and guide lines are anti-aliased.

RENDER WITH ALPHA BLENDING

If enabled, the handle and guide lines will be slightly transparent.

HANDLE COLOR

The basic color of all the handles and guides. The default is bright grey. Click the color preview region to get a color picker dialog.

HANDLE PICK SIZE

The pick region size of the handles. Larger values will make the handles easier to pick, however, values above 10 should be used with caution, since handles may be unintentionally picked with such a forgiving value.

5.6 MEMORY

LIMIT VIEWER MEMORY USAGE

If enabled, the image cache has a maximum size specified by the Image Cache Size.

IMAGE CACHE SIZE

The size of the image cache, in Mb.

IMAGE COMPRESSION

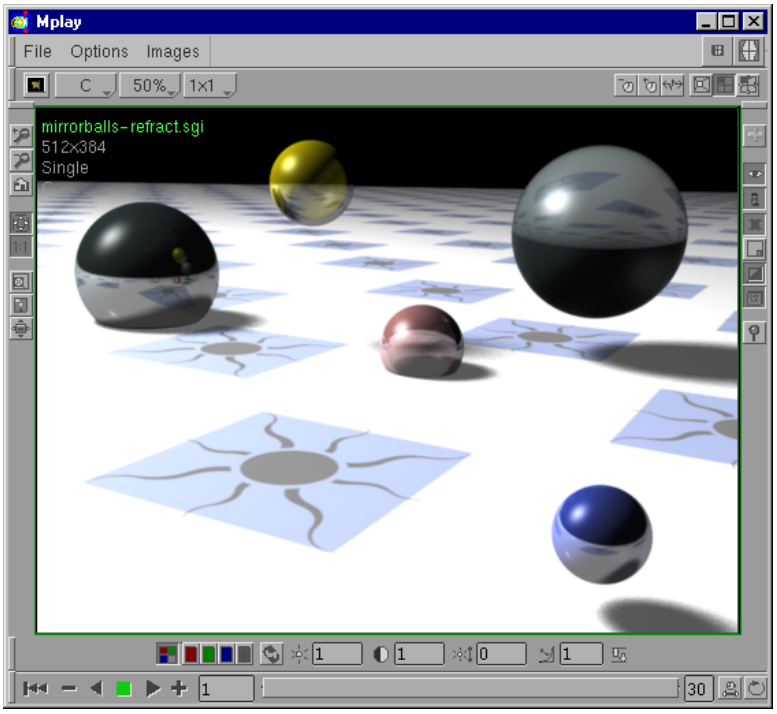
Enables lossless compression on the cached images, with varying levels of compression/CPU usage.

CLEAR IMAGES FROM MEMORY

Flushes the image cache, freeing all image memory used by MPlay, with the exception of the currently displayed image(s).

2 mPlay

1 MPLAY



mplay replaces iplay, and is as similar as possible to the Houdini COP viewer.

1.1 TOP MPLAY CONTROLS

On the same line as the Menu bar along the right side are the Window and Rendering controls. The Rendering controls will only appear if mPlay was launched with the -K option, or if mPlay was launched via a render.

HALF WINDOW SIZE

The mPlay window will be reduced in size by 1/2 (until it reaches the minimum window size).

DOUBLE WINDOW SIZE

The mPlay window will be doubled in size, up to the maximum size of the screen.

START NEW SEQUENCE (RENDER ONLY)

All subsequent rendered images will begin in a new sequence.

KILL RENDERS (RENDER ONLY)

All active renders will be terminated immediately.

DISCONNECT (RENDER ONLY)

This mPlay session will stop listening for render requests to the mPlay device. On the next flipbook or render to mp, a new mPlay will be spawned.

1.2 STATUS BAR

Messages are displayed here. Currently only Render Updates are supported.

2 MPLAY MENUS

2.1 FILE MENU

OPEN

Opens a new sequence, clearing all the other sequences.
See: *Open File Dialog* p. 502.

MERGE

Opens a new sequence and adds it to the sequence list, keeping all the previous sequences.

SAVE CURRENT FRAME

Saves the image in the current viewport at the current time.

SAVE CURRENT SEQUENCE

Saves the sequence in the current viewport.

SAVE PREVIEW

Saves the current image(s) exactly as they are currently displayed, including colour correction, cropping, scaling, and transparency with background image. It will bring up a standard save dialogue where you can specify the filename, frame range, and step size.

LOAD AUDIO

Launches a dialog to load and offset an audio track.
See: *Load Audio Dialog* p. 504.

SEQUENCE LIST

Launches the Sequence List dialog (documented below).

CLEAR CACHE

Empties all images from the cache which are not in use.

CACHE ALL IMAGES

Caches all images in all sequences, adjusting the memory size accordingly.

NEW VIEWER

Creates another viewer window, which may be switched to a different viewing mode. All viewers are linked by the playbar, so changing the frame on one will update all the viewers to the new time.

QUIT

Quits mPlay, closing all open viewers.

2.2 OPTIONS MENU

SETTINGS

Opens the *Settings Dialog* p. 507.

DOUBLE BUFFER

Toggles between double and single buffer modes. Double buffering reduces the amount of flickering associated with redraws; Single buffering tends to playback slightly faster.

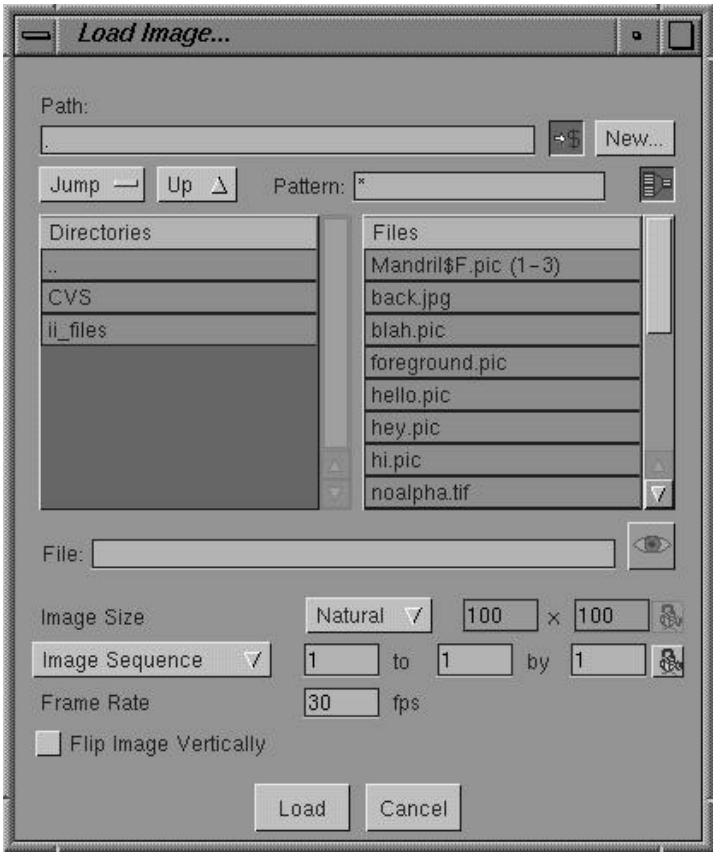
HIDE EXTRA UI

If enabled, only the viewports are shown. To restore the UI, use the Ctrl-RMB menu in the viewport and select "Toggle Extra UI" or use the Toggle UI hotkey: U.

2.3 IMAGE MENU

This menu lists all the sequences that are currently loaded. Selecting a sequence will put that sequence into the current viewport.

3 OPEN FILE DIALOG



This dialog is displayed whenever you load a new sequence.

FILE

The filename of the image sequence.

IMAGE SIZE MENU

Images in the sequence can be loaded at natural, 75% res, 66% res, 50% res, 33% res, 25% res or *Custom Res*.

MANUAL IMAGE SIZE FIELDS

If *Custom Res* is selected in the Image Size menu, these two fields allow manual specification of the resolution.

LOCK IMAGE SIZE

If enabled, selecting new sequences will not overwrite the Image Size fields. Normally they are automatically updated with the resolution of the newly selected sequence.

SINGLE IMAGE / IMAGE SEQUENCE MENU

Sequences are normally interpreted as Single Images if there is no frame number in the filename, otherwise they are interpreted as an Image Sequence. This menu allows you to override this interpretation.

FRAME RANGE AND STEP

The current frame range and frame step of the sequence. This can be modified to show only part of the sequence.

LOCK FRAME RANGE

If enabled, the Frame Range fields will not be automatically updated when another sequence is selected.

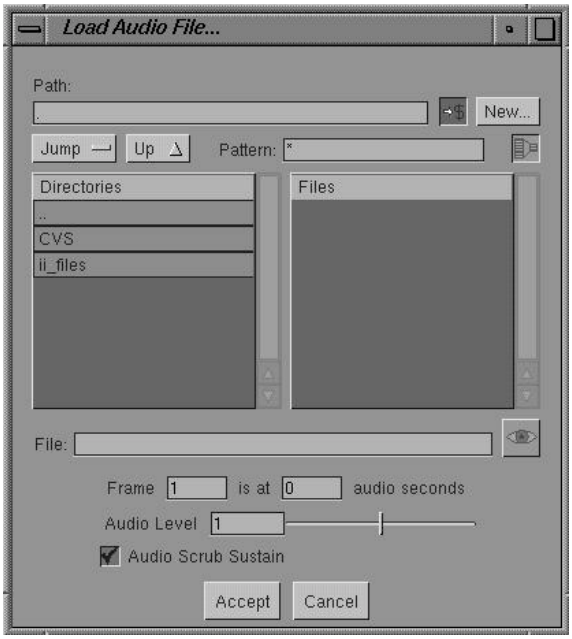
FRAME RATE

Specifies the frame rate of the selected sequence. It will be set to the global frame rate initially.

FLIP IMAGE VERTICALLY

If enabled, all images in the sequences are flipped vertically.

4 LOAD AUDIO DIALOG



This dialog loads an audio track into MPlay, usually for lip-synching.

FILE

The audio file to load. Any supported audio, data or channel format is allowed.

FRAME ALIGNMENT

Aligns the start of the audio with a given animation frame. The animation frame field, audio time field or both may be used to align the audio track.

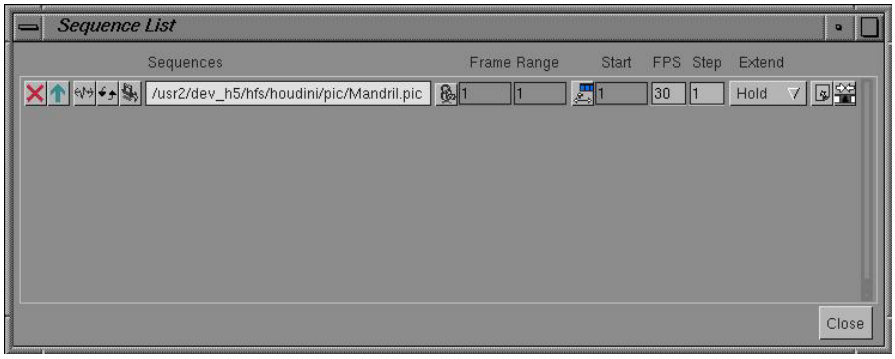
AUDIO LEVEL

The volume of the audio.

AUDIO SCRUB SUSTAIN

If enabled, the audio will be sustained while scrubbing the playbar. Otherwise it is difficult to identify the sound while scrubbing slowly.

5 SEQUENCE LIST DIALOG



The sequence list manager shows all the current sequences, their frame range, rate and step, as well as several controls to manipulate and modify the sequences.

If a background image is loaded, it will appear as the last image. Some options are disabled for this sequence.

From left to right, the controls are:

REMOVE SEQUENCE

Removes the entire sequence from mPlay.

REORDER SEQUENCE

Moves the sequence up one in the sequence list, shifting all the Viewport contents.

FIT FRAME RANGE TO THIS SEQUENCE

Sets the global frame range to the current frame range of this sequence.

RELOAD SEQEUENCE

Forces a reload of all images in the sequence.

SAVE SEQUENCE

Launches a file dialog which allows you to save all or portions of the sequence.

FILENAME

The filename of the sequence, which cannot be changed.

LOCK FRAME RANGE

If enabled, the frame range of the sequence can be manually overriden.

FRAME RANGE

The frame range of the sequence. If "Lock Frame Range" is on, you can specify a new frame range for the sequence.

OVERRIDE START FRAME

If enabled, the sequence can be shifted to a new start frame. Useful for aligning sequence in time with different frame ranges.

START FRAME

The current start frame of the sequence.

FPS

The frame rate of the sequence. Normally you will want to change the frame rate of mPlay to change the frame rate; this allows you to compare two sequences of differnt rates.

STEP

The frame step of the sequence. A step of 1 shows every frame.

EXTEND

Specifies how the sequence is extended outside its frame range - Black frames, Cycled, Mirror or Held.

FLIP IMAGE

If enabled, all the images in the sequence are flipped vertically.

REMOVE BLACK FRAMES

If enabled, any missing frames are removed from the sequence. This will cause any frames after missing frames to be out of synch with their actual frame number, but no black frames will appear during playback.

This only has an effect if mPlay was invoked with the *-g* commandline option.

6 SETTINGS DIALOG

This dialog contains the common mPlay settings for playback and loading images.

FRAME RANGE

The global frame range.

STEP

The global frame step.

FRAME RATE

The global frame rate.

CHANGE RATE OF ALL SEQUENCES

If enabled, when the Frame Rate field above is changed, all loaded sequences will also be set to that rate.

REAL TIME

Enables realtime playback. MPlay will attempt to play the sequence back as closely to realtime as possible (which it may not do on the first pass through if disk access is not fast enough to load images in realtime).

PLAY MODE

Sets the playbar mode to *Loop*, *Play Once*, or *Zig-Zag* (i.e. back and forth).

LOAD COMPONENTS

Normally Color and Alpha are loaded, if present. However, memory can be conserved by loading Color components only. This applies to all RGBA image formats. The new Houdini PIC format has its planes loaded on demand, so this will not affect PIC sequences.

MISSING FRAMES

Specifies the method for replacing missing frames.

Use Nearest Frame	The closest frame in time is chosen to replace the missing frame.
Use Previous Frame	The last valid frame before the missing frame is used.
Use Next Frame	The next valid frame after the missing frame is used.
Use Black Frame	Black is shown for the missing frame.

7 MPLAY – COMMAND LINE OPTIONS

7.1 SYNTAX

```
mplay [-profile] [options] image_files...
```

7.2 OPTIONS

PROFILES

`-default, -tools, -render, -flipbook, -viewer, -full, -minimal.`

IMAGE OPTIONS

`-g`	Group the command line images into separate sequences, based on base name and extension.
`-u`	Leave the images in the command line unsorted (in the order they appear).
`-Z [pad]`	Load only images that are padded to 'pad' digits (or 0 for non-padded images only).
`-z [level]`	Load images at the specified zoom level (in %): 12, 25, 33, 50, 66, 75 or 100.
`-v`	Flip all images vertically.
`-B [file]`	Set the background image(s). This will automatically enable transparency and background images.
`-c`	Load RGB color components only (no alpha).
`-U`	Use an unlimited amount of memory for images.
`-m [mem]`	Limit the memory usage to 'mem' Mb.
`-w [width]`	Load images at width specified (used only by stdin)
`-h [height]`	Load images at height specified (used only by stdin)
`-S [nframes]`	Load nframes images from stdin in RGBA format (used only by stdin).
`-L [lutfile]`	Sets 'lutfile' as the lookup table for cineon images.
`-l [w] [g] [iw]`	Sets the Cineon white point 'w', the film gamma 'g' and the image white point 'iw'.
`-N`	Leave Cineon files in their natural 10 bit log space.

PLAYBACK OPTIONS

`-C`	Precache all images at startup.
`-f [s] [e] [st]`	Sets the frame range (s,e) and frame step (st).
`-p`	Startup in playback mode.
`-P [mode]`	Sets the playback mode to 'loop', 'once' or 'zigzag'.
`-r [fps]`	Set the frames per second for realtime play.
`-R`	Turn on realtime play without specifying a rate.

UI OPTIONS

`-b [s|d]`	Startup in single (s) or double (d) buffer mode.
	Single buffer provides faster playback speed (default).
`-F`	Full image view mode; do not show any extra UI.
`-K`	Tell MPlay to listen on a socket for input images.
`-k`	Tell MPlay to listen on a socket for flipbook images.
	Images rendered to the ip device will be displayed.
`-T`	MPlay will always remain a topmost window (NT only).
`-V [x] [y]`	Sets the viewport layout to 'x' cols by 'y' rows.

AUDIO OPTIONS

`-a [file]`	Set audio filename.
`-A [volume]`	Sets the volume level (default 1).
`-o [fr] [sec]`	Set the animation frame 'fr' corresponding to 'sec' audio seconds.
`-s on|off`	Enable or disable the audio scrub sustain.

3 Compositing Guide

1 COMPOSITING BASICS

1.1 INTRODUCTION

Halo is the new compositor and image editor for Houdini. It supports a greater number of Composite OPerators (COPs), more data types and formats and a more complete workspace than the Houdin 4.0 Compositor. Halo is tightly coupled with Mantra, allowing it to read and use geometric and shader data to create more advanced post-render effects.

Halo is heavily multithreaded and takes advantage of as many processors as are available on the local machine, resulting in a considerable performance benefit for multiprocessor workstations. Its tile-based architecture uses memory very efficiently, processing large volumes of image data without requiring gigabytes of memory.

1.2 SEQUENCES

Sequences are the data which COPs cook. They contain resolution, frame range, extend condition and image structure information. These are all constant over time, meaning that they cannot be animated.

```
Full Name:     /img/img1/still2
Operator type: still

---------------------------------------------------

Operation:     File: ./depth.pic

Size:          320 x 243
Interlacing:   None
Range:         Single Image
Frame Rate:    -
Extend:        -
Planes:        5
Bytes/Pixel:   40

---------------------------------------------------

  C  { r g b }               8 Bit Integer
  A                          8 Bit Integer
  P  { r g b }              32 Bit Floating Point
  N  { r g b }              32 Bit Floating Point
  Of  { r g b }             32 Bit Floating Point
```

The COP info for a File Still COP.
This file contains Color, Alpha, Point, Normal and Opacity information.

The image structure is defined by a list of planes. Most images have the common Color and Alpha planes, however, extra information, such as masks, Z-depth, normals and bump maps, can be stored in the same sequence as well.

1.3 PLANES AND CHANNELS

Planes describe the type and format of a certain type of image map contained within the sequence. Each plane has a name, a data type and a list of 1 to 4 channels. Each channel has a name as well, normally 'r', 'g', 'b', 'x', 'y' or 'z'.

The types of planes currently recognized by Halo are (with their default name and configuration):

Color (C)	Image color, represented by three channels, r, g and b.
Alpha (A)	Image alpha, 1 channel.
Mask (M)	Operation mask, which acts as a stencil for a filter operation. 1 or 3 channels.
Depth (Z)	Z depth, 1 32 bit floating point channel.
Point (P)	3D camera space point position, 3 32 bit floating point channels (x,y,z)
Normal (N)	Object point normals, 3 32 bit floating point channels (x,y,z)
Bump (B)	Bump map, 2 32 bit floating point channels (u,v)
Velocity (V)	Point Velocity map, 3 32 bit floating point channels (x,y,z)
Luminance (L)	1 single channel.

The default names of the planes can be changed in the Compositing preferences (see *Interface > Preferences > Compositing*).

Other planes may be generated by Mantra, such as any exported shader variables. These may be used by the compositor, but it does not recognize them as anything special (similar to spare channels).

DATA FORMATS (BIT DEPTH)

Halo supports four data formats for images:

- 8 bit integer (256 discrete values)
- 16 bit integer (65,000 discrete values)
- 32 bit integer (2 billion discrete values)
- 32 bit floating point

Each of the integer formats can optionally have white and black points set. By default, the white and black points are the 0 and the maximum value of the format (8 bit - 0, 255; 16 bit - 0, 65535; 32 bit - 0, 2 billion). This allows you to reduce the

head and foot clipping errors at the expense of quantization errors. For example, a 16 bit image with black and white points set at 24,000 and 40,000 gives you 16,000 levels between black and white, and quite a bit of head and foot room (the full range is -1.5 to 2.6).

1.4 COP NETWORK TILES

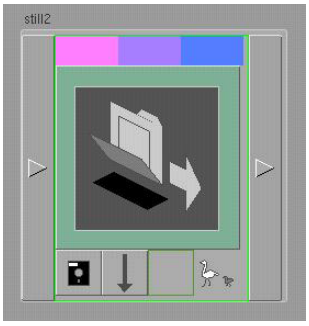
TEMPLATE / RENDER / DISPLAY FLAGS

The COP Network tiles have quite a bit of information packed into them.

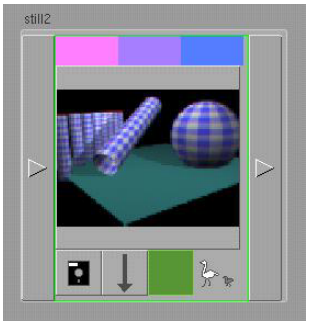
Along the top are three colored flags. The first flag is the pink Template flag, which is used when diffing nodes together to compare them). Only one Template flag may be set in a network at a time.

The second flag is the purple Render flag, which is used to specify the COP Network's output node. Only one render flag may be set in a network at a time.

The third flag is the blue Display flag, which is used to specify which COPs are displayed in the viewer. Multiple display flags may be set at once. Clicking on the display flag turns on the display flag and turns off all other node's display flags. Shift Clicking the display flag toggles it without affecting other nodes. The number of COPs that can be displayed simultaneously is determined by the number of viewports in the viewport layout of the viewer (e.g., a layout of 2×2 can display four COPs). If all the viewports are in use, the newly displayed COP will replace the COP in the current viewport).



COP Tile



COP Tile with Preview

INPUT / OUTPUT CONNECTORS

Along each side of the tile are the input and output connectors, which are exactly the same as all other Houdini Connectors.

CACHE / BYPASS / PREVIEW FLAGS

Along the bottom of the tile are the Disk Cache flag, Bypass flag, Preview flag and the Preview Selection.

disk cache

The Disk Cache flag caches the output results to disk as the COP cooks. The disk location is specified by the Proxy Directory preference, found in the Compositing Preferences "Proxy" page (see: *Interface > Preferences > Compositing > Proxy Page*). This does incur a performance hit while cooking while images are being cached, but prevents further cooking before the node. It is similar to a lock flag; however, if network before the cached node is changed, it will re-cache the new results.

bypass flag

The next flag is the Bypass flag. It causes the operation to be completely ignored, as if the node was not connected in the network.

preview flags

The next two flags control the COP Tile Preview state. When the green Preview flag is on, the COP Operation Icon is replaced by a small 100×100 preview of the image (the aspect ratio is maintained, so if the aspect is not 1, the larger of the X and Y resolutions will be 100).

preview display menu

The second Preview icon is a menu, which controls what plane the Preview displays. The default is "Follow", which causes the Tile to follow whatever its first input tile's preview is. If the COP has no inputs, Follow defaults to using the first plane. Changing the preview plane will cause all its outputs to switch to the same plane if they are "Following" their input. This means long chains of COP tiles can be switched to another plane by simply changing the preview plane of the first tile in the chain.

1.5 COP TILE AUTOCOLORING

COP tiles are automatically color coded by default to make networks easier to read. If the color of a tile is changed by the user, the autocoloring is no longer used on that tile. The color of the tile reflects which COP family it belongs to (with its default coloring):

Generator (green) — Generators create planes, so it is often useful to know where in your network planes are being created. Generators may have an input, so it isn't always obvious what nodes are generators.

Pixel Operation (blue) — Chains of Pixel Operations are automatically collapsed into one operation, resulting in quicker cooking and less quantization error. However, this only works if no other COP nodes are between the Pixel Operations in the chain. The coloring of these nodes makes it easier to identify and group Pixel Operations.

Timing Operation (beige) These operations do not affect images, only the timing or the sequence itself. They do not use any cache memory and are extremely quick.

VEX Operation (magenta) Some COPs are implemented in VEX. VEX COPs differ slightly in the way they interpret input planes, so it is useful to know when you are using one (see: *Reference > 07-VOPs*).

1.6 COOKING

Halo cooks images quite differently than the rest of Houdini, and it is useful to understand how it works so your networks can work more efficiently.

TILE BASED

All images are cooked in tiles, which by default are 128×128 square regions of the image. This allows the work to be effectively split up among multiple processors. Small portions of an image can also be used without the entire image cooking, and constant tiles (all black, white or some other constant value) are optimized out in the pipeline.

MULTITHREADING

Halo supports cooking on more than one local CPU, which results in almost halving (two CPUs) or quartering (four CPUs) the cook time. Since multithreading incurs a slight management overhead, there is no benefit to enabling multithreading on single CPU workstations. Halo supports up to 64 cooking threads.

ON-DEMAND COOKING

Planes and tiles are only cooked if they are needed to speed up cooking and reduce memory requirements. This means that if your image has Color and Alpha, but your network never requires alpha and you only output color, Alpha will never be cooked. Similarly, if a tile is never needed (such as one that has been cropped or transformed out of the image), it will not be cooked.

BYPASSING AND SCOPING

COPs that are bypassed do not make a copy of input data. Similarly, if an operation is only scoped to affect the Color plane, any other planes will be "passed through" the COP without any copying or cooking.

Timing and management COPs (such as Shift or Merge) do not copy image data unless necessary (i.e., the resolution is different, or frames need to be blended together).

CACHING

Halo uses a global caching scheme to store image data. There are two global caches: the Playback cache and the Cook cache. The playback cache contains complete images used for display. The larger this cache is, the more images can be 'flipped' by scrubbing on the playbar. The size of this cache can be specified in the Halo Viewer Display Options dialog - press 'd' (default hotkey) in the Viewer pane.

The second cache stores raw tiles, and is used heavily during cooking. The size of this cache can affect cooking speed – a larger cache will hold more tiles and reduce the number of times a tile must be re-cooked in similar cooks. The size of this cache can be set in the Compositing preferences (see: *Interface > Preferences > Compositing*).

One of the interesting qualities about these caches is that they remember the most recent images, and how they were created. So if you change a parameter on a COP, then change it back, you will likely get the previously cached copied (similarly with flipping frame numbers). One of the advantages of this cache behaviour is that you can quickly toggle between parameter settings to compare the differences.

1.7 SPEEDING UP COOKING

While working interactively with COPs, your workflow can be substantially sped up by using some of its interactivity features in addition to the normal cooking optimization features listed above. All of these interactive features may be used simultaneously.

FULL IMAGE SIZE REDUCTION

The simplest way to reduce cooking times is to cook a smaller image. The Image Viewer allows you to cook at different scale factors of the image resolution, from 12.5% to 800% (see: *2D Viewport* p. 477). A reduction in the image resolution by 2 results in a 4x speed increase.

AREAS OF INTEREST

In cases where the operation only occurs in a small area, the image can be interactively cropped to display only that part of the image. Only tiles which belong to that part of the image will be cooked. The interactive speedup depends on the size of the region selected. This region is very easy to set up by entering the View state and left mouse dragging over the area. To return to the full image, press the Clear Selection button (on the Left Adapt bar), type Shift C (default hotkey), or return to the View state and Left click ( ) outside the image.

INTERACTIVE COOK MODE

This mode is invaluable when interactively dragging parameter sliders or viewport handles. As soon as an interactive drag begins, the image automatically scales down to a much lower resolution (by default, a quarter of the current resolution) . When you release the handle or slider to its final value, the image returns to its previous higher resolution and does a longer cook. You can specify the resolution reduction

factor, the minimum image resolution to enable this mode and other options in the Compositing Preferences (see: *Interface > Preferences > Compositing > Cooking*).

INCREMENTAL UPDATE MODE

When Incremental mode is enabled, as tiles are cooked, the image in the viewport is updated. The image starts out as a dull gray and slowly gets filled in by the cooked tiles. To cook a specific area of the image, left click on that area during the cook. You can interrupt cooking at any time by pressing 'Esc' or right clicking in the viewport that is being cooked. This option is enabled by default and can be changed in the Compositing Preferences (see: *Interface > Preferences > Compositing > Cooking*)).

2 OPERATIONS

2.1 FAMILIES OF COPS

Most COPs belong to one of six families of operations. Each family has common parameters and a consistent way of behaving.

Generators — Similar to the concept of Houdini Generators, all members of the generator family create new images and generally create new planes.

Scoped Filters — Scoped filters are filter operations which may be applied to only specified planes, channels or frames. Certain operations cannot be scoped, such as a Scale or Crop COP (which changes the resolution), but most filters belong to this family.

Masked Filters — Masked filters can affect portions of an image through the use of a mask. This mask is an image itself which is similar to an alpha matte. All Masked Filters also belong to the Scoped Filters family, as they are simply a more specific case of scoping.

Pixel Filters — Pixel filters are highly optimized operations that can be combined into a single operation if they are grouped together in a chain. All Pixel Filters belong to the Masked Filter family.

Timing Modifiers — Timing modifiers move frames to different frame numbers, modify the frame range or shift the sequence in time. Timing modifiers don't generally cook image information, and are thus very efficient in both memory and cooking performance.

VEX Operations — Some COPs are implemented in VEX, Houdini's native Vector Expression scripting language.

2.2 GENERATORS

Generators create new planes. They all have the same parameters for specifying the image and sequence information. Generators define the following information:

image information

- Resolution
- Pixel Aspect Ratio
- Planes to Create or Add
- Raster Depth
- Interlacing Options

sequence information

- Frame Range
- Optional Frame Rate
- Extend Conditions

If a generator has an input, it can either add a plane to the sequence (Inline Generation) or affect an existing plane using a simple operation (Quick Composite). These techniques have several advantages:

If a generator has an input, it can either add a plane to the sequence (Inline Generation) or affect an existing plane using a simple operation (Quick Composite). These techniques have several advantages:

- The frame range, resolution, interlace options and extend conditions are inherited from the input. This makes matching the resolution and frame range of another sequence much easier; if these are changed in the input, they automatically update.

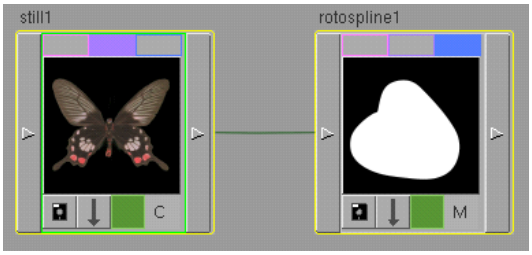
- The number of nodes needed is reduced; no merge or composite node is needed. This also boosts performance and memory efficiency.

When either generators are in Inline Generation or Quick Composite mode, most of their Image and Sequence parameters are disabled because they are overridden by the input. The "Add Plane" parameter in the Image page becomes enabled, which allows you to specify the plane to create or modify, and the operations to perform.

If the plane specified does not exist, or the operation is set to Rename or Replace, the generator creates a new plane. Otherwise, a Quick Composite is done.

INLINE GENERATION

Planes are generated "inline" when a generator adds a plane to an existing sequence. A generated plane can have its own data type and composition; it is not restricted to the input types.



A Rotospline COP, acting as an inline generator and creating a new Mask plane (M) which is then added to the File's sequence.

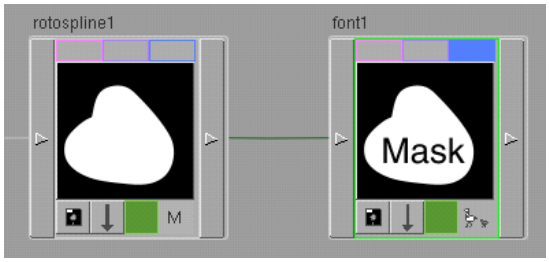
QUICK COMPOSITE

A generator performing a quick composite generates the plane and uses a simple operation to combine the input plane (I) with the generated plane (G). The simple operations are:

Add	Input plane added to the generated plane (I+G)
Subtract	Input plane subtracted from the generated plane (I-G)

Multiply	Input plane multiplied by the generated plane (IxG)
Min	Minimum pixel value of input and generated planes (min{I,G})
Max	Maximum pixel value of input and generated planes (max{I,G})
Average	Average pixel value of the input and generated planes (I+G)/2

This is most useful for creating masks, slates or adding noise to images.



A Font COP subtracting its generated mask from a Rotospline COP.

2.3 SCOPED FILTERS

This family of operators allows an operation to be applied to selected planes and frames. By default, all planes and frames are selected.

Plane scoping is straightforward. Planes and channels that are not scoped are passed through as if the node was bypassed. Some sample plane scopes:

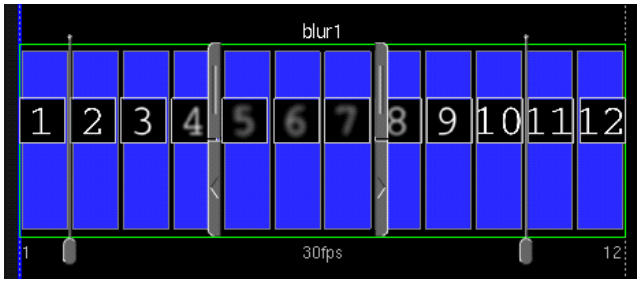
- C A — Color and Alpha are scoped.
- * — All Planes are scoped.
- C.r — The red component of color is scoped.

The RGBA push buttons can also be used to scope the common color and alpha channels.

Frame scoping has more options, including different methods of selecting frames:

All	All frames are scoped.
Inside Range	All the frames within the frame range specified are scoped, with optional dropoff regions at each end of the range.
Outside Range	All the frames outside the frame range specified are scoped, with optional dropoff regions at each end of the range.
Even/Odd Frames	Only the even or odd frames are scoped.
Custom	All of the frames in the custom list are scoped.

EXAMPLE

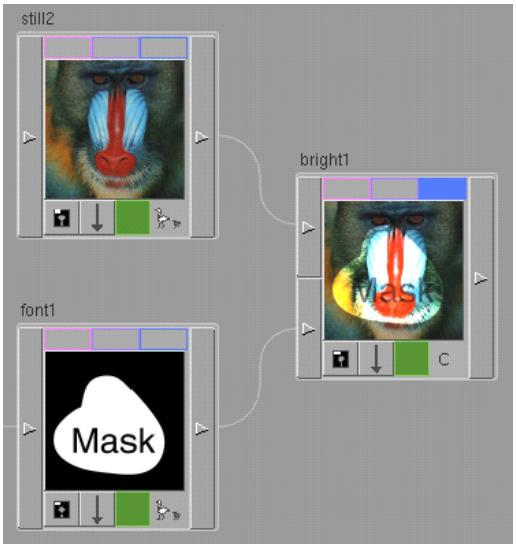


A short blurred sequence scoped with "Inside Range", with small dropoff regions where the effect of the blur is lessened to nothing. The handles can be used to edit the range.

2.4 MASKED FILTERS

Many operations can be scoped on a per pixel basis using a mask image. This mask can be any plane or channel within the input sequence, or any plane or channel in the sequence of the mask input. The mask acts as a stencil - wherever the mask is 1 (white), the operation is performed. Wherever the mask is 0, the input pixel is not affected. If the mask is an intermediate value (between 0 and 1), the input pixel is linearly blended with the output pixel. The mask can be inverted so that all pixels outside the mask are affected instead.

Using the Alpha plane as a mask is a very efficient way of masking color correction operations to the actual image without affecting outside black levels.



A Bright COP applying a masked bright to the Mandril. This can be done by using a mask in the input sequence (left) or by using a sequence attached to the mask input (right).

2.5 PIXEL FILTERS

Pixel filters have the unique ability to collapse into a single operation with adjacent pixel filters in a network chain. This has the following advantages:

- Quantization and Cutoff errors are reduced by doing quantization once, at the end of the Pixel Filter chain, rather than at every node.
- Pixel values can be carried well above white and below black during the pixel chain without being clamped, even if the image's native data format would clamp it. The values are clamped at the end of the chain.
- Less memory is used; in a chain of N pixel filters, only 1 image is cooked, rather than N.
- The network and quantization overhead is reduced, resulting in faster cooking.

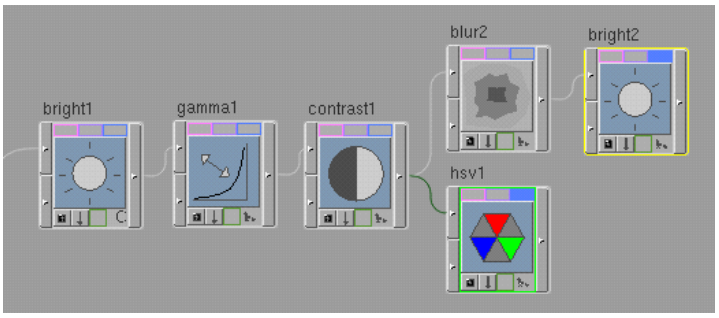
The collapsing of pixel filters can occur on as few as two Pixel Filter COPs up to an unlimited number. If a Pixel Filter chain branches into two outputs, both Pixel Filters, then each output pixel Filter will cook the chain independently of the other.

At any point in the chain, you can tell a Pixel Filter COP to quantize. This will terminate the chain at that point and then start collapsing COPs again at the next Pixel Filter COP. If you display a Pixel Filter COP in the middle of the chain, the displayed image will be the collapsed Pixel Filter chain up to that point.

In order to take advantage of these characteristics of pixel filters, the following must be true:

- The pixel filter chain must be unbroken - other types of COPs cannot be inserted in between (even COPs which do not affect the image).
- All Pixel Filters are maskable (see Masked Filters). If a mask is used, it must be the same for all Pixel Filters in that chain, otherwise collapsing will stop at the first Pixel Filter with a different mask. A warning will be logged to notify you that quantization is occurring at that node (to get rid of this warning, fix the condition or set the Quantize parameter to "At This Node").

EXAMPLE



A simple Pixel Filter chain. The bright1-hsv1 chain is collapsed and computed at hsv1. The bright1-bright2 chain is interrupted by the Blur COP, so the bright1-constrast1 chain is collapsed and computed at contrast1, which is then used by the blur. bright2 is not collapsed in any way.

Pixel Filter COPs have network tiles that are colored blue by default for easy identification and grouping. Most color correction COPs are pixel filters.

2.6 TIMING MODIFIERS

Timing Modifiers perform a variety of editing operations and allow you to cut, splice, shift and sequence frames easily. Most Timing Modifiers do not need to cook images, so they are very quick and memory efficient. Some Timing COPs allow you to blend frames together; in this case, new images are produced and this efficiency advantage is lost.

Timing Modifiers are best viewed in the Timeline view mode. To switch to the Timeline view, type Ctrl 2 in the COP Viewport (default hotkey) or click the icon menu in the top left corner of the viewer, just above the viewport area. To return to Image view mode, press Ctrl 1 or use the icon menu (see *Timeline View* p. 490).

2.7 VEX OPERATORS

VEX operations are very similar to other generators and filters, with a few extra features. All VEX Generators have the same characteristics as normal generators, and all VEX filters are Masked Filters. As well, VEX operators support parameter overloading and exported variables.

PARAMETER OVERLOADING

If the first input has a plane which matches an operation parameter's channel name, the input plane will be used as the parameter's value, effectively overriding it. The overloaded parameter is then evaluated from the plane on a per pixel basis.

For example, if the COP has the following planes:

- C{r,g,b}
- A
- fogdens

and it is fed into a VEX Fog COP, the fog density will be determined at each pixel by the fogdens plane, since the Fog Density parameter's channel name is fogdens.

EXPORTED VARIABLES

VEX scripts can export parameter variables. In COPs, an exported variable creates a new plane with the same name as the VEX parameter. If that plane already exists in the input sequence, it is replaced by the VEX version. Each VEX type is mapped to a COP data type:

VEX Type	COP Type
int	Single channel 32 bit integer
float	Single channel 32 bit float
vector	3 channel 32 bit float
vector4	4 channel 32 bit float
matrix3	3 element array of 3 channel 32 bit floats
matrix4	4 element array of 4 channel 32 bit floats

3 WORKFLOW

3.1 INTRODUCTION

The traditional Houdini network workflow is completely compatible with Halo. It is also augmented by Halo's new interactive viewport workflow, which is similar to Houdini's modeling workflow. All of the new workflow changes are in the viewport.

3.2 CREATING NETWORKS

Adding new nodes can be done directly from the viewport by pressing Tab to bring up the Operator menu. Inputs can be wired up and planes can be scoped or generated without wiring or flipping through the pages of Parameter Dialogs.

To create a node, the procedure is:

1. Select a node using the Tab operator menu.
2. Pick the nodes to wire the inputs to using the Viewport(s) or the Selector Toolbox (located at the top of the viewport, just below the State Toolbar).
3. Select the planes to scope or generate using the State Toolbox.
4. Complete the creation of the node by selecting a viewport to place it in.

WIRING INPUTS IN THE IMAGE AND GRAPH VIEW MODES

To create a new COP in the Image or Graph view modes, type "Tab" or "Backspace" to bring up the operator menu and select a COP. If the selected COP is a filter, it will automatically be wired to the COP currently displayed in that viewport.

To add more inputs, you can left click on the viewports containing the COPs you wish to wire. Each viewport will contain the label of the input that its COP will be wired to.

WIRING INPUTS IN THE TIMELINE VIEW MODE

When in Timeline mode, creating a new COP is very similar to the other two modes. Select a COP using the operator menu. Now select each sequence you need to wire by clicking on the sequence bars of the COPs.

USING THE SELECTOR TOOLBOX FOR GENERATORS

The Generator Selector toolbox. The State icon (the hand) and the Help Icon (?) are always in the toolbox and not used by the selectors.

The selector toolbox can be used to select inputs and optionally determine the planes to create.

The first half of the toolbox deals with input wiring, and is common between the Generator and Filter Selectors. The text prompt shows you the input label of the input you are currently wiring. The pulldown menu allows you to select any COP in your current network. The next button completes the node creation and places the node in the current viewport if pressed. The "X" button removes the last wired input and allows you to re-wire it.

The second half of the toolbox is specific to the Generator Selector. If the toggle is off, none of the settings are applied to the created node - its defaults are used instead.

The first menu selects which type of plane to create. The next string field allows you to enter your own custom planes (i.e., foo{r,g,b} - see the Generator help cards for more information). The next menu sets the compositing operation to perform if the generator is doing Quick Compositing. The last menu selects the data type for the plane.

USING THE SELECTOR TOOLBOX FOR FILTERS

The Filter Selector, which allows you to select the plane scope for the operation.

The Filter Selector is similar to the Generator Selector; the first half regarding wiring is identical.

The second half contains an optional plane scoping selection, identical to the one found in the COP's parameter dialog. If the Scope toggle is not on, the scope is not affected and left at its default (all planes).

FINISHING THE COP CREATION

Once you have selected all the COPs inputs and optionally specified the plane scope or generated planes, Right click in the viewport where you wish to place the new COP or Middle click to add a new viewport containing the new COP (if no viewports are available, the new COP will be placed in the current viewport). The Selector Toolbox will be replaced by the COP's toolbox.

3.3 WORKING WITH MULTIPLE VIEWPORTS

Halo's Viewer allows you to view multiple COPs at a time, making it easier to compare different stages of your network or different techniques. The Image Viewer and Graph Viewer can display up to 16 COPs at the same time (using a 4×4 viewport layout). The Timeline viewer can display any number of COPs.

DISPLAYING MULTIPLE COPS

To display more than one COP, each COP you want displayed needs to have its display flag on. Shift Left clicking the display flags on the will toggle the display flags without affecting other nodes.

In Timeline mode, you can also change the default behavior of showing the Displayed COPs. The "Show ...." icon menu in the top right of the viewer can be set to display all COPs in the Network, or all Timing related COPs (such as Generators or Timing COPs).

THE CURRENT VIEWPORT

The current viewport is the viewport outlined in green, with the node name displayed in green. The COP in the current viewport has its Parameter toolbox and PI buttons displayed. To select a new current viewport, move the mouse into a viewport and type X (the default hotkey).

In the Timeline viewer, there is only one viewport with multiple sequences displayed. To set the current sequence (which has the same effect as setting the current COP above), move the mouse over a sequence and type X (default hotkey).

SELECTED VIEWPORTS

Selected viewports have their node name displayed in yellow; non selected viewports' node names are gray. Selected viewports are affected by most of the viewer operations:

- Homing and adapting
- Plane selection
- Resolution reduction
- Color correction
- Channel selection
- Display item toggles (labels, guides, handles, previews)

By default, all the viewports are selected. Type V to toggle off selection off all viewports; only the current viewport will be selected and the above settings can be applied to only the current viewport. Press V to select all the viewports again.

In the Timeline viewer, only one viewport is available and it is always selected and current.

TEMPORARY VIEWPORT ZOOMING

Sometimes you need to see more of a certain viewport for a short time. Move the mouse into that viewport and type T (default hotkey) to zoom that viewport. All the

other viewports will be hidden and the zoomed viewport will fill the entire viewer. Type T to return to the split view.

This operation will make the zoomed viewport the current viewport.

3.4 NAVIGATING THE NETWORKS

Navigating back or forward in the network from the currently displayed COP can be done using hotkeys or by selecting one of the *Move To...* menu options in the Viewer Controls pulldown menu on the left side of the State toolbar.

COP Navigation	Default Hotkey
J or PgUp	Single channel 32bit integer
K or PgDn	Single channel 32bit float
Home	3 channel 32bit float
End	4 channel 32bit float
Shift PgUp	3 element array of 3 channel 32bit floats
Shift PgDn	4 element array of 4 channel 32bit floats

3.5 MODIFYING OPERATIONS

There are two ways to change the parameters of a displayed COP - through its handles or parameters. The operation toolbar provides a small subset of an operation's parameters above the viewports, while the handles appear directly on the displayed images.

USING THE TOOLBOX AND PARAMETERS DIALOG

Changing and animating parameters in the operation toolbox is exactly the same as in the normal Parameters dialog. The COP in the current viewport will have its toolbox parameters shown in the toolbox (type X in a viewport, or over a sequence in Timeline mode, to make it current).

For a more complete list of parameters, press 'p' to pop up a Parameter window.

USING HANDLES

Handles are drawn over the images (Image view), sequences (Timeline view) and graphs (Graph view). Any visible handles can be moved by left dragging it to a new location. Middle dragging ( ) a handle causes an XCF slider to pop up and affect that part of the handle. Right clicking ( ) on a handle pops up its handle menu.

Handles can be hidden by turning off the Handles display toggle on the Display bar to the right of the viewports. Selected handles can be hidden by toggling off their parent PI using the PI buttons on the Adapt bar to the left of the viewports.

The handle colour and rendering style can be changed in the *Handle* page of the Display Options (see *Display Options* p. 485).

4 HANDLES

4.1 MOUSE CONTROLS

Each handle responds in the same way to different mouse buttons:

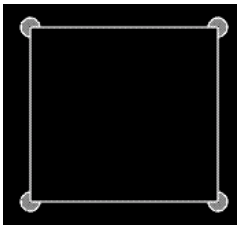
Drag	Moves the handle. Using Shift or Ctrl may produce different behaviours.
Drag	XCF slider to change value of that part of the handle.
Click	Handle menu.

All handles are animatable, except for Timeline handles, which represent times themselves. The handle menus contain many options for animation.

Each of the handle types is explained in detail, with its viewer type listed beside it.

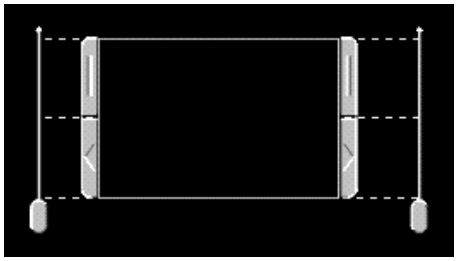
4.2 TYPES OF HANDLES

BOX HANDLE (IMAGE)



This handle defines a rectangular area. Left dragging a corner or edge moves that corner or edge. Shift Left dragging the box moves the entire handle without changing its shape. Ctrl Left dragging a corner or an edge moves that corner or edge and its opposite pair (in the opposite direction), uniformly scaling the box.

FRAME RANGE HANDLE (TIMELINE)



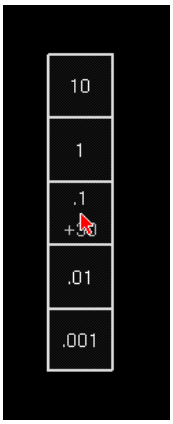
The frame range handle is available on all Generator COPs that do not have inputs.

The thick handles at the beginning and end of the sequence are used to change the start and length of the sequence. Dragging the top part of this handle (with the

| symbol) will shift the entire handle in time. Dragging the bottom part of the handle (with the < or > symbol) changes the start or end time.

The thin outer handles control the "Hold For N Frames" extend condition, and only appear if the Pre or Post Extend is set to "Hold for N Frames". Dragging these handles changes the number of frames the first or last frame is held for.

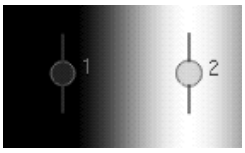
LADDER HANDLE (ALL VIEWERS)



The ladder handle is an invisible handle which is activated by left dragging on the background. Some COPs do not have a parameter tied to the ladder handle. The parameter tied to this handle is outlined in red in the Parameter dialog.

The ladder handle is an invisible handle which is activated by Shift-middle dragging (Shift) on the background. Some COPs do not have a parameter tied to the ladder handle. The parameter tied to this handle is outlined in red in the Parameter dialog.

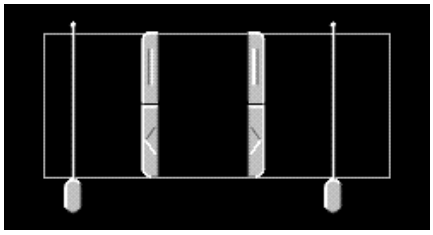
RAMP HANDLE (IMAGE)



The Ramp handles are used by the Ramp COP. Left clicking on a Ramp handle pops up a color picker for that handle. Left dragging the handle changes its position in the image. To add more Ramp handles, Shift Left click on the background where you want the new handle to appear.

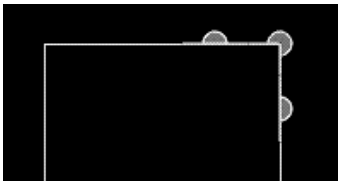
In the handle menu, the interpolation options for the ramp handle's segment can be selected, and the ramp handle can be removed.

RANGE HANDLE (TIMELINE)



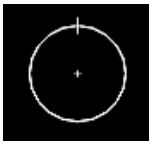
The range handle defines a range of frames, with optional dropoff regions before and after the range. It works in exactly the same way as the frame range handle (see: *Frame Range Handle (Timeline)* p. 527).

RESOLUTION HANDLE (IMAGE)



The resolution handle is available on all Generator COPs which do not have an input. It has three parts - the X control, the Y res control and the XY control (corner handle). Dragging the X or Y res control increases or decreases the resolution of the image in either X or Y. Dragging the XY control changes both. If you Shift Left drag any part of this handle, it will increase or decrease the resolution while maintaining the original aspect ratio.

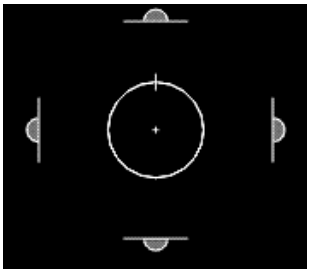
ROTATE HANDLE (IMAGE)



The rotate handle controls a single rotation value and a pivot location. The center of the handle always sits at the pivot location. To change the rotation, grab the circle at any point and left drag it to its new angle. To constrain to 45 degree increments, hold down Shift while dragging.

To change the pivot location, Ctrl+Left drag the rotate circle until its center is at the desired location.

SCALE HANDLE (IMAGE)



The scale handle consists of 4 parts, one pair of handles for each axis. Left dragging the horizontal axis scale handles will scale horizontally, while left dragging the vertical scale handles will do the same vertically. Shift+Left dragging any part of the handle will uniformly scale in bothX and Y.

SPLINE POINT HANDLE (IMAGE)

The Spline Point handle is used by rotospline and has many different parts.

The point itself is the large circle in the center of the spline point. Left dragging this point moves the handle. Left clicking this point "breaks" the continuity of the spline at that point by allowing the tangents to move independently - the point will change to a diamond to indicate this. Left clicking again will tie the tangents back together.

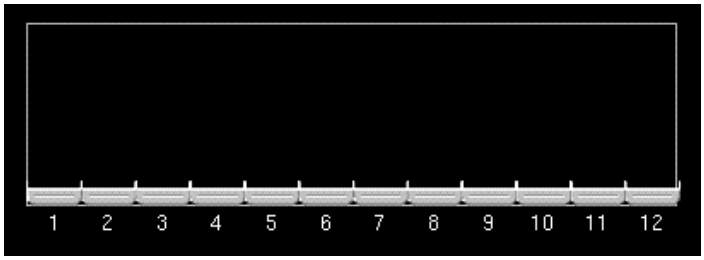
Each tangent has a pin handle, with a line and a end point. Left dragging the end point moves the end point, changing both the length and the angle of the tangent. Shift+Left dragging this point changes the length of the other tangent as well (and its angle, if the tangents are independent). Ctrl + Left (Ctrl + LMB) dragging this point only changes its length, leaving the angle untouched.

Left dragging (LMB) the line part of the tangent handle only changes its angle. Shift+Left (Shift + LMB) dragging the line changes the angle of the other tangent, if the tangents are independent.

SHIFT HANDLE (TIMELINE)

The shift handle is a simple handle used to shift a sequence in time. Left drag either part of the handle to move the sequence forward or backward in time.

SHUFFLE HANDLE (TIMELINE)



The shuffle handles are used by the Shuffle COP. Left dragging one of the frames' handle will move that frame forward or backward in time, shifting all the frames around it to fill the space left by the frame. Shift+Left dragging swaps the dragged frame with the frame it is dragged to. The number under the handle shows the original input frame number.

TRANSLATE (IMAGE)

The translate handle moves the image in X and Y. Left dragging the center circle moves freely in both directions, while left dragging any of the arrows moves only in that axis.

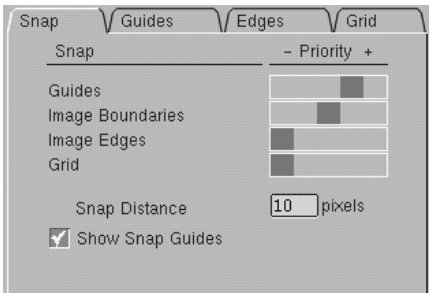
4.3 SNAPPING

Many of the Image handles are positional, so several snapping methods are provided to help make positioning these handles easier.

To turn snapping on, type Ctrl J (default hotkey) or click on the snap button on the left side of the State toolbar and select "Snap". To change the snap options, type Ctrl K (default hotkey) or use the snap button to select "Snap Options".

The snap options dialog contains four pages.

SNAP TYPES



The first page contains the snap types and their priorities:

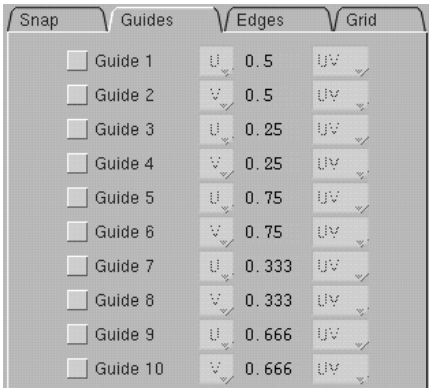
Guides	Snaps to user defined horizontal or vertical guides.
Image Boundaries	Snaps to the left, right, top and bottom sides of the image.
Image Edges	Snaps to edges that are detected in the image itself.
Grid	Snaps to a uniform grid.

If the priority is set to the lowest level (leftmost position on the slider), that type of snapping is disabled. Position snapping always snaps to the highest priority guide, edge or grid line if more than one area within snapping distance.

The *Snap Distance* determines how far away from a guide, grid line or image boundary the snap influence extends. Any handle closer than this distance to the snap line is immediately snapped to that line.

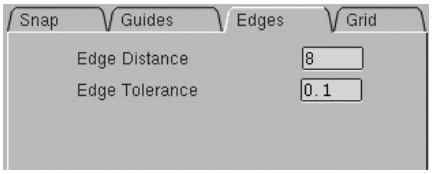
If Show Snap Guides is on, all images will be overlaid with the grid and guide lines.

GUIDES



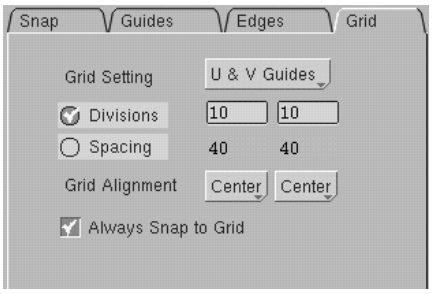
The next page contains all the user defined guides. Up to 10 are available. To add a guide, enable the toggle. Next, specify whether the guide is for horizontal (U) or vertical (V) snapping. The number field and the menu determine the location of the guide.

EDGES



The Edges page allows you to set the parameters for edge detection snapping. The Edge Distance parameter specifies the maximum distance that a point will snap to an image line. The Edge Tolerance parameter determines how much of a change in the image constitutes an edge. The default setting weeds out most image noise. Higher values (0.2, 0.3) will only cause snappingto very abrupt lines, while lower values (closer to 0) will snap to very faint lines.

GRIDS



The *Grid* page defines the structure of the snapping grid. The Grid Setting parameter allows you to choose a full grid (both U and V guides) or just U or V guides. The next parameter, the Divisions/Spacing parameter, sets the distance between each grid line (for both U and V). If Divisions is selected, the grid uses that number of guides. If Spacing is selected, a guide is placed every N pixels.

The Grid Alignment parameter shifts the grid to align with the left, right or center of the image (or for V guides, top, bottom or center).

If Always Snap to Grid is on, the Snap distance is ignored and the position will always be snapped to the nearest grid line(s). If off, the position must be within the Snap Distance of a grid line to snap.

4 COPs

1 BLEND COP

1.1 DESCRIPTION

This operations blends frames from two sequences together using a simple linear blend. An optional third sequence can be used to specify the blend factor on a per-pixel basis.

1.2 PARAMETERS – BLEND PAGE

BLEND METHOD

When a third input is not attached, a global blend is applied between the 2 inputs.

Use Blend Factor Out = (1-Blend) * Input1 + Blend * Input2

Use Blend Weights Out = Weight1 * Input1 + Weight2 * Input2

BLEND FACTOR

Globally blends between input one (0) and two (1).

INPUT 1 WEIGHT

If using blend weights, this specifies the factor to multiply input 1 by.

INPUT 2 WEIGHT

This specifies the factor to multiply input 2 by.

NORMALIZE WEIGHTS

If enabled, the weights will always be scaled to sum up to 1.

BLEND MASK

If a third input is used to control the blending, this menu selects the plane or component to use as the blend mask. Black is input 1, white is input 2.

INVERT BLEND MASK

If enabled, black is input 2, while white is input 1.

1.3 PARAMETERS – MERGE PAGE

These parameters specify how to build the output sequence when there are differences between the input sequences.

PLANE MERGE

If the planes in the inputs differ, this specifies what the output planes should be.

RASTER DEPTH

If the raster depth for a given plane differs between inputs, this specifies when the output raster depth for the plane should be.

FRAME RANGE

If the frame ranges of the inputs differ, this determines what the output range should be.

FRAME RATE

If the frame rates of the inputs differ, this determines what the output frame rate should be.

FRAME MATCH

If the frame rates of the inputs differ, this determines which input frame to pick when the cook time doesn't reside on a frame boundary.

1.4 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W, H	Width and height of image.
I	Image index (0 at start frame).
IT	Image time (0 at start frame).
AI	Current plane array index.
PI	Current plane index.
PC	Number of channels in current plane.

2 BLUR COP

Blurs an image.

2.1 PARAMETERS – BLUR PAGE

SIZE

Defines the diameter of the blur for both X and Y.

X/Y FILTER

Defines the blur kernel function.

ACCURATE MASK BLUR

If enabled, the mask affects the diameter of the blur at each pixel, rather than just blending the input with the output. This produces much more realistic blur transitions for greyscale masks, at a significant performance expense.

BLUR SIZE TOLERANCE

When doing accurate mask blurs, this specifies the kernel size tolerance. By default this is set to 0.1, so only kernels evenly divisible by 0.1 will be used. Higher values blur faster, but tend to introduce ringing artifacts. Set to zero for completely accurate blurs (very slow for floating point masks).

OPERATION MASK

Normally the mask is specified by the second input, however, you can also pick a mask from the first input as well.

INVERT MASK

If enabled, the operation mask is inverted before the operation is performed.

PLANE SCOPE

Selects the planes or components to modify.

2.2 PARAMETERS – FRAME SCOPE PAGE

Planes remain unaffected if they are not scoped. The Frame Scope page has parameters for modifying a subrange of the frame range. Frames and planes that are not scoped are passed through the COP without modification.

FRAME SCOPE

Applies the operation to only some frames in the sequence – either All, Inside Range, Outside Range, Even Frames, Odd Frames or Custom.

FRAME RANGE

Specifies the frame range for Inside/Outside Range.

FRAME DROPOFF

Defines transition ranges for before and after the range, which ramp from zero effect to full effect. This controls the amount of the operation applied.

NON-SCOPED EFFECT

Normally the effect on non-scoped frames is zero (bypass frame), but it can be set to non-zero values to produce a reduced or increased effect on non-scoped frames.

FRAME LIST

Allows manual scoping using frame patterns.

```
(e.g. "1 5 10", "[1-20]", "[1-20:2]", "[1-10] [40-50]" )
```

AUTOMATICALLY ADJUST FOR LENGTH CHANGES

If enabled, this will stretch or compress the frame ranges and transistion ranges if the sequence length grows or shrinks.

2.3 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W, H	Width and height of image.
I	Image index (0 at start frame).
IT	Image time (0 at start frame).
AI	Current plane array index.
PI	Current plane index.
PC	Number of channels in current plane.

3 BRIGHT COP

3.1 DESCRIPTION

Applies a brightness factor and bright shift to the first input. The pixels are multiplied first by the brightness factor, then the shift is added.

The second input is an optional mask for the operation. A mask is a single component of a plane which determines which areas of the image are affected by this operation. Where the mask is between zero and one, the input is blended with the output. White means full effect, black means no effect (though the mask can be inverted to reverse the effect).

This is a collapsable pixel operation. When placed in sequence with other collapsable pixel operations, the operations are combined into one operation at the final node in the sequence. This only quantizes the data once and allows the intermediate operations to produce and carry values outside the normal range of the pixels' data format, reducing quantization error and clipping.

3.2 PARAMETERS – BRIGHT PAGE

BRIGHTNESS

The brightness factor.

BRIGHT SHIFT

The bright shift to add.

use component controls

Allows you to affect each channel of a plane differently.
Incurs a small performance hit:

Red, Green, Blue Bright Shift
: The first field is the per-component Brightness, and the second field is the per-component Bright Shift.

Component 4
: The brightness is multiplied by the global brightness, and the shift is added to the global shift.

QUANTIZE

If this node is in the middle of a collapsable pixel chain, you can force this node to quantize and store the images as if it were the final node.

OPERATION MASK

Normally the mask is specified by the second input, however, you can also pick a mask from the first input as well.

INVERT MASK

If enabled, the operation mask is inverted before the operation is performed.

PLANE SCOPE

Selects the planes or components to modify.

3.3 PARAMETERS – FRAME SCOPE PAGE

Planes remain unaffected if they are not scoped. The Frame Scope page has parameters for modifying a subrange of the frame range. Frames and planes that are not scoped are passed through the COP without modification.

FRAME SCOPE

Applies the operation to only some frames in the sequence – either All, Inside Range, Outside Range, Even Frames, Odd Frames or Custom.

FRAME RANGE

Specifies the frame range for Inside/Outside Range.

FRAME DROPOFF

Defines transition ranges for before and after the range, which ramp from zero effect to full effect. This controls the amount of the operation applied.

NON-SCOPED EFFECT

Normally the effect on non-scoped frames is zero (bypass frame), but it can be set to non-zero values to produce a reduced or increased effect on non-scoped frames.

FRAME LIST

Allows manual scoping using frame patterns.

```
(e.g. "1 5 10", "[1–20]", "[1–20:2]", "[1–10] [40–50]" )
```

AUTOMATICALLY ADJUST FOR LENGTH CHANGES

If enabled, this will stretch or compress the frame ranges and transistion ranges if the sequence length grows or shrinks.

3.4 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W, H	Width and height of image.
I	Image index (0 at start frame).
IT	Image time (0 at start frame).
AI	Current plane array index.
PI	Current plane index.
PC	Number of channels in current plane.

4 BUMP COP

4.1 DESCRIPTION

Builds a bump map from a plane.

4.2 PARAMETERS – BUMP PAGE

BUMP

Determines what to generate the bump map from.

SCALE

Scales the bumps after generation.

SIMPLE BUMP MAP

If enabled, only 5 pixels are used to determine the bump map, otherwise all 8 neighbors plus the current pixel is used.

GENERATE BUMP MAP

If enabled, instead of converting planes to bump maps, a source plane is used and the output bump map is added to the plane list.

SOURCE PLANE

The plane to use as the bump source.

BUMP NAME

The name of the new bump plane.

PLANE SCOPE

Selects the planes or components to bump if 'Generate Bump Map' is off.

4.3 PARAMETERS – FRAME SCOPE PAGE

Planes remain unaffected if they are not scoped. The Frame Scope page has parameters for modifying a subrange of the frame range. Frames and planes that are not scoped are passed through the COP without modification.

FRAME SCOPE

Applies the operation to only some frames in the sequence – either All, Inside Range, Outside Range, Even Frames, Odd Frames or Custom.

FRAME RANGE

Specifies the frame range for Inside/Outside Range.

FRAME DROPOFF

Defines transition ranges for before and after the range, which ramp from zero effect to full effect. This controls the amount of the operation applied.

NON-SCOPED EFFECT

Normally the effect on non-scoped frames is zero (bypass frame), but it can be set to non-zero values to produce a reduced or increased effect on non-scoped frames.

FRAME LIST

Allows manual scoping using frame patterns.

```
(e.g. "1 5 10", "[1-20]", "[1-20:2]", "[1-10] [40-50]" )
```

AUTOMATICALLY ADJUST FOR LENGTH CHANGES

If enabled, this will stretch or compress the frame ranges and transistion ranges if the sequence length grows or shrinks.

4.4 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W, H	Width and height of image.
I	Image index (0 at start frame).
IT	Image time (0 at start frame).
AI	Current plane array index.
PI	Current plane index.
PC	Number of channels in current plane.

5 CHANNEL COPY COP

5.1 DESCRIPTION

This operation allows you to copy channels from the planes of two inputs into the output image. An entire vector plane can be copied to a single channel using any one of the standard mono operations.

For example, you can set the alpha channel of the output image to be equal the luminance of the color plane of the second input image by doing:

EXAMPLES

Target `[ A ]`

Source `[ Input B:C ] [ Luminance ]`

By default, all of the planes from the first input are passed through unchanged.

5.2 PARAMETERS

SOURCE/TARGET

Source is copied to Target.

5.3 LOCAL VARIABLES

There are no local variables.

5.4 SEE ALSO

- *Swap COP* p. 679

6 CHROMAKEY COP

This COP is used to mask or "key" an image based on its color. The colors keyed lie in the hue range, the saturation range and the luminance range specified. Each rolloff region extends one of the ranges with a soft rolloff function (linear, ease in, ease out, ease in ease out and gaussian).

The key plane is used to determine the areas of the image to mask. The mask is then applied to all scoped planes, including the key plane (if it is scoped). Normally this key plane is color. The color can be picked on the image by following the blue prompts.

Tip: The *Screenkey COP* p. 665 is better suited to blue and green screen removal.

6.1 PARAMETERS

HUE/SATURATION

The hue and saturation ranges of colors to key. The color wheel shows the key selection.

LUMINANCE

Defines the luminance range of the colors to key.

DISCARD KEYED REGION

If on, the keyed region is masked out (black). Otherwise the rest of the image is masked out.

HUE ROLLOFF

Specifies the sharpness of the hue cutoff. This extends the hue range on either side by the rolloff size.

SATURATION ROLLOFF

Specifies the sharpness of the saturation cutoff.

LUMINANCE ROLLOFF

Specifies the sharpness of the luminance cutoff.

ROLLOFF FUNCTION

Specifies the rolloff function of the rolloff regions.

SUPERSAMPLE

The number of subpixels sampled per pixel in one direction (2 samples 4 pixels, 3 samples 9). More subsamples produce finer edges, at the cost of performance.

KEY PLANE

Specifies the plane to key. All scoped planes will be masked based on the result of the Chromakey on this plane.

6.2 PARAMETERS – FRAME SCOPE PAGE

Planes remain unaffected if they are not scoped. The Frame Scope page has parameters for modifying a subrange of the frame range. Frames and planes that are not scoped are passed through the COP without modification.

FRAME SCOPE

Applies the operation to only some frames in the sequence – either All, Inside Range, Outside Range, Even Frames, Odd Frames or Custom.

FRAME RANGE

Specifies the frame range for Inside/Outside Range.

FRAME DROPOFF

Defines transition ranges for before and after the range, which ramp from zero effect to full effect. This controls the amount of the operation applied.

NON-SCOPED EFFECT

Normally the effect on non-scoped frames is zero (bypass frame), but it can be set to non-zero values to produce a reduced or increased effect on non-scoped frames.

FRAME LIST

Allows manual scoping using frame patterns.

```
(e.g. "1 5 10", "[1–20]", "[1–20:2]", "[1–10] [40–50]" )
```

AUTOMATICALLY ADJUST FOR LENGTH CHANGES

If enabled, this will stretch or compress the frame ranges and transistion ranges if the sequence length grows or shrinks.

6.3 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W, H	Width and height of image.
I	Image index (0 at start frame).
IT	Image time (0 at start frame).
AI	Current plane array index.
PI	Current plane index.
PC	Number of channels in current plane.

7 COLOR COP

7.1 DESCRIPTION

This COP creates a constant color image. If an input is attached, this COP will add a new plane to the sequence or modify an existing plane.

7.2 PARAMETERS – COLOR PAGE

COLOR

The color of the plane. The 4th component is interpreted as alpha (transparency) and will affect the alpha plane.

COMPONENT 4

The value of the 4th component, in the case where the plane is a 4 element vector.

7.3 PARAMETERS – IMAGE PAGE

SIZE

The resolution of the image.

ASPECT RATIO

The aspect ratio of the pixels in the image.

IMAGE PLANES

If there is no input attached, this menu allows you to quickly generate different types of planes.

ADD PLANE

If an input is attached, this menu allows you to choose which plane to generate, modify or replace.

CUSTOM PLANES

This string parm allows you to specify your own plane formats. The syntax is:

```
planename(arraysize){comp1,comp2,comp3,comp4}:format(black,white)
```

All parts are optional except for planename. arraysize is optional and must be 1 or greater. comp1-4 are arbitrary strings representing the component names. 'format' is

either i8, i16, i32 or f32. black and white are integers representing the black and white points for integer formats.

RASTER DEPTH

The depth of the planes generated.

BLACK/WHITE POINTS

Toggle on to specify black and white points.

INTERLACING

Allows you to generate interlaced images.

None	Normal image.
Line Doubled	Scanlines are doubled to fill the image.
Black Interlaced	Black scanlines are inserted.
Half Res Interlaced	Image is compressed vertically by 1/2.

The second menu controls the field dominance of the sequence.

7.4 PARAMETERS – SEQUENCE PAGE

SINGLE IMAGE

If enabled, there is only 1 image and it exists at all frames; the frame range and rate are not used.

START FRAME

The start of the sequence.

LENGTH

The length of the sequence.

FRAME RATE

The frame rate of the sequence – provides a manual override to the Houdini frame rate.

PRE/POST EXTEND

How the sequence behaves outside its frame range:

Black Frames	Frames are black (zero).

Cycle	The sequence is cycled, 1,2,3,4 / 1,2,3,4.
Mirror	The sequence is mirrored, 1,2,3,4 / 3,2,1.
Hold	The first/last frame is held forever.
Hold for N Frames	The first or last frame is held for some number of frames, before or after which black frames are used.

PRE/POST HOLD

If Extend is set to 'Hold for N Frames', this speficies the number of frames to hold for.

7.5 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W, H	Width and height of image.
I	Image index (0 at start frame).
IT	Image time (0 at start frame).
AI	Current plane array index.
PI	Current plane index.
PC	Number of channels in current plane.

8 COLOR REPLACE COP

8.1 DESCRIPTION

This COP is used to replace a color region in an image with another region. The color region is defined by the hue, saturation, and luminance ranges specified. Each of these ranges can be extended with a soft rolloff function. The new region is simply specified by a target color to which the center of the source region should map. The rest of the region is mapped to its corresponding position around the target color.

8.2 PARAMETERS

SOURCE HUE/SATURATION

The hue and saturation ranges of the source region to be mapped. The color wheel shows the key selection.

SOURCE LUMINANCE

The luminance range of the source region to be mapped.

TARGET COLOR

The color to which the center of the source region will map.

HUE ROLLOFF

Specifies the sharpness of the hue cutoff.
This extends the hue range on either side by the rolloff size.

SATURATION ROLLOFF

Specifies the sharpness of the saturation cutoff.

LUMINANCE ROLLOFF

Specifies the sharpness of the luminance cutoff.

ROLLOFF FUNCTION

Specifies the rolloff function of the rolloff regions.

OPERATION

Specifies exactly how the color replace is performed.

SUPERSAMPLE

The number of subpixels sampled per pixel in one direction (2 samples 4 pixels, 3 samples 9). More subsamples produce finer edges, at the cost of performance.

8.3 PARAMETERS – FRAME SCOPE PAGE

Planes remain unaffected if they are not scoped. The Frame Scope page has parameters for modifying a subrange of the frame range. Frames and planes that are not scoped are passed through the COP without modification.

FRAME SCOPE

Applies the operation to only some frames in the sequence – either All, Inside Range, Outside Range, Even Frames, Odd Frames or Custom.

FRAME RANGE

Specifies the frame range for Inside/Outside Range.

FRAME DROPOFF

Defines transition ranges for before and after the range, which ramp from zero effect to full effect. This controls the amount of the operation applied.

NON-SCOPED EFFECT

Normally the effect on non-scoped frames is zero (bypass frame), but it can be set to non-zero values to produce a reduced or increased effect on non-scoped frames.

FRAME LIST

Allows manual scoping using frame patterns.

```
(e.g. "1 5 10", "[1–20]", "[1–20:2]", "[1–10] [40–50]" )
```

AUTOMATICALLY ADJUST FOR LENGTH CHANGES

If enabled, this will stretch or compress the frame ranges and transistion ranges if the sequence length grows or shrinks.

8.4 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W, H	Width and height of image.
I	Image index (0 at start frame).
IT	Image time (0 at start frame).
AI	Current plane array index.
PI	Current plane index.
PC	Number of channels in current plane.

8.5 SEE ALSO

- Color Wheel COP
- *HSV COP* p. 614

9 COMPOSITE COP

9.1 DESCRIPTION

This operation does a composite (over, under, inside, add, etc) between two images. The first image is the foreground, which may be translated relative to the second input, the background. The size of the resulting image is the size of the background image. This COP supports multi-channel alpha (*A{r, g, b}*).

Tip: The Layer COP allows multiple inputs to be composited instead of just two.

9.2 PARAMETERS – COMPOSITE PAGE

OPERATION

Specifies the compositing operation:

Over	Places the foreground over the background.
Under	Places the foreground under the background's alpha.
Atop	Places the foreground over the background only where the background alpha exists.
Inside	Places the foreground inside the background's alpha.
Outside	Places the foreground outside the background's alpha.
Screen	Inverts both, multiplies, and inverts the product.
Add	Adds the foreground to the background.
Subtract	Subtracts the foreground from the background.
Diff	Takes the absolute difference between the foreground and the background.
Multiply	Multiplies the background by the foreground.
Minimum	Takes the minimum of the foreground and background.
Maximum	Takes the maximum of the foreground and background.
Average	Takes the average of the foreground and background.
Exclusive OR	Depending on the alpha – will show any area where one or the other exists, but will show nothing where both exist.

IMAGE UNITS

Determines if the Offset is in *Pixels* or *UV* units.

TRANSLATE / ROTATE / SCALE / PIVOT

Translates the foreground in X,Y relative to the background.

IMAGE FILTER

Specifies the filter to use when transforming.

IMAGE WRAP

The foreground image's wrapping style: *Repeat*, *Clamped*, *Black*, or *Mirror*.

MOTION BLUR

Enables motion blur, and specifies the time range around the current frame to blur.

motion frame bias

Shifts the time range for the blur.

motion blur segments

Number of samples to blur together in the specified time range.

9.3 PARAMETERS – MERGE PAGE

These parameters specify how to build the output sequence when there are differences between the input sequences.

PLANE MERGE

If the planes in the inputs differ, this specifies what the output planes should be.

RASTER DEPTH

If the raster depth for a given plane differs between inputs, this specifies when the output raster depth for the plane should be.

FRAME RANGE

If the input frame ranges differ, this determines what the output range should be.

FRAME RATE

If the frame rates of the inputs differ, this determines what the output frame rate should be.

FRAME MATCH

If the frame rates of the inputs differ, this determines which input frame to pick when the cook time doesn't reside on a frame boundary.

9.4 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W, H	Width and height of image.
I	Image index (0 at start frame).
IT	Image time (0 at start frame).
AI	Current plane array index.
PI	Current plane index.
PC	Number of channels in current plane.

10 CONTRAST COP

10.1 DESCRIPTION

This operation increases or decreases the contrast of an image.

The second input is an optional mask for the operation. A mask is a single component of a plane which determines which areas of the image are affected by this operation. Where the mask is between zero and one, the input is blended with the output. White means full effect, black means no effect (though the mask can be inverted to reverse the effect).

This is a collapsable pixel operation. When placed in sequence with other collapsable pixel operations, the operations are combined into one operation at the final node in the sequence. This only quantizes the data once and allows the intermediate operations to produce and carry values outside the normal range of the pixels' data format, reducing quantization error and clipping.

10.2 PARAMETERS – CONTRAST PAGE

RANGE / SCALE METHODS

The two methods attempt to be consistent with one another, however, the *Range* method can represent a wider variety of color transformations once the range moves outside 0 to 1. In this case, switching back to *Scale* may change the results.

Each method provides a global setting and a component setting. The global contrast is applied first, and then the component contrast. The contrast is still done in one pass.

range

Contrast is increased by narrowing the range, and decreased by widening it. This method maps black and white to the new range values.

scale

Contrast is determined by a contrast factor and center. Increasing the contrast parm increases overall contrast by scaling the range about the contrast center, normally 50% grey.

QUANTIZE

If this node is in the middle of a collapsable pixel chain, you can force this node to quantize and store the images as if it were the final node.

OPERATION MASK

Normally the mask is specified by the second input, however, you can also pick a mask from the first input as well.

INVERT MASK

If enabled, the operation mask is inverted before the operation is performed.

PLANE SCOPE

Selects the planes or components to modify.

10.3 PARAMETERS – FRAME SCOPE PAGE

Planes remain unaffected if they are not scoped. The Frame Scope page has parameters for modifying a subrange of the frame range. Frames and planes that are not scoped are passed through the COP without modification.

FRAME SCOPE

Applies the operation to only some frames in the sequence – either All, Inside Range, Outside Range, Even Frames, Odd Frames or Custom.

FRAME RANGE

Specifies the frame range for Inside/Outside Range.

FRAME DROPOFF

Defines transition ranges for before and after the range, which ramp from zero effect to full effect. This controls the amount of the operation applied.

NON-SCOPED EFFECT

Normally the effect on non-scoped frames is zero (bypass frame), but it can be set to non-zero values to produce a reduced or increased effect on non-scoped frames.

FRAME LIST

Allows manual scoping using frame patterns.

```
(e.g. "1 5 10", "[1–20]", "[1–20:2]", "[1–10] [40–50]" )
```

AUTOMATICALLY ADJUST FOR LENGTH CHANGES

If enabled, this will stretch or compress the frame ranges and transistion ranges if the sequence length grows or shrinks.

10.4 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W, H	Width and height of image.
I	Image index (0 at start frame).
IT	Image time (0 at start frame).
AI	Current plane array index.
PI	Current plane index.
PC	Number of channels in current plane.

11 CONVERT COP

11.1 DESCRIPTION

Changes the data format of a plane (i.e. how many bits per pixel you get)

11.2 PARAMETERS

RASTER DEPTH

Specifies the raster depth (8, 16, 32 bit integer or 32 bit float), and whether to use black and white points (for integer formats).

BLACK / WHITE POINTS

The black and white points for integer formats.

SCOPE

The planes to convert.

12 CONVOLVE COP

12.1 DESCRIPTION

This operation performs a generic convolve on the source image. The convolve kernel can be supplied as either the second input, or through the matrix parameters.

12.2 PARAMETERS

KERNEL SIZE

The size of the convolve kernel matrix to use.

-4..0..4

The rows of the kernel matrix. The matrix is always centered in the middle of the 9×9 set of parameters.

In the case of an even size, the matrix will extend further down, or to right.

KERNEL PLANE

Which plane of the second input to use as the kernel matrix.

NORMALIZE KERNEL

Scales each component of the kernel to ensure that the absolute value of the sum of the components is 1. Naturally, has no effect if the components sum to 0.

OPERATION MASK

Normally the mask is specified by the second input, however, you can also pick a mask from the first input as well.

INVERT MASK

If enabled, the operation mask is inverted before the operation is performed.

PLANE SCOPE

Selects the planes or components to modify.

12.3 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W, H	Width and height of image.
I	Image index (0 at start frame).
IT	Image time (0 at start frame).
AI	Current plane array index.
PI	Current plane index.
PC	Number of channels in current plane.

13 CORNER PIN COP

This operation allow you to fit an image into an arbitrary quadrilateral, which allows you to do simple perspective tricks, shearing and fitting.

Four points are used to pin the image and represent the different corners of the input image.

13.1 PARAMETERS

UNITS

Specifies the units of the point coordinates (UVs or Pixels) entered below.

BOTTOM LEFT / RIGHT / TOP LEFT / RIGHT

The four corners point of the image.

FILTER

The filter to use when scaling the image to fit the new area.

PLANE SCOPE

Selects the planes or components to modify.

13.2 PARAMETERS – FRAME SCOPE PAGE

Note: The frame can only be fully scoped or not.

FRAME SCOPE

Applies the operation to only some frames in the sequence – either All, Inside Range, Outside Range, Even Frames, Odd Frames or Custom.

FRAME RANGE

Specifies the frame range for Inside/Outside Range.

FRAME DROPOFF

Defines transition ranges for before and after the range, which ramp from zero effect to full effect. This controls the amount of the operation applied.

NON-SCOPED EFFECT

Normally the effect on non-scoped frames is zero (bypass frame), but it can be set to non-zero values to produce a reduced or increased effect on non-scoped frames.

FRAME LIST

Allows manual scoping using frame patterns.

(e.g. "1 5 10", "[1-20]", "[1-20:2]", "[1-10] [40-50]")

AUTOMATICALLY ADJUST

If enabled, this will stretch or compress the frame for Length Changes ranges and transistion ranges if the sequence length grows or shrinks.

13.3 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W, H	Width and height of image.
I	Image index (0 at start frame).
IT	Image time (0 at start frame).
AI	Current plane array index.
PI	Current plane index.
PC	Number of channels in current plane.

14 CROP COP

14.1 DESCRIPTION

This operation crops an image, reducing the resolution of the images.

14.2 PARAMETERS

UNITS

Specifies the units to crop in: pixels or UV.

HORIZONTAL CROP

The left/right crop values.

VERTICAL CROP

The bottom/top crop values.

15 DEFORM COP

15.1 DESCRIPTION

This operation deforms an image by moving the underlying UV coordinates. An input plane is used to define the deformation. This plane can define the deformation in several ways:

UV Map — The plane contains the UV coordinates of the input pixels. (Hint: Use a UV Map generator to create a base UV map to manipulate)

UV Shift — The plane contains per-pixel translations to apply to the image. Floating point deform plane or planes with negative values work best with this method.

UV Gradient — The plane is a 1 channel mask. Pixels are moved in the direction of the gradient (2D vector pointing in the direction of greatest value increase). (Hint: Try using a concentric ramp as a deform plane)

This operation can also be thought of as a per-pixel transform.

15.2 PARAMETERS

DEFORM PLANE

The input plane that describes the deformation.

Deform

The deform method to use (see above)

SCALE

The scale applied to the UV Shift or UV Gradient method transformations.

IMAGE WRAP

How UV coordinates above 1 or below 0 are wrapped back into the 0 to 1 range, if at all.

15.3 PARAMETERS – FRAME SCOPE PAGE

Planes remain unaffected if they are not scoped. The Frame Scope page has parameters for modifying a subrange of the frame range. Frames and planes that are not scoped are passed through the COP without modification.

FRAME SCOPE

Applies the operation to only some frames in the sequence – either All, Inside Range, Outside Range, Even Frames, Odd Frames or Custom.

FRAME RANGE

Specifies the frame range for Inside/Outside Range.

FRAME DROPOFF

Defines transition ranges for before and after the range, which ramp from zero effect to full effect. This controls the amount of the operation applied.

NON-SCOPED EFFECT

Normally the effect on non-scoped frames is zero (bypass frame), but it can be set to non-zero values to produce a reduced or increased effect on non-scoped frames.

FRAME LIST

Allows manual scoping using frame patterns.

```
(e.g. "1 5 10", "[1-20]", "[1-20:2]", "[1-10] [40-50]" )
```

AUTOMATICALLY ADJUST FOR LENGTH CHANGES

If enabled, this will stretch or compress the frame ranges and transistion ranges if the sequence length grows or shrinks.

15.4 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W, H	Width and height of image.
I	Image index (0 at start frame).
IT	Image time (0 at start frame).
AI	Current plane array index.
PI	Current plane index.
PC	Number of channels in current plane.

16 DELETE COP

16.1 DESCRIPTION

This operation removes planes or components from an input sequence. This operation does not use any cache memory; it simply acts as a selective bypass.

16.2 PARAMETERS

DELETE

Specifies whether to delete planes that were scoped or non-scoped.

PLANE SCOPE

The planes and/or components to delete or save.

17 DEPTH OF FIELD

17.1 DESCRIPTION

This operation creates a depth-of-field mask, which describes how out of focus parts of the image are. Combined with a Blur COP with the mask set to M and "Accurate Blur Mask" on, a depth-of-field blur can be done. This mask can also used as an input to color correction operations to accentuate an area of interest.

A point or depth plane must be present in order for this operation to produce valid results.

This operation is implemented in VEX.

17.2 PARAMETERS

FOCUS DISTANCE

The distance where everything is entirely in focus.

DISTANCE ADJUSTMENT

Adds a constant value to the distance (which is not the same as adjusting the focus distance, which adjusts the dropoff as well).

DEFAULT MASK VALUE

The mask value to use when a depth-of-field value cannot be computed.

OPERATION MASK

Not used.

INVERT MASK

Not used.

PLANE SCOPE

Not used.

FRAME SCOPE PAGE

Not used.

18 EDGE DETECT COP

18.1 DESCRIPTION

Detects the edges in the input image. The second input is an optional mask for the operation. A mask is a single component of a plane which determines which areas of the image are affected by this operation. Where the mask is between zero and one, the input is blended with the output. White means full effect, black means no effect (though the mask can be inverted to reverse the effect).

18.2 PARAMETERS – EDGE DETECT PAGE

TYPE

The edge detection method:

Prewitt	A 3×3 kernel detector.
Sobel	A 3×3 kernel detector with higher contrast.
Marr-Hildreth	A variable kernel detector. The remaining parameters control the behaviour of this detector.

SIZE

The detection radius of the Marr-Hildreth detector.

FEATURE SIZE

The feature size to detect (fraction of the detection radius).

NOISE THRESHOLD

The tolerance for edge noise. Values above zero start removing "noisy" edges.

OPERATION MASK

Normally the mask is specified by the second input, however, you can also pick a mask from the first input as well.

INVERT MASK

If enabled, the operation mask is inverted before the operation is performed.

PLANE SCOPE

Selects the planes or components to modify.

18.3 PARAMETERS – FRAME SCOPE PAGE

Planes remain unaffected if they are not scoped. The Frame Scope page has parameters for modifying a subrange of the frame range. Frames and planes that are not scoped are passed through the COP without modification.

FRAME SCOPE

Applies the operation to only some frames in the sequence – either All, Inside Range, Outside Range, Even Frames, Odd Frames or Custom.

FRAME RANGE

Specifies the frame range for Inside/Outside Range.

FRAME DROPOFF

Defines transition ranges for before and after the range, which ramp from zero effect to full effect. This controls the amount of the operation applied.

NON-SCOPED EFFECT

Normally the effect on non-scoped frames is zero (bypass frame), but it can be set to non-zero values to produce a reduced or increased effect on non-scoped frames.

FRAME LIST

Allows manual scoping using frame patterns.

```
(e.g. "1 5 10", "[1-20]", "[1-20:2]", "[1-10] [40-50]" )
```

AUTOMATICALLY ADJUST FOR LENGTH CHANGES

If enabled, this will stretch or compress the frame ranges and transistion ranges if the sequence length grows or shrinks.

18.4 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W, H	Width and height of image.
I	Image index (0 at start frame).
IT	Image time (0 at start frame).
AI	Current plane array index.
PI	Current plane index.
PC	Number of channels in current plane.

19 EQUALIZE COP

19.1 DESCRIPTION

This operation equalizes colors by stretching the image histogram. Several modes are available – selectable via the *Operation* menu.

The transform is either a shift or a scale, depending on the fit method.

19.2 PARAMETERS

OPERATION

The equalization operation to perform (see above).

Stretch Range to Black/White
: The minimum and maximum values found in the image are mapped to black and white, which may result in a contrast adjustment and a luminance shift.

Move Minimum Value to Black
: The values are transformed so that the minimum value maps to black.

Move Maximum Value to White
: The values are transformed so that the maximum value maps to white.

Shift Average Luminance
: The global luminance is computed and all values are transformed so that the global luminance matches the specified value.

Equalize Luminance Across Frames
: The global luminance is computed for several frames around the current frame. The current frame's global luminance is transformed to match the average global luminance, effectively removing frame flicker.

LUMINANCE

The method for computing luminance.

BLACK

What value 'black' is defined to be, normally zero.
(black & white are independent of black/white points)

WHITE

What value 'white' is defined to be, normally one.

AVERAGE LUMINANCE

The luminance to move the average luminance to.

FRAMES BEFORE

Number of frames before the current frame to analyze (for Equalize Luminance only).

FRAMES AFTER

Number of frames after the current frame to analyze.

EFFECT

The amount of effect equalize has on the image (0 is none, 1 is full effect).

OPERATION MASK

This operation is a scopable operation that may be masked.

Operation Masking is done with the use of a mask plane (typically M). A mask plane controls which areas of the image are affected by this operation. Where the mask is between 0 (black) and 1 (white), the input is blended with the output. White means full effect, black means no effect (though the mask can be inverted to reverse the effect).

The mask plane can 1 or 3 channels. A single channel mask plane affects all components, whereas a 3 channel mask plane affects each component separately. The mask may be in the first input's plane or attached as a second input.

operation mask

The mask is specified in the first input or the mask input. The mask plane can then be selected from this input's planes. If a component is selected, it is a single channel mask. If a multi-channel plane is selected, it acts a multi-channel mask.

invert mask

If enabled, the mask is inverted so that areas outside the mask are affected instead.

plane scope

Selects the planes or components to modify. If a plane is scoped, all of its components are. i.e.:

`C A`	Color and alpha are scoped.
`C.r A`	The red component of color and alpha are scoped.
`C.r C.g`	The red and green components of color are scoped.
`*`	All planes are scoped.

19.3 PARAMETERS – FRAME SCOPE PAGE

Planes remain unaffected if they are not scoped. The Frame Scope page has parameters for modifying a subrange of the frame range. Frames and planes that are not scoped are passed through the COP without modification.

FRAME SCOPE

Applies the operation to only some frames in the sequence – either All, Inside Range, Outside Range, Even Frames, Odd Frames or Custom.

FRAME RANGE

Specifies the frame range for Inside/Outside Range.

FRAME DROPOFF

Defines transition ranges for before and after the range, which ramp from zero effect to full effect. This controls the amount of the operation applied.

NON-SCOPED EFFECT

Normally the effect on non-scoped frames is zero (bypass frame), but it can be set to non-zero values to produce a reduced or increased effect on non-scoped frames.

FRAME LIST

Allows manual scoping using frame patterns.

```
(e.g. "1 5 10", "[1-20]", "[1-20:2]", "[1-10] [40-50]" )
```

AUTOMATICALLY ADJUST FOR LENGTH CHANGES

If enabled, this will stretch or compress the frame ranges and transistion ranges if the sequence length grows or shrinks.

19.4 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W, H	Width and height of image.
I	Image index (0 at start frame).
IT	Image time (0 at start frame).
AI	Current plane array index.
PI	Current plane index.
PC	Number of channels in current plane.

20 EXPAND COP

20.1 DESCRIPTION

This operation expands and shrinks mattes, as well as providing a non-destructive way of removing unwanted holes and specks from the matte.

Note: This can be a very slow operation for expansions larger than 10 pixels.

The second input is an optional mask for the operation. A mask is a single component of a plane which determines which areas of the image are affected by this operation. Where the mask is between zero and one, the input is blended with the output. White means full effect, black means no effect (though the mask can be inverted to reverse the effect).

20.2 PARAMETERS – EXPAND PAGE

OPERATION

The matte operation to perform:

Expand	Expands the matte outwards while preserving edges.
Shrink	Shrinks the matte inwards while preserving edges.
Fill Holes	Fills holes in the matte smaller than a specified size.
Remove Specks	Removes specks smaller than a specified size.

SIZE

The number of pixels to expand or shrink. For filling holes and removing specks, this is the rough diameter of the hole or speck.

DROPOFF

When expanding or shrinking, this adds a fuzzy edge to the resulting matte if non-zero. The fuzzy edge size is given in pixels.

DROPOFF FUNCTION

The dropoff function for the fuzzy matte edge.

HOLE THRESHOLD

An area is considered a "hole" if the matte intensity drops below this value.

SPECK THRESHOLD

An area is considered a "speck" if the matte intensity goes above this value.

SMOOTHNESS

For expanding and shrinking, this smooths out the edges by sampling more than one pixel along the edge. Practical values are 1-6, except for very large expansions, which may need more.

HIGH QUALITY

For expanding and shrinking, this uses a more accurate but slower algorithm. It removes artifacts in large expansions (>10).

OPERATION MASK

Normally the mask is specified by the second input, however, you can also pick a mask from the first input as well.

INVERT MASK

If enabled, the operation mask is inverted before the operation is performed.

PLANE SCOPE

Selects the planes or components to modify.

20.3 PARAMETERS – FRAME SCOPE PAGE

Planes remain unaffected if they are not scoped. The Frame Scope page has parameters for modifying a subrange of the frame range. Frames and planes that are not scoped are passed through the COP without modification.

FRAME SCOPE

Applies the operation to only some frames in the sequence – either All, Inside Range, Outside Range, Even Frames, Odd Frames or Custom.

FRAME RANGE

Specifies the frame range for Inside/Outside Range.

FRAME DROPOFF

Defines transition ranges for before and after the range, which ramp from zero effect to full effect. This controls the amount of the operation applied.

NON-SCOPED EFFECT

Normally the effect on non-scoped frames is zero (bypass frame), but it can be set to non-zero values to produce a reduced or increased effect on non-scoped frames.

FRAME LIST

Allows manual scoping using frame patterns.

```
(e.g. "1 5 10", "[1-20]", "[1-20:2]", "[1-10] [40-50]" )
```

AUTOMATICALLY ADJUST FOR LENGTH CHANGES

If enabled, this will stretch or compress the frame ranges and transistion ranges if the sequence length grows or shrinks.

20.4 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W, H	Width and height of image.
I	Image index (0 at start frame).
IT	Image time (0 at start frame).
AI	Current plane array index.
PI	Current plane index.
PC	Number of channels in current plane.

21 EXTEND COP

21.1 DESCRIPTION

This operation extends the length of a sequence so that it can be animated beyond its frame range. This operation can also be used to change the sequence's extend conditions.

Note: This operation does not use any cache memory.

21.2 PARAMETERS

EXTEND BEFORE/AFTER

The number of frames to extend before or after the sequence. The menu determine how the missing frames are filled in.

Black Frames	Black frames are used for the extended fraems.
Cycle	Frames are cycled from the sequence so the extended sequence appears cyclic.
Mirror	Frames are cycled in a mirrored fashion so the extended sequence cycles back and forth.
Hold	The first/last frame is held for the extended frames.

PRE/POST EXTEND

Changes the Pre or Post extend condition of the sequence.

PRE/POST HOLD

Changes the Pre or Post hold of the sequence when the new extend condition is 'Hold for N frames'.

22 FETCH COP

22.1 DESCRIPTION

This COP fetches a sequence of images from another COP, even in another COP-Net. None of the image data is actually stored at this node.

22.2 PARAMETERS

COP NETWORK / COP

The COPNet and COP to fetch from.

23 FIELD MERGE COP

23.1 DESCRIPTION

Merges two fields into one Interlaced Frame.

23.2 PARAMETERS

DETECT FIELD TYPE FROM INPUT

Attempts to determine the type of field (odd or even).

ODD LINES IN ODD FIELDS

Ensures that odd numbered lines (1, 3, 5, 7...) go into odd fields.

INTERLACE METHOD

Black or No Interlacing	Tells Field Merge to grab ever other scanline.
Half Res	Uses a half-res image to provide the lines for the merge (e.g. for a 100 line result, it will need a 50 line image).

24 FIELD SPLIT COP

24.1 DESCRIPTION

Splits an interlaced frame into two fields per frame (odd and even fields).

24.2 PARAMETERS

SPLIT

Frame to 2 Fields Splits an interlaced frame into 2 fields per frame.

Odd Fields Extracts just the odd fields.

Even Fields Extracts just the even fields.

ODD LINES IN ODD FIELDS

Ensures that odd numbered lines (1, 3, 5, 7...) go into odd fields.

INTERLACE METHOD

Black Interlaced Fields will be interlaced with black.

Half Res You'll get half the scanlines (thus consuming half the memory), but it doubles the aspect ratio to make the pixels taller. For example, a 100 line image will become 50 lines, but since the aspect ratio will be 2:1, it will appear as tall as the 100 line image.

Line Doubled Same as *Half Res*, but instead of changing the aspect ratio, two lines of pixels are used for each line.

25 FIELD SWAP COP

25.1 DESCRIPTION

This operation swaps the two fields containing the even and odd scanlines of the frame. If the sequence is interlaced or has already been interlaced with a Field Split operation, then it will just swap the frames representing even and odd scanlines. If the sequence is not interlaced, then the even and odd scanlines are swapped within a frame.

25.2 SEE ALSO

- *Field Merge COP* p. 579
- *Field Split COP* p. 580
- *Pulldown COP* p. 650
- *Pushup COP* p. 651

26 FILE COP

26.1 DESCRIPTION

This COP loads image files into Houdini. Files without numbers in the filename (i.e. *default.pic*) are interpreted as single images. Otherwise, the number in the filename is considered to be the frame number of the image.

For numbered files, the frame range is automatically computed by searching the directory where the files found. Missing frames will be replaced with black.

If you want to bring in a single still-frame image, see the *File Still COP* p. 585.

26.2 PARAMETERS – FILE PAGE

FILE

The path of the file(s) to load. The file is searched for using the HOUDINI_TEXTURE_PATH environment variable. Multiple files can be specified by including: $F, $I or * in the filename for frame numbers.

FILE SIZE

When enabled, it overrides the resolution of the file by the resolution specified here.

size / image filter

When the file size is overriden, this specifies the image filter to use when scaling.

ASPECT RATIO

Specifies the pixel aspect ratio for the image.

FLIP IMAGE

In case they're upside-down.

OVERRIDE FILE RASTER DEPTH

If enabled, the raster depth of the file is overriden by the depth specified below.

depth / black-white point

When *Override File Raster Depth* is on, these two parameters become enabled. They allow you to manually set the bit-depth (8, 16, 32 bit and floating point); and to manually specify a black and white point of the images being read in.

OVERRIDE FRAME RANGE

If off, the frame range is automatically determined by the lowest and highest frame numbers found in the files. Otherwise the Start and Length parameters on the Sequence page determine the frame range.

detect frame range

If *Override Frame Range* is enabled, you can do a one-time detect of the frame range of the seqeunce by clicking this button.

still image / start frame - length

If enabled, there is only 1 image and it exists at all frames; the frame range and rate are not used.

Check the *Still Image* button if there is only one image and it exists for all frames (the frame range and rate will not used). Otherwise, you can specify the *Start Frame* and *Length* in the fields provided.

MISSING FRAMES

If a frame is missing in the sequence, this specifies how to handle it (closest frame, next frame, use black).

26.3 PARAMETERS – CINEON PAGE

CONVERT FROM 10 BIT LOG

When enabled, Cineon files are converted from their native 10 bit log format to a linear color space that the compositor uses.

CINEON LUT

Specifies a LookUp Table (LUT) file which translates the cineon file's log space into linear color space.

CINEON WHITE POINT

The white point is the cineon number that represents 90% intensity, used in the Cineon log to linear conversion. This is not used if a LUT file is specified.

CINEON FILM GAMMA

The film gamma adjusts the gamma of the Cineon logarithmic curve, used in the Cineon log to linear conversion. This is not used if a LUT file is specified.

IMAGE WHITE POINT

Specifies the linear value that represents 100% intensity (white), used in the Cineon log to linear conversion. This is not used if a LUT file is specified.

26.4 PARAMETERS – SEQUENCE PAGE

FRAME RATE

The frame rate of the sequence.

PRE/POST EXTEND

How the sequence behaves outside its frame range:

Black Frames	Frames are black (zero).
Cycle	The sequence is cycled, 1,2,3,4 / 1,2,3,4.
Mirror	The sequence is mirrored, 1,2,3,4 / 3,2,1.
Hold	The first/last frame is held forever.
Hold for N Frames	The first or last frame is held for some number of frames, before or after which black frames are used.

PRE/POST HOLD

If Extend is set to *Hold for N Frames*, then this speficies the number of frames to hold for.

27 FILE STILL COP

27.1 DESCRIPTION

This COP loads a single image file. The image will be available at any frame in Houdini. If you want to load a sequence of images, use the *File COP* p. 582 instead.

27.2 PARAMETERS – FILE PAGE

FILE

The path of the file(s) to load. The file is searched for using the HOUDINI_TEXTURE_PATH environment variable. Multiple files can be specified by including: $F, $I or * in the filename for frame numbers.

FILE SIZE

When enabled, it overrides the resolution of the file by the resolution specified here.

size / image filter

When the file size is overriden, this specifies the image filter to use when scaling.

ASPECT RATIO

Specifies the pixel aspect ratio for the image.

FLIP IMAGE

In case they're upside-down.

OVERRIDE FILE RASTER DEPTH

If enabled, the raster depth of the file is overriden by the depth specified below.

depth / black-white point

When *Override File Raster Depth* is on, these two parameters become enabled. They allow you to manually set the bit-depth (8, 16, 32 bit and floating point); and to manually specify a black and white point of the images being read in.

27.3 PARAMETERS – CINEON PAGE

CONVERT FROM 10 BIT LOG

When enabled, Cineon files are converted from their native 10 bit log format to a linear color space that the compositor uses.

CINEON LUT

Specifies a LookUp Table (LUT) file which translates the cineon file's log space into linear color space.

CINEON WHITE POINT

The white point is the cineon number that represents 90% intensity, used in the Cineon log to linear conversion. This is not used if a LUT file is specified.

CINEON FILM GAMMA

The film gamma adjusts the gamma of the Cineon logarithmic curve, used in the Cineon log to linear conversion. This is not used if a LUT file is specified.

IMAGE WHITE POINT

Specifies the linear value that represents 100% intensity (white), used in the Cineon log to linear conversion. This is not used if a LUT file is specified.

28 FLIP COP

28.1 DESCRIPTION

This operation flips the image horizontally and/or vertically.

It can also be used to rotate the image 90º so its sideways.

28.2 PARAMETERS – FLIP PAGE

FLIP HORIZONTAL / VERTICALLY

Flips the image in the specified direction.

FLOP 90 DEGREES

Rotates the image by 90° onto its side.

PLANE SCOPE

Selects the planes and/or components to flip.

28.3 PARAMETERS – FRAME SCOPE PAGE

Planes remain unaffected if they are not scoped. The Frame Scope page has parameters for modifying a subrange of the frame range. Frames and planes that are not scoped are passed through the COP without modification.

FRAME SCOPE

Applies the operation to only some frames in the sequence – either All, Inside Range, Outside Range, Even Frames, Odd Frames or Custom.

FRAME RANGE

Specifies the frame range for Inside/Outside Range.

FRAME DROPOFF

Defines transition ranges for before and after the range, which ramp from zero effect to full effect. This controls the amount of the operation applied.

NON-SCOPED EFFECT

Normally the effect on non-scoped frames is zero (bypass frame), but it can be set to non-zero values to produce a reduced or increased effect on non-scoped frames.

FRAME LIST

Allows manual scoping using frame patterns.

(e.g. "1 5 10", "[1-20]", "[1-20:2]", "[1-10] [40-50]")

AUTOMATICALLY ADJUST FOR LENGTH CHANGES

If enabled, this will stretch or compress the frame ranges and transistion ranges if the sequence length grows or shrinks.

29 FONT COP

29.1 DESCRIPTION

The Font COP renders anti-aliased text. If an input is attached, this COP will add a new plane to the sequence or modify an existing plane.

Both Type 1 and True Type fonts can be used. The fonts available are searched for in the HOUDINI_OUTLINEFONT_PATH environment variable.

29.2 PARAMETERS – FONT PAGE

START FONT MANAGER

Launches the font manager, which can be used to add and remove fonts.

FONT

The font to use.

USE TEXT FILE

If enabled, the text is read from an ASCII file instead of the 'Text' parameter.

TEXT

The text to render.

TEXT FILE

The name of the text file(s).

TEXT LINE

When reading from a text file, this specifies the first line to start rendering.

LIMIT NUM LINES

If enabled, this limits the number of lines rendered (useful when specifying a text file).

TEXT SIZE

The size of the text.

KERNING

Increases or decreases the horizontal and vertical spacing (i.e. 'Leading') between characters and lines.

ITALIC

The italic angle.

Note: This is not a true *Italic* version of the font, just the font made Obilque.

ANTIALIAS

The render antialias level from 1x1 (none) to 8x8 (highest).

FONT DETAIL

The level of detail to use when converting the font to polygons to be rendered.

29.3 PARAMETERS – LAYOUT PAGE

JUSTIFY

How to orient the text around the text position.

UNITS

Specifies the units that the Translate and Pivot parameters are in (0-1 UVs, or 0-XRES pixels).

TRANSLATE

Translation of the text.

SCALE

Scale of the text.

ROTATE

Rotation of the text.

PIVOT

Pivot location for Scale and Rotate.

COLOR

The color of the text.

29.4 PARAMETERS – IMAGE PAGE

SIZE

The resolution of the image.

ASPECT RATIO

The ratio of width to height for the image.

IMAGE PLANES

If there is no input attached, this menu allows you to quickly generate different types of planes.

ADD PLANE

If an input is attached, this menu allows you to choose which plane to generate, modify or replace.

CUSTOM PLANES

This string parm allows you to specify your own plane formats. The syntax is:

```
planename(arraysize){comp1,comp2,comp3,comp4}:format(black,white)
```

All parts are optional except for planename. arraysize is optional and must be 1 or greater. comp1-4 are arbitrary strings representing the component names. 'format' is either i8, i16, i32 or f32. black and white are integers representing the black and white points for integer formats.

RASTER DEPTH

The depth of the planes generated.

BLACK/WHITE POINTS

Toggle on to specify black and white points.

INTERLACING

Allows you to generate interlaced images.

None	Normal image.
Half Res Interlaced	Image is compressed vertically by 1/2 by using only every other scanline (but double the aspect ratio).
Black Interlaced	Black scanlines are inserted.
Line Doubled	Same as *Half Res*, but instead of changing the aspect ratio, two lines of pixels are used for each line.

The second menu controls the field dominance of the sequence.

29.5 PARAMETERS – SEQUENCE PAGE

SINGLE IMAGE

If enabled, there is only 1 image and it exists at all frames; the frame range and rate are not used.

START FRAME

The start of the sequence.

LENGTH

The length of the sequence.

frame rate

Enable the toggle to set the frame rate of the sequence.

PRE/POST EXTEND

How the sequence behaves outside its frame range:

Black Frames	Frames are black (zero).
Cycle	The sequence is cycled, 1,2,3,4 / 1,2,3,4.
Mirror	The sequence is mirrored, 1,2,3,4 / 3,2,1.
Hold	The first/last frame is held forever.
Hold for N Frames	The first or last frame is held for some number of frames, before or after which black frames are used.

PRE/POST HOLD

If Extend is set to 'Hold for N Frames', then this parameter speficies the number of frames to hold for.

29.6 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W, H	Width and height of image.
I	Image index (0 at start frame).
IT	Image time (0 at start frame).
AI	Current plane array index.
PI	Current plane index.
PC	Number of channels in current plane.

30 FOG COP

DESCRIPTION

This operator adds a variety of atmospheric effects to an image, including fog, haze and heat waves. A point or depth plane is required.

30.1 PARAMETERS – FOG PAGE

FOG TYPE

The atmospheric effect. (see above)

FOG DENSITY

How quickly the atmospheric effect is applied. For each unit, this amount is applied.

FOG COLOR

The color of the fog for fog effects.

DISTANCE OFFSET

A constant value added to the per-pixel distance.

FOG DIRECTION

The direction the distance is computed in.

OPERATION MASK

This operation is a scopable operation that may be masked.

Operation Masking is done with the use of a mask plane (typically M). A mask plane controls which areas of the image are affected by this operation. Where the mask is between 0 (black) and 1 (white), the input is blended with the output. White means full effect, black means no effect (though the mask can be inverted to reverse the effect).

The mask plane can 1 or 3 channels. A single channel mask plane affects all components, whereas a 3 channel mask plane affects each component separately. The mask may be in the first input's plane or attached as a second input.

operation mask

The mask is specified in the first input or the mask input. The mask plane can then be selected from this input's planes. If a component is selected, it is a single channel mask. If a multi-channel plane is selected, it acts a multi-channel mask.

invert mask

If enabled, the mask is inverted so that areas outside the mask are affected instead.

plane scope

Selects the planes or components to modify. If a plane is scoped, all of its components are. i.e.:

`C A`	Color and alpha are scoped.
`C.r A`	The red component of color and alpha are scoped.
`C.r C.g`	The red and green components of color are scoped.
`*`	All planes are scoped.

30.2 PARAMETERS – HEAT PAGE

SMOOTHNESS

The number of samples taken from the image. '1' produces a grainy effect, while higher values produce a blurry effect.

HORIZONTAL SCALE

How much horizontal deviation the heat waves cause.

VERTICAL SCALE

How much vertical deviation the heat waves cause.

TIME SCALE

How quickly the heat waves change.

NOISE OFFSET

The 3D noise offset for the heat waves. Animate the 'Y' parameter with $F to see rising heat waves.

30.3 PARAMETERS – LAYER PAGE

LAYERED

Turns layered fog on, with the fog appearing in the specified area.

LAYER EDGE

Where the fog begins to falloff to zero.

LAYER FALLOFF

The size of the falloff region.

FALLOFF FUNCTION

The interpolation of the falloff region.

30.4 PARAMETERS – NOISE PAGE

USE FOG NOISE

If on, the fog is not uniform. This takes quite a bit longer to compute.

NOISE PARAMETERS

The standard parameters for sparse noise.

NOISE STEP

How often the noise is sampled along the way to the final point.

30.5 PARAMETERS – FRAME SCOPE PAGE

Planes remain unaffected if they are not scoped. The Frame Scope page has parameters for modifying a subrange of the frame range. Frames and planes that are not scoped are passed through the COP without modification.

FRAME SCOPE

Applies the operation to only some frames in the sequence – either All, Inside Range, Outside Range, Even Frames, Odd Frames or Custom.

FRAME RANGE

Specifies the frame range for Inside/Outside Range.

FRAME DROPOFF

Defines transition ranges for before and after the range, which ramp from zero effect to full effect. This controls the amount of the operation applied.

NON-SCOPED EFFECT

Normally the effect on non-scoped frames is zero (bypass frame), but it can be set to non-zero values to produce a reduced or increased effect on non-scoped frames.

FRAME LIST

Allows manual scoping using frame patterns.

(e.g. "1 5 10", "[1-20]", "[1-20:2]", "[1-10] [40-50]")

AUTOMATICALLY ADJUST FOR LENGTH CHANGES

If enabled, this will stretch or compress the frame ranges and transistion ranges if the sequence length grows or shrinks.

30.6 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W, H	Width and height of image.
I	Image index (0 at start frame).
IT	Image time (0 at start frame).
AI	Current plane array index.
PI	Current plane index.
PC	Number of channels in current plane.

31 FUNCTION COP

31.1 DESCRIPTION

This operation performs a variety of mathematical functions on the input image.

The second input is an optional mask for the operation. A mask is a single component of a plane which determines which areas of the image are affected by this operation. Where the mask is between zero and one, the input is blended with the output. White means full effect, black means no effect (though the mask can be inverted to reverse this).

This is a collapsable pixel operation. When placed in sequence with other collapsable pixel operations, the operations are combined into one operation at the final node in the sequence. This only quantizes the data once and allows the intermediate operations to produce and carry values outside the normal range of the pixels' data format, reducing quantization error and clipping.

31.2 PARAMETERS – FUNCTION PAGE

FUNCTION

The math function to perform.

BASE

The base for *LogX* and *B^x* .

EXPONENT

The exponent for *x^E* .

ERROR HANDLING

If a math error occurs, the value causing the error can be replaced with an 'error' value, or kept as is.

ERROR VALUE

The value to replace errors with.

QUANTIZE

If this node is in the middle of a collapsable pixel chain, you can force this node to quantize and store the images as if it were the final node.

OPERATION MASK

Normally the mask is specified by the second input, however, you can also pick a mask from the first input as well.

INVERT MASK

If enabled, the operation mask is inverted before the operation is performed.

PLANE SCOPE

Selects the planes or components to modify.

31.3 PARAMETERS – FRAME SCOPE PAGE

Planes remain unaffected if they are not scoped. The Frame Scope page has parameters for modifying a subrange of the frame range. Frames and planes that are not scoped are passed through the COP without modification.

FRAME SCOPE

Applies the operation to only some frames in the sequence – either All, Inside Range, Outside Range, Even Frames, Odd Frames or Custom.

FRAME RANGE

Specifies the frame range for Inside/Outside Range.

FRAME DROPOFF

Defines transition ranges for before and after the range, which ramp from zero effect to full effect. This controls the amount of the operation applied.

NON-SCOPED EFFECT

Normally the effect on non-scoped frames is zero (bypass frame), but it can be set to non-zero values to produce a reduced or increased effect on non-scoped frames.

FRAME LIST

Allows manual scoping using frame patterns.

```
(e.g. "1 5 10", "[1–20]", "[1–20:2]", "[1–10] [40–50]" )
```

AUTOMATICALLY ADJUST FOR LENGTH CHANGES

If enabled, this will stretch or compress the frame ranges and transistion ranges if the sequence length grows or shrinks.

31.4 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W, H	Width and height of image.
I	Image index (0 at start frame).
IT	Image time (0 at start frame).
AI	Current plane array index.
PI	Current plane index.
PC	Number of channels in current plane.

32 GAMMA COP

32.1 DESCRIPTION

This operation applies gamma correction to the image.

The second input is an optional mask for the operation. A mask is a single component of a plane which determines which areas of the image are affected by this operation. Where the mask is between zero and one, the input is blended with the output. White means full effect, black means no effect (though the mask can be inverted to reverse the effect).

This is a collapsable pixel operation. When placed in sequence with other collapsable pixel operations, the operations are combined into one operation at the final node in the sequence. This only quantizes the data once and allows the intermediate operations to produce and carry values outside the normal range of the pixels' data format, reducing quantization error and clipping.

32.2 PARAMETERS – GAMMA PAGE

GAMMA

The gamma to apply to the image.

USE COMPONENT COTROLS

Allows you to affect each channel of a plane individually.
Incurs a small performance hit.

RED / GREEN / BLUE / COMPONENT-4

The per-component gamma. The global gamma is multiplied by the component gamma to get the final gamma value.

QUANTIZE

If this node is in the middle of a collapsable pixel chain, you can force this node to quantize and store the images as if it were the final node.

OPERATION MASK

Normally the mask is specified by the second input, however, you can also pick a mask from the first input as well.

INVERT MASK

If enabled, the operation mask is inverted before the operation is performed.

PLANE SCOPE

Selects the planes or components to modify.

32.3 PARAMETERS – FRAME SCOPE PAGE

Planes remain unaffected if they are not scoped. The Frame Scope page has parameters for modifying a subrange of the frame range. Frames and planes that are not scoped are passed through the COP without modification.

FRAME SCOPE

Applies the operation to only some frames in the sequence – either All, Inside Range, Outside Range, Even Frames, Odd Frames or Custom.

FRAME RANGE

Specifies the frame range for Inside/Outside Range.

FRAME DROPOFF

Defines transition ranges for before and after the range, which ramp from zero effect to full effect. This controls the amount of the operation applied.

NON-SCOPED EFFECT

Normally the effect on non-scoped frames is zero (bypass frame), but it can be set to non-zero values to produce a reduced or increased effect on non-scoped frames.

FRAME LIST

Allows manual scoping using frame patterns.

```
(e.g. "1 5 10", "[1-20]", "[1-20:2]", "[1-10] [40-50]" )
```

AUTOMATICALLY ADJUST FOR LENGTH CHANGES

If enabled, this will stretch or compress the frame ranges and transistion ranges if the sequence length grows or shrinks.

32.4 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W, H	Width and height of image.
I	Image index (0 at start frame).
IT	Image time (0 at start frame).
AI	Current plane array index.
PI	Current plane index.
PC	Number of channels in current plane.

33 GEOKEY COP

33.1 DESCRIPTION

This operation keys out parts of the image based on point position, normal direction or both. A point plane and/or a normal are needed to perform this operation. This operation is implemented in VEX.

Geokey can simulate lighting from point lights and infinite sources by generating masks that can be used by colour correction COPs, like the Bright COP.

33.2 PARAMETERS – GEOKEY PAGE

KEY OPERATION

Distance from Point — All pixels within a certain distance of a specified point are keyed (Point plane required).

Normal Direction — All pixels with normals pointing in the same direction as the specified normal are keyed (Normal plane required).

Angle from Point — All pixels with normals pointing at the specified point are keyed (Point and normal planes required).

Distance & Angle From Point — All pixels with normals pointing at the specified point, within a certain distance are keyed (Point and Normal planes required).

Clip Plane — All pixels on one side of the clip plane are keyed (Point plane required).

POINT ORIGIN

A point to key from.

POINT DISTANCE

The distance from the point at which to stop keying.

DISTANCE DROPOFF

The size of the dropoff region after the distance radius.

NORMAL DIRECTION

The normal direction to key from.

NORMAL DEVIATION

The amount of degrees that a normal can deviate from the specified normal before being rejected.

NORMAL DROPOFF

The amount of degrees of dropoff after the normal deviation.

CLIPPING PLANE

The orientation of the clip plane.

CLIP PLANE NORMAL

The normal of the user-defined clip plane.

CLIP PLANE ORIGIN

Translates the clip plane.

ROLLOFF

The rolloff function for the dropoff regions.

SUPERSAMPLE

The number of subpixels sampled per pixel in one direction (2 samples 4 pixels, 3 samples 9). More subsamples produce finer edges, at the cost of performance.

DISCARD KEYED REGION

If enabled, the keyed region is discarded.

OPERATION MASK

Normally the mask is specified by the second input, however, you can also pick a mask from the first input as well.

INVERT MASK

If enabled, the operation mask is inverted before the operation is performed.

PLANE SCOPE

Selects the planes or components to modify.

33.3 PARAMETERS – FRAME SCOPE PAGE

Planes remain unaffected if they are not scoped. The Frame Scope page has parameters for modifying a subrange of the frame range. Frames and planes that are not scoped are passed through the COP without modification.

FRAME SCOPE

Applies the operation to only some frames in the sequence – either All, Inside Range, Outside Range, Even Frames, Odd Frames or Custom.

FRAME RANGE

Specifies the frame range for Inside/Outside Range.

FRAME DROPOFF

Defines transition ranges for before and after the range, which ramp from zero effect to full effect. This controls the amount of the operation applied.

NON-SCOPED EFFECT

Normally the effect on non-scoped frames is zero (bypass frame), but it can be set to non-zero values to produce a reduced or increased effect on non-scoped frames.

FRAME LIST

Allows manual scoping using frame patterns.

```
(e.g. "1 5 10", "[1-20]", "[1-20:2]", "[1-10] [40-50]" )
```

AUTOMATICALLY ADJUST FOR LENGTH CHANGES

If enabled, this will stretch or compress the frame ranges and transistion ranges if the sequence length grows or shrinks.

33.4 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W, H	Width and height of image.
I	Image index (0 at start frame).
IT	Image time (0 at start frame).
AI	Current plane array index.
PI	Current plane index.
PC	Number of channels in current plane.

34 GEOMETRY COP

34.1 DESCRIPTION

This COP renders geometry from a SOP as a single color image. The geometry is converted to polygons for rendering. An orthographic projection is used.

If an input is attached, this COP will add a new plane to the sequence or modify an existing plane.

34.2 PARAMETERS – GEOMETRY PAGE

OBJECT / SOP

The Object and SOP to fetch the geometry from.

VIEW DOWN AXIS

The axis the implicit orthographic camera is looking down.

FIT GEOMETRY TO IMAGE

If enabled, the geometry is automatically scaled to entirely fit within the image.

PRESERVE ASPECT RATIO WHEN FILTERING

If enabled, the 1:1 X:Y aspect ratio will be maintained when the geometry is fitted to the image.

CONVERT DETAIL

The level of detail that is used in the conversion of the geometry to polygons before rendering.

ANTI ALIAS

The antialias level, from 1×1 (none) to 8×8 (highest).

FILL COLOR

The color to apply to the rendered image.

34.3 PARAMETERS – TRANSFORM PAGE

These parameters allow you to apply a 3D transformation to the geometry before rendering.

34.4 PARAMETERS – IMAGE PAGE

SIZE

The resolution of the image.

ASPECT RATIO

The ratio of width to height of the image.

IMAGE PLANES

If there is no input attached, this menu allows you to quickly generate different types of planes.

ADD PLANE

If an input is attached, this menu allows you to choose which plane to generate, modify or replace.

CUSTOM PLANES

This string parm allows you to specify your own plane formats. The syntax is:

```
planename(arraysize){comp1,comp2,comp3,comp4}:format(black,white)
```

All parts are optional except for planename. arraysize is optional and must be 1 or greater. comp1-4 are arbitrary strings representing the component names. 'format' is either i8, i16, i32 or f32. black and white are integers representing the black and white points for integer formats.

RASTER DEPTH

The depth of the planes generated.

BLACK/WHITE POINTS

Toggle on to specify black and white points.

INTERLACING

Allows you to generate interlaced images.

None	Normal image.
Black Interlaced	Black scanlines are inserted.
Half Res Interlaced	Image is compressed vertically by 1/2.
Line Doubled	Same as Half Res, only two lines are used for each halved scanline.

The second menu controls the field dominance of the sequence.

34.5 PARAMETERS – SEQUENCE PAGE

SINGLE IMAGE

If enabled, there is only 1 image and it exists at all frames; the frame range and rate are not used.

START FRAME

The start of the sequence.

LENGTH

The length of the sequence.

FRAME RATE

The frame rate of the sequence.

PRE/POST EXTEND

How the sequence behaves outside its frame range:

Black Frames	Frames are black (zero).
Cycle	The sequence is cycled, 1,2,3,4 / 1,2,3,4.
Mirror	The sequence is mirrored, 1,2,3,4 / 3,2,1.
Hold	The first/last frame is held forever.
Hold for N Frames	The first or last frame is held for some number of frames, before or after which black frames are used.

PRE/POST HOLD

If Extend is set to 'Hold for N Frames', this speficies the number of frames to hold for.

34.6 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W, H	Width and height of image.
I	Image index (0 at start frame).
IT	Image time (0 at start frame).
AI	Current plane array index.
PI	Current plane index.
PC	Number of channels in current plane.

35 GRADIENT COP

This operation does a variety of gradient related effects.

35.1 PARAMETERS

GRADIENT TYPE

The channel used to compute the gradient.

OUTPUT

The type of output produce:

UV Gradient — Computes the UV gradient of the image, which is a 2D vector which points in the direction of greatest luminance increase. The magnitude of the vector is the increase amount. Similar to the results produced by the Bump COP.

Normal Map — Computes a normal map from the gradient. The normal and the gradient are similar - the normal is a normalized 3D vector with the Z component set to 1 and X & Y set to the U & V values of the gradient.

Gradient Magnitude — Computes the gradient magnitude, which appears as a luminance edge-detected image.

Thresholded Magnitude — Computes the gradient magnitude and only accepts values between the low and high threshold values. If normalize is on, the values are mapped from low - high to 0 - 1.

LOW/HIGH THRESHOLD

The low and high thresholds for thresholded magnitude output.

NORMALIZE

If UV Gradient output is used, this normalizes the gradient's magnitudes to 1. If Thresholded Magnitude is used, this maps the low to high range to 0 - 1.

OPERATION MASK

This operation is a scopable operation that may be masked.

Operation Masking is done with the use of a mask plane (typically M). A mask plane controls which areas of the image are affected by this operation. Where the mask is between 0 (black) and 1 (white), the input is blended with the output. White

means full effect, black means no effect (though the mask can be inverted to reverse the effect).

The mask plane can 1 or 3 channels. A single channel mask plane affects all components, whereas a 3 channel mask plane affects each component separately. The mask may be in the first input's plane or attached as a second input.

operation mask

The mask is specified in the first input or the mask input. The mask plane can then be selected from this input's planes. If a component is selected, it is a single channel mask. If a multi-channel plane is selected, it acts a multi-channel mask.

invert mask

If enabled, the mask is inverted so that areas outside the mask are affected instead.

plane scope

Selects the planes or components to modify. If a plane is scoped, all of its components are. i.e.:

`C A`	Color and alpha are scoped.
`C.r A`	The red component of color and alpha are scoped.
`C.r C.g`	The red and green components of color are scoped.
`*`	All planes are scoped.

35.2 PARAMETERS – FRAME SCOPE PAGE

Planes remain unaffected if they are not scoped. The Frame Scope page has parameters for modifying a subrange of the frame range. Frames and planes that are not scoped are passed through the COP without modification.

FRAME SCOPE

Applies the operation to only some frames in the sequence – either All, Inside Range, Outside Range, Even Frames, Odd Frames or Custom.

FRAME RANGE

Specifies the frame range for Inside/Outside Range.

FRAME DROPOFF

Defines transition ranges for before and after the range, which ramp from zero effect to full effect. This controls the amount of the operation applied.

NON-SCOPED EFFECT

Normally the effect on non-scoped frames is zero (bypass frame), but it can be set to non-zero values to produce a reduced or increased effect on non-scoped frames.

FRAME LIST

Allows manual scoping using frame patterns.

(e.g. "1 5 10", "[1-20]", "[1-20:2]", "[1-10] [40-50]")

AUTOMATICALLY ADJUST FOR LENGTH CHANGES

If enabled, this will stretch or compress the frame ranges and transistion ranges if the sequence length grows or shrinks.

35.3 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W, H	Width and height of image.
I	Image index (0 at start frame).
IT	Image time (0 at start frame).
AI	Current plane array index.
PI	Current plane index.
PC	Number of channels in current plane.

36 HSV COP

36.1 DESCRIPTION

This operation converts between RGB and HSV color spaces, and also performs a variety of HSV operations (hue shifts, saturation reduction, etc).

The second input is an optional mask for the operation. A mask is a single component of a plane which determines which areas of the image are affected by this operation. Where the mask is between zero and one, the input is blended with the output. White means full effect, black means no effect (though the mask can be inverted to reverse the effect).

This is a collapsable pixel operation. When placed in sequence with other collapsable pixel operations, the operations are combined into one operation at the final node in the sequence. This only quantizes the data once and allows the intermediate operations to produce and carry values outside the normal range of the pixels' data format, reducing quantization error and clipping.

36.2 PARAMETERS – HSV PAGE

OPERATION

The operation to perform, either HSV Adjust, Convert RGB to HSV or HSV to RGB.

HUE SHIFT

Shifts the Hue by degrees around the HSV cone.

MAINTAIN LUMINANCE DURING HUE SHIFT

Maintains the perceptual luminance of the pixel when hues shift since some hues appear brighter than others.

SATURATION SCALE AND SHIFT

Scales and/or shifts the saturation. Normal saturation values lie between 0 and 1.

VALUE SCALE/SHIFT

Scales and/or shifts the value. Normal values lie between 0 and 1.

QUANTIZE

If this node is in the middle of a collapsable pixel chain, you can force this node to quantize and store the images as if it were the final node.

OPERATION MASK

Normally the mask is specified by the second input. However, you can also pick a mask from the first input as well.

INVERT MASK

If on, the operation mask is inverted before the operation is performed.

PLANE SCOPE

Selects the planes or components to modify.

36.3 PARAMETERS – FRAME SCOPE PAGE

Planes remain unaffected if they are not scoped. The Frame Scope page has parameters for modifying a subrange of the frame range. Frames and planes that are not scoped are passed through the COP without modification.

FRAME SCOPE

Applies the operation to only some frames in the sequence – either All, Inside Range, Outside Range, Even Frames, Odd Frames or Custom.

FRAME RANGE

Specifies the frame range for Inside/Outside Range.

FRAME DROPOFF

Defines transition ranges for before and after the range, which ramp from zero effect to full effect. This controls the amount of the operation applied.

NON-SCOPED EFFECT

Normally the effect on non-scoped frames is zero (bypass frame), but it can be set to non-zero values to produce a reduced or increased effect on non-scoped frames.

FRAME LIST

Allows manual scoping using frame patterns.

```
(e.g. "1 5 10", "[1–20]", "[1–20:2]", "[1–10] [40–50]" )
```

AUTOMATICALLY ADJUST FOR LENGTH CHANGES

If enabled, this will stretch or compress the frame ranges and transistion ranges if the sequence length grows or shrinks.

36.4 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W, H	Width and height of image.
I	Image index (0 at start frame).
IT	Image time (0 at start frame).
AI	Current plane array index.
PI	Current plane index.
PC	Number of channels in current plane.

37 INVERT COP

37.1 DESCRIPTION

Applies a photographic pixel inversion to the image.

37.2 PARAMETERS

QUANTIZE

Allows you to quantize the image either specifically or *Where Optimal*.

OPERATION MASK

This operation is a scopable operation that may be masked.

Operation Masking is done with the use of a mask plane (typically M). A mask plane controls which areas of the image are affected by this operation. Where the mask is between 0 (black) and 1 (white), the input is blended with the output. White means full effect, black means no effect (though the mask can be inverted to reverse the effect).

The mask plane can 1 or 3 channels. A single channel mask plane affects all components, whereas a 3 channel mask plane affects each component separately. The mask may be in the first input's plane or attached as a second input.

operation mask

The mask is specified in the first input or the mask input. The mask plane can then be selected from this input's planes. If a component is selected, it is a single channel mask. If a multi-channel plane is selected, it acts a multi-channel mask.

invert mask

If enabled, the mask is inverted so that areas outside the mask are affected instead.

plane scope

Selects the planes or components to modify. If a plane is scoped, all of its components are. i.e.:

`C A`	Color and alpha are scoped.
`C.r A`	The red component of color and alpha are scoped.
`C.r C.g`	The red and green components of color are scoped.
`*`	All planes are scoped.

Planes remain unaffected if they are not scoped. The Frame Scope page has parameters for modifying a subrange of the frame range. Frames and planes that are not scoped are passed through the COP without modification.

FRAME SCOPE

Applies the operation to only some frames in the sequence – either All, Inside Range, Outside Range, Even Frames, Odd Frames or Custom.

FRAME RANGE

Specifies the frame range for Inside/Outside Range.

FRAME DROPOFF

Defines transition ranges for before and after the range, which ramp from zero effect to full effect. This controls the amount of the operation applied.

NON-SCOPED EFFECT

Normally the effect on non-scoped frames is zero (bypass frame), but it can be set to non-zero values to produce a reduced or increased effect on non-scoped frames.

FRAME LIST

Allows manual scoping using frame patterns.

```
(e.g. "1 5 10", "[1-20]", "[1-20:2]", "[1-10] [40-50]" )
```

AUTOMATICALLY ADJUST FOR LENGTH CHANGES

If enabled, this will stretch or compress the frame ranges and transistion ranges if the sequence length grows or shrinks.

38 LAYER COP

This operation does a composite (over, under, inside, add, etc) between up to eight images. The first image is always the background image, and subsequent images are layered in order. The size of the resulting image is the size of the background image.

In the case of an over, the result image is:

```
4 over (3 over (2 over 1))
```

for four inputs, 1 to 4.

Tip: For a more traditional A over B method, use the *Composite COP* ***p. 553.***

38.1 PARAMETERS – COMPOSITE PAGE

OPERATION

Specifies the global compositing operation:

Over	Places the foreground over the background.
Under	Places the foreground under the background's alpha.
Atop	Places the foreground over the background only where the background alpha exists.
Inside	Places the foreground inside the background's alpha.
Outside	Places the foreground outside the background's alpha.
Screen	Inverts both, multiplies, and inverts the product.
Add	Adds the foreground to the background.
Subtract	Subtracts the foreground from the background.
Diff	Takes the absolute difference between the foreground and the background.
Multiply	Multiplies the background by the foreground.
Minimum	Takes the minimum of the foreground and background.
Maximum	Takes the maximum of the foreground and background.
Average	Takes the average of the foreground and background.

IMAGE UNITS

Selects pixels or UV units for the transforms.

IMAGE FILTER

Specifies the filter to use when transforming.

38.2 PARAMETERS – TRANSFORM PAGE

Note: There is one set of these parameters per foreground input.

OPERATION

Specifies the composite operation for this input, and how this input wraps when outside its image bounds (repeat, clamp, decal, mirror). The default compositing operation is "global" which uses the operation specified on the Composite page.

TRANSLATE / ROTATE / SCALE / PIVOT

Transforms this foreground in X,Y relative to the background.

38.3 PARAMETERS – MERGE PAGE

These parameters specify how to build the output sequence when there are differences between the input sequences. See the Composite COP for more details.

38.4 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W, H	Width and height of image.
I	Image index (0 at start frame).
IT	Image time (0 at start frame).
AI	Current plane array index.
PI	Current plane index.
PC	Number of channels in current plane.

39 LIGHTING COP

39.1 DESCRIPTION

This operator adds a light to the image. The light can be directional or non, and have ambient, specular and diffuse components. The image can be a flat image, an image with a bump map, or a deep raster image containing point and/or normal planes. Right click on the dialog '?' help for more help on VEX.

39.2 PARAMETERS – LIGHTING PAGE

SURFACE TYPE

Specifies the type of surface lighting to use:

Flat	Image has uniform normals and uniform depth.
Bump Map	Image has bumped normals and uniform depth.
Point & Normal	Image has normal & point maps for 3D lighting.
Point Only	Image has a point map for pseudo-3D lighting.
Normal Map	Image has uniform depth and varying normals.

EYE DISTANCE

The distance from the eye to the image (at Z=0).

AMBIENT

The ambient component of the light.

DIFFUSE

The diffuse component of the light.

SPECULAR

The specular component of the light.

CORRECT FOR ASPECT RATIO

If the image is not square, this adjusts the coordinates so that spotlights are still circular.

ADD TO ORIGINAL COLOR

The lighting is added to the original image if on.

OPERATION MASK

This operation is a scopable operation that may be masked.

Operation Masking is done with the use of a mask plane (typically M). A mask plane controls which areas of the image are affected by this operation. Where the mask is between 0 (black) and 1 (white), the input is blended with the output. White means full effect, black means no effect (though the mask can be inverted to reverse the effect).

The mask plane can 1 or 3 channels. A single channel mask plane affects all components, whereas a 3 channel mask plane affects each component separately. The mask may be in the first input's plane or attached as a second input.

operation mask

The mask is specified in the first input or the mask input. The mask plane can then be selected from this input's planes. If a component is selected, it is a single channel mask. If a multi-channel plane is selected, it acts a multi-channel mask.

invert mask

If enabled, the mask is inverted so that areas outside the mask are affected instead.

plane scope

Selects the planes or components to modify. If a plane is scoped, all of its components are. i.e.:

`C A`	Color and alpha are scoped.
`C.r A`	The red component of color and alpha are scoped.
`C.r C.g`	The red and green components of color are scoped.
`*`	All planes are scoped.

39.3 PARAMETERS – LIGHT PAGE

POSITION

The position of the light. In Flat, Bump Map and Normal Map modes, the image coordinates are {0,0,0} (bottom left) to {1,1,0} (top right).

ATTENUATION

The distance at which the light is at 50% intensity.

DIRECTIONAL LIGHT

If on, the light is directional.

DIRECTION

The direction vector of the light.

CONE

The cone size of the light, in degrees.

CONE FALLOFF

The falloff cone size of the light, in degrees.

FALLOFF

The falloff function for the light.

39.4 PARAMETERS – MATERIAL PAGE

DIFFUSE MODEL

The type of diffuse model to use:

Simple	Simple dot product model.
Oren-Nayar	Rougher material model, like clay.

diffuse roughness

The roughness for the Oren-Nayar model.

SPECULAR MODEL

The specular model to use, Phong or Blinn.

exponent

The Phong specular exponent.

roughness

The Blinn roughness parameter.

39.5 PARAMETERS – VOLUMETRIC PAGE

ATMOSPHERE SCATTER

The amount of light scatter the atmosphere causes.
Higher numbers produce foggier lights.

LIGHT FALLOFF

The distance that the volumetric fog extends away from the light.

FALLOFF FUNCTION

The volumetric fog falloff function.

LIGHT HOTSPOT SIZE

Increases or decreases the light hotspot size.

RAY MARCH STEP

The step size when marching through the light volume. Smaller values produce finer results at the expense of computation time.

39.6 PARAMETERS – PLANES PAGE

BUMP, POINT NORMAL PLANES IN 2ND INPUT

If on, all the specified planes are in input 2, otherwise they are in input 1.

BUMP, POINT, NORMAL NAME

The name of the corresponding input planes.

39.7 PARAMETERS – FRAME SCOPE PAGE

Planes remain unaffected if they are not scoped. The Frame Scope page has parameters for modifying a subrange of the frame range. Frames and planes that are not scoped are passed through the COP without modification.

FRAME SCOPE

Applies the operation to only some frames in the sequence – either All, Inside Range, Outside Range, Even Frames, Odd Frames or Custom.

FRAME RANGE

Specifies the frame range for Inside/Outside Range.

FRAME DROPOFF

Defines transition ranges for before and after the range, which ramp from zero effect to full effect. This controls the amount of the operation applied.

NON-SCOPED EFFECT

Normally the effect on non-scoped frames is zero (bypass frame), but it can be set to non-zero values to produce a reduced or increased effect on non-scoped frames.

FRAME LIST

Allows manual scoping using frame patterns.

(e.g. "1 5 10", "[1-20]", "[1-20:2]", "[1-10] [40-50]")

AUTOMATICALLY ADJUST FOR LENGTH CHANGES

If enabled, this will stretch or compress the frame ranges and transistion ranges if the sequence length grows or shrinks.

39.8 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W, H	Width and height of image.
I	Image index (0 at start frame).
IT	Image time (0 at start frame).
AI	Current plane array index.
PI	Current plane index.
PC	Number of channels in current plane.

40 LIMIT COP

40.1 DESCRIPTION

This operation limits the pixel range at the high end, low end or both.

The second input is an optional mask for the operation. A mask is a single component of a plane which determines which areas of the image are affected by this operation. Where the mask is between zero and one, the input is blended with the output. White means full effect, black means no effect (though the mask can be inverted to reverse the effect).

This is a collapsable pixel operation. When placed in sequence with other collapsable pixel operations, the operations are combined into one operation at the final node in the sequence. This only quantizes the data once and allows the intermediate operations to produce and carry values outside the normal range of the pixels' data format, reducing quantization error and clipping.

40.2 PARAMETERS – LIMIT PAGE

LOWER LIMIT

If enabled, the pixel values are clamped to this value if they are less that it.

UPPER LIMIT

If enabled, the pixel values are clamped to this value if they are greater that it.

QUANTIZE

If this node is in the middle of a collapsable pixel chain, you can force this node to quantize and store the images as if it were the final node.

OPERATION MASK

Normally the mask is specified by the second input, however, you can also pick a mask from the first input as well.

INVERT MASK

If enabled, the operation mask is inverted before the operation is performed.

PLANE SCOPE

Selects the planes or components to modify.

40.3 PARAMETERS – FRAME SCOPE PAGE

Planes remain unaffected if they are not scoped. The Frame Scope page has parameters for modifying a subrange of the frame range. Frames and planes that are not scoped are passed through the COP without modification.

FRAME SCOPE

Applies the operation to only some frames in the sequence – either All, Inside Range, Outside Range, Even Frames, Odd Frames or Custom.

FRAME RANGE

Specifies the frame range for Inside/Outside Range.

FRAME DROPOFF

Defines transition ranges for before and after the range, which ramp from zero effect to full effect. This controls the amount of the operation applied.

NON-SCOPED EFFECT

Normally the effect on non-scoped frames is zero (bypass frame), but it can be set to non-zero values to produce a reduced or increased effect on non-scoped frames.

FRAME LIST

Allows manual scoping using frame patterns.

```
(e.g. "1 5 10", "[1–20]", "[1–20:2]", "[1–10] [40–50]" )
```

AUTOMATICALLY ADJUST FOR LENGTH CHANGES

If enabled, this will stretch or compress the frame ranges and transistion ranges if the sequence length grows or shrinks.

40.4 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W, H	Width and height of image.
I	Image index (0 at start frame).
IT	Image time (0 at start frame).
AI	Current plane array index.
PI	Current plane index.
PC	Number of channels in current plane.

41 LOOKUP COP

41.1 DESCRIPTION

This operation applies a lookup table to the input, from either a LookUp Table (LUT) file, a CHOP channel, or a second Input Map.

The second input defines the lookup table when the LUT source is Input Row or Input Column. One row or column is taken as the lookup table. The lookup map is evaluated at U or V position specified by the input pixel value (0-1). Any input values below 0 or above 1 are clamped to 0 or 1. The first plane is always used as the lookup table, and if it has multiple components, they are applied to the appropriate components in the output. The map is not interpolated, so small maps can be used to quantize the image.

The third input is an optional mask for the operation. A mask is a single component of a plane which determines which areas of the image are affected by this operation. Where the mask is between zero and one, the input is blended with the output. White means full effect, black means no effect (though the mask can be inverted to reverse the effect).

This is a collapsable pixel operation. When placed in sequence with other collapsable pixel operations, the operations are combined into one operation at the final node in the sequence. This only quantizes the data once and allows the intermediate operations to produce and carry values outside the normal range of the pixels' data format, reducing quantization error and clipping.

41.2 PARAMETERS – LOOKUP PAGE

LUT SOURCE

The lookup table can be applied from a CHOP channel or LUT file.

LUT FILE

The LUT file to load and apply.

CHOP NET / CHOP

The CHOP to fetch the LUT from.

row/col position

The U or V coordinate of the row or column in the input image which represents the lookup table.

QUANTIZE

If this node is in the middle of a collapsable pixel chain, you can force this node to quantize and store the images as if it were the final node.

OPERATION MASK

Normally the mask is specified by the second input, however, you can also pick a mask from the first input as well.

INVERT MASK

If enabled, the operation mask is inverted before the operation is performed.

PLANE SCOPE

Selects the planes or components to modify.

41.3 PARAMETERS – FRAME SCOPE PAGE

Planes remain unaffected if they are not scoped. The Frame Scope page has parameters for modifying a subrange of the frame range. Frames and planes that are not scoped are passed through the COP without modification.

FRAME SCOPE

Applies the operation to only some frames in the sequence – either All, Inside Range, Outside Range, Even Frames, Odd Frames or Custom.

FRAME RANGE

Specifies the frame range for Inside/Outside Range.

FRAME DROPOFF

Defines transition ranges for before and after the range, which ramp from zero effect to full effect. This controls the amount of the operation applied.

NON-SCOPED EFFECT

Normally the effect on non-scoped frames is zero (bypass frame), but it can be set to non-zero values to produce a reduced or increased effect on non-scoped frames.

FRAME LIST

Allows manual scoping using frame patterns.

```
(e.g. "1 5 10", "[1-20]", "[1-20:2]", "[1-10] [40-50]" )
```

AUTOMATICALLY ADJUST FOR LENGTH CHANGES

If enabled, this will stretch or compress the frame ranges and transistion ranges if the sequence length grows or shrinks.

41.4 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W, H	Width and height of image.
I	Image index (0 at start frame).
IT	Image time (0 at start frame).
AI	Current plane array index.
PI	Current plane index.
PC	Number of channels in current plane.

42 LUMAKEY COP

This operation keys the image based on luminance (or similar function).

The second input is an optional mask for the operation. A mask is a single component of a plane which determines which areas of the image are affected by this operation. Where the mask is between zero and one, the input is blended with the output. White means full effect, black means no effect (though the mask can be inverted to reverse the effect).

42.1 PARAMETERS

MIN LUMINANCE

If enabled, this sets the lower limit for the key.

MAX LUMINANCE

If enabled, this sets the upper limit for the key.

DISCARD KEYED REGION

If enabled, the keyed region is discarded.

ROLLOFF REGION

The size of the rolloff region, in case a sharp edge is not wanted.

ROLLOFF FUNCTION

Specifies the rolloff function of the rolloff region.

LUMINANCE FUNCTION

Specifies how to prep the color to key off.

SUPERSAMPLE

The number of subpixels sampled per pixel in one direction (2 samples 4 pixels, 3 samples 9). More subsamples produce finer edges, at a slight performance cost (as only the edges are supersampled).

KEY PLANE

Specifies the plane to key off of.

OPERATION MASK

Normally the mask is specified by the second input, however, you can also pick a mask from the first input as well.

INVERT MASK

If enabled, the operation mask is inverted before the operation is performed.

PLANE SCOPE

Selects the planes or components to modify.

42.2 PARAMETERS – FRAME SCOPE PAGE

Planes remain unaffected if they are not scoped. The Frame Scope page has parameters for modifying a subrange of the frame range. Frames and planes that are not scoped are passed through the COP without modification.

FRAME SCOPE

Applies the operation to only some frames in the sequence – either All, Inside Range, Outside Range, Even Frames, Odd Frames or Custom.

FRAME RANGE

Specifies the frame range for Inside/Outside Range.

FRAME DROPOFF

Defines transition ranges for before and after the range, which ramp from zero effect to full effect. This controls the amount of the operation applied.

NON-SCOPED EFFECT

Normally the effect on non-scoped frames is zero (bypass frame), but it can be set to non-zero values to produce a reduced or increased effect on non-scoped frames.

FRAME LIST

Allows manual scoping using frame patterns.

```
(e.g. "1 5 10", "[1-20]", "[1-20:2]", "[1-10] [40-50]" )
```

AUTOMATICALLY ADJUST FOR LENGTH CHANGES

If enabled, this will stretch or compress the frame ranges and transistion ranges if the sequence length grows or shrinks.

42.3 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W, H	Width and height of image.
I	Image index (0 at start frame).
IT	Image time (0 at start frame).
AI	Current plane array index.
PI	Current plane index.
PC	Number of channels in current plane.

43 MEDIAN COP

43.1 DESCRIPTION

This operation applies a 3×3 or 5×5 median filter to the input image. This is used to remove 'features' represented by individual pixels, such as 'shot' noise or pixel dropout.

43.2 PARAMETERS

FILTER SIZE

Increases the size of the area over which it computes the median (in pixels).

OPERATION MASK

Normally the mask is specified by the second input, however, you can also pick a mask from the first input as well.

INVERT MASK

If on, the operation mask is inverted before the operation is performed.

PLANE SCOPE

Selects the planes or components to modify.

43.3 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W, H	Width and height of image.
I	Image index (0 at start frame).
IT	Image time (0 at start frame).
AI	Current plane array index.
PI	Current plane index.
PC	Number of channels in current plane.

44 MERGE COP

44.1 DESCRIPTION

This operation merges the planes of several inputs together. Most of the parameters determine how to handle differences in the sequences like image size, frame range and plane conflicts.

44.2 PARAMETERS

Plane Conflict - Planes from different inputs with the same name are in conflict. A conflicting plane is the second plane or later which matches an existing plane name. This parameter determines how to resolve the conflict.

Rename Conflicting Plane The plane is renamed by adding a unique suffix number.

Add to Plane Array if Identical else Rename
A plane array is created if the planes data format and structure match, otherwise the conflicting plane is renamed.

Add to Plane Array if Identical else Ignore
A plane array is created if the planes data format and structure match, otherwise the conflicting plane is not merged in.

Ignore Conflicting Planes Any conflicting planes are not merged in.

Error if Conflicts Occur A conflict flags a cooking error.

RESOLUTION MATCH

If the resolutions of the inputs are not all the same, this parameter determines how to choose the output resolution.

SIZE

If Resolution Match is set to 'Specify a Resolution', this is the parameter which specifies the size.

SCALE TO NEW SIZE

If on, all inputs not matching the output resolution are scaled to the output resolution, otherwise they are cropped or extended with black.

SCALE FILTER

The filter to use when scaling images.

FRAME RANGE

If the frame ranges of the inputs differ, this determines what the output range should be.

FRAME RATE

If the frame rates of the inputs differ, this determines what the output frame rate should be.

FRAME MATCH

If the frame rates of the inputs differ, this determines which input frame to pick when the cook time doesn't reside on a frame boundary.

44.3 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W, H	Width and height of image.
I	Image index (0 at start frame).
IT	Image time (0 at start frame).
AI	Current plane array index.
PI	Current plane index.
PC	Number of channels in current plane.

45 MONO COP

45.1 DESCRIPTION

This operation converts a color or vector into a scalar quantity, like luminance or length. Optionally, vector planes can be converted to scalar planes.

The second input is an optional mask for the operation. A mask is a single component of a plane which determines which areas of the image are affected by this operation. Where the mask is between zero and one, the input is blended with the output. White means full effect, black means no effect (though the mask can be inverted to reverse the effect).

This is a collapsable pixel operation. When placed in sequence with other collapsable pixel operations, the operations are combined into one operation at the final node in the sequence. This only quantizes the data once and allows the intermediate operations to produce and carry values outside the normal range of the pixels' data format, reducing quantization error and clipping.

45.2 PARAMETERS – MONO PAGE

OPERATION

How to convert the color or vector to a scalar.

KEEP VECTOR PLANES AS VECTORS

If on, vector planes are not converted to scalar planes.

QUANTIZE

If this node is in the middle of a collapsable pixel chain, you can force this node to quantize and store the images as if it were the final node.

OPERATION MASK

Normally the mask is specified by the second input, however, you can also pick a mask from the first input as well.

INVERT MASK

If on, the operation mask is inverted before the operation is performed.

PLANE SCOPE

Selects the planes or components to modify.

45.3 PARAMETERS – FRAME SCOPE PAGE

Planes remain unaffected if they are not scoped. The Frame Scope page has parameters for modifying a subrange of the frame range. Frames and planes that are not scoped are passed through the COP without modification.

FRAME SCOPE

Applies the operation to only some frames in the sequence – either All, Inside Range, Outside Range, Even Frames, Odd Frames or Custom.

FRAME RANGE

Specifies the frame range for Inside/Outside Range.

FRAME DROPOFF

Defines transition ranges for before and after the range, which ramp from zero effect to full effect. This controls the amount of the operation applied.

NON-SCOPED EFFECT

Normally the effect on non-scoped frames is zero (bypass frame), but it can be set to non-zero values to produce a reduced or increased effect on non-scoped frames.

FRAME LIST

Allows manual scoping using frame patterns.

```
(e.g. "1 5 10", "[1-20]", "[1-20:2]", "[1-10] [40-50]" )
```

AUTOMATICALLY ADJUST FOR LENGTH CHANGES

If enabled, this will stretch or compress the frame ranges and transistion ranges if the sequence length grows or shrinks.

45.4 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W, H	Width and height of image.
I	Image index (0 at start frame).
IT	Image time (0 at start frame).
AI	Current plane array index.
PI	Current plane index.
PC	Number of channels in current plane.

46 MOSAIC COP

46.1 DESCRIPTION

This operation takes a sequence of images and combines them into 1 image by tiling them. If the sequence is not completely divisible by the number of images per line or images per frame, the missing tiles are filled with a background color.

46.2 PARAMETERS

IMAGES PER LINE

Defines the number of image per row or per column, depending on whether images are stacked by row or column.

STACK VERTICALLY

Defines the vertical stack order.

STACK HORIZONTALLY

Defines the horizontal stack order.

STACK IMAGES IN ROWS

If on, images are stacked horizontally first, then vertically. If off, images are stacked vertically first.

MAX IMAGES/FRAME

Limits the number of input images in one image. If on, each 'N' input images form 1 output image. If off, the entire sequence is put into 1 image.

KEEP FULL SIZE

If on, the image will always have at least as many images as specified in 'Images per Line' and 'Max Images/Frame', even if the sequence is shorter than either value. The missing frames are filled with the background color.

BACKGROUND COLOR - THE COLOR TO SUBSTITUTE FOR MISSING IMAGES.

46.3 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W, H	Width and height of image.

47 NULL COP

47.1 DESCRIPTION

This operation does nothing. It acts simply as a placeholder to make wiring networks easier, or to allow you to reference a single output COP without having to update all the references to it if the real output COP changes.

This COP does not use any image cache space, nor does it cook anything.

48 NOISE COP

48.1 DESCRIPTION

This COP generates continuous noise patterns. If an input is attached, this COP will add a new plane to the sequence or modify an existing plane.

Tip: Film grain should be added with the Grain COP.

48.2 PARAMETERS – NOISE PAGE

NOISE TYPE

Specifies the type of noise:

Hermite Interpolation	Fast, somewhat uniform.
Sparse Convolution	Slower, more random.
Improved Hermite	Fast, better randomness than Hermite Interpolation.
Alligator	Slow, cell-like noise.
Random	Random value per pixel.

SEED

Random seed for the noise.

NOISE PER COMPONENT

If enabled, different noise values are generated per component; otherwise, all components share the same pixel values.

TURBULANCE

The number of noise generations to use.

ROUGHNESS

The amplitude of higher frequency noise contributions.

EXPONENT

Raises the noise to the given exponent.

SPATIAL FREQUENCY

The scale of the noise; decreasing increase feature size.

SPATIAL OFFSET

Allows you to pan around in the noise.

FRAME FREQUENCY

How quickly the noise changes over time.

FRAME OFFSET

Allows you to shift noise frames through time.

AMPLITUDE

Amplitude of the final noise intensity.

SHIFT

Constant value added to all noise results.

48.3 PARAMETERS – IMAGE PAGE

SIZE

The resolution of the image.

ASPECT RATIO

The ratio of width to height of the image.

IMAGE PLANES

If there is no input attached, this menu allows you to quickly generate different types of planes.

ADD PLANE

If an input is attached, this menu allows you to choose which plane to generate, modify or replace.

CUSTOM PLANES

This string parm allows you to specify your own plane formats. The syntax is:

```
planename(arraysize){comp1,comp2,comp3,comp4}:format(black,white)
```

All parts are optional except for planename. arraysize is optional and must be 1 or greater. comp1-4 are arbitrary strings representing the component names. 'format' is either i8, i16, i32 or f32. black and white are integers representing the black and white points for integer formats.

RASTER DEPTH

The depth of the planes generated.

BLACK/WHITE POINTS

Toggle on to specify black and white points.

INTERLACING

Allows you to generate interlaced images.

None	Normal image.
Black Interlaced	Black scanlines are inserted.
Half Res Interlaced	Image is compressed vertically by 1/2.
Line Doubled	Same as *Half Res*, only two lines are used for each halved scanline.

The second menu controls the field dominance of the sequence.

48.4 PARAMETERS – SEQUENCE PAGE

SINGLE IMAGE

If enabled, there is only 1 image and it exists at all frames; the frame range and rate are not used.

START FRAME

The start of the sequence.

LENGTH

The length of the sequence.

FRAME RATE

Enable this option to set the frame rate of the sequence.

PRE/POST EXTEND

How the sequence behaves outside its frame range:

Black Frames	Frames are black (zero).
Cycle	The sequence is cycled, 1,2,3,4 / 1,2,3,4.
Mirror	The sequence is mirrored, 1,2,3,4 / 3,2,1.

Hold	The first/last frame is held forever.
Hold for N Frames	The first or last frame is held for some number of frames, before or after which black frames are used.

PRE/POST HOLD

If Extend is set to 'Hold for N Frames', this speficies the number of frames to hold for.

48.5 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W, H	Width and height of image.
I	Image index (0 at start frame).
IT	Image time (0 at start frame).
AI	Current plane array index.
PI	Current plane index.
PC	Number of channels in current plane.

49 PIXEL COP

49.1 DESCRIPTION

This operation allows you to specify an expression to modify the pixels of image. The expression is applied to each pixel in turn, and can be specified separately for each colour component (R, G, B, and Alpha).

It is the 2D equivalent of the Point SOP.

49.2 PARAMETERS

EXPRESSIONS

You can limit which expressions are active at any given time with this menu. This way you can turn off the expression for the colour or alpha planes without having delete the expression.

Generic expressions (the default) can be used for everything – all planes, including Color & alpha. The *Use Color & Alpha Expression Only* option will use only the Color & Alpha expressions on Cr, Cg, Cb and A.

RED / GREEN / BLUE / ALPHA / COMPONENT-N

Enter expressions for the particular colour plane here. Use the *Expressions* menu (above) if you want to disable the expression for a particular plane. See *Variables Specific to the Pixel COP* p. 648 for the names of variables you can use here.

OPERATION MASK

This operation is a scopable operation that may be masked.

Operation Masking is done with the use of a mask plane (typically M). A mask plane controls which areas of the image are affected by this operation. Where the mask is between 0 (black) and 1 (white), the input is blended with the output. White means full effect, black means no effect (though the mask can be inverted to reverse the effect).

The mask plane can 1 or 3 channels. A single channel mask plane affects all components, whereas a 3 channel mask plane affects each component separately. The mask may be in the first input's plane or attached as a second input.

operation mask

The mask is specified in the first input or the mask input. The mask plane can then be selected from this input's planes. If a component is selected, it is a single channel mask. If a multi-channel plane is selected, it acts a multi-channel mask.

invert mask

If enabled, the mask is inverted so that areas outside the mask are affected instead.

plane scope

Selects the planes or components to modify. If a plane is scoped, all of its components are. i.e.:

`C A`	Color and alpha are scoped.
`C.r A`	The red component of color and alpha are scoped.
`C.r C.g`	The red and green components of color are scoped.
`*`	All planes are scoped.

49.3 PARAMETERS – FRAME SCOPE PAGE

Planes remain unaffected if they are not scoped. The Frame Scope page has parameters for modifying a subrange of the frame range. Frames and planes that are not scoped are passed through the COP without modification.

FRAME SCOPE

Applies the operation to only some frames in the sequence – either All, Inside Range, Outside Range, Even Frames, Odd Frames or Custom.

FRAME RANGE

Specifies the frame range for Inside/Outside Range.

FRAME DROPOFF

Defines transition ranges for before and after the range, which ramp from zero effect to full effect. This controls the amount of the operation applied.

NON-SCOPED EFFECT

Normally the effect on non-scoped frames is zero (bypass frame), but it can be set to non-zero values to produce a reduced or increased effect on non-scoped frames.

FRAME LIST

Allows manual scoping using frame patterns.

`(e.g. "1 5 10", "[1–20]", "[1–20:2]", "[1–10] [40–50]" )`

AUTOMATICALLY ADJUST FOR LENGTH CHANGES

If enabled, this will stretch or compress the frame ranges and transistion ranges if the sequence length grows or shrinks.

49.4 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W, H	Width and height of image.
I	Image index (0 at start frame).
IT	Image time (0 at start frame).
AI	Current plane array index.
PI	Current plane index.
PC	Number of channels in current plane.

49.5 VARIABLES SPECIFIC TO THE PIXEL COP

R, G, B, A	The values of C.r, C.g, C.b (colour) and A (alpha).
C1, C2, C3, C4	The values of components 1-4 of the cooked plane.
RS, GS, RS, RS	The values of colour and alpha in the second input.
CS1,CS2,CS3,CS4	The values of components 1-4 of the cooked plane in the second input.
RT, GT, BT, AT	The values of color and alpha in the third input.
CT1,CT2,CT3,CT4	The values of components 1-4 of the cooked plane in the third input.
U,V	The UV coordinates of the current pixel (0 to 1).
X,Y	The pixel location of the current pixel (0 to res-1)
CH	The component (channel) of the current expression (0 to 3).

50 PREMULTIPLY COP

50.1 DESCRIPTION

This operation allows colour to be converted to or from a premultiplied form. Premultiplied colour is colour than has already been multiplied by alpha.

If mlti-channel alpha is given, the appropriate components are multiplied (cr × Ar, cg × Ag, cb × Ab).

50.2 PARAMETERS

OPERATION

The colour plane can either be multiplied or divided by the alpha plane.

ALPHA PLANE

The name of the alpha plane.

SCOPE

The planes to affect (normally just colour).

51 PULLDOWN COP

51.1 DESCRIPTION

This operation performs a pulldown (cine-expand) on the input sequence. A pulldown converts non-interlaced film to interlaced video sequences.

51.2 PARAMETERS

FILM RATE

The frame rate of the film sequence (normally 24fps)

VIDEO RATE

The frame rate of the output video (30fps for NTSC, 25fps for PAL)

FIELD OFFSET

The frame offset where the pulldown pattern begins.

FIELD DOMINANCE

The field dominance of the video.

ODD DOMINANT (FIELD 1)

The odd scanlines (1,3,5...) appear in the first field of the video pair.

EVEN DOMINANT (FIELD 2)

The even scanlines (2,4,6...) appear in the first field of the video pair.

52 PUSHUP COP

52.1 DESCRIPTION

This operation performs a pushup (cine-compress) on the input sequence. A pushup converts interlaced video to a non-interlaced film sequence.

52.2 PARAMETERS

FILM RATE

The frame rate of the film sequence (normally 24fps)

VIDEO RATE

The frame rate of the output video (30fps for NTSC, 25fps for PAL)

FIELD OFFSET

The frame offset where the pushup pattern begins.

FIELD DOMINANCE

The field dominance of the video.

ODD DOMINANT (FIELD 1)

The odd scanlines (1,3,5...) appear in the first field of the video pair.

EVEN DOMINANT (FIELD 2)

The even scanlines (2,4,6...) appear in the first field of the video pair.

53 QUANTIZE COP

53.1 DESCRIPTION

This operation quantizes input data into discrete steps. Large steps produce a posterizing effect.

The second input is an optional mask for the operation. A mask is a single component of a plane which determines which areas of the image are affected by this operation. Where the mask is between zero and one, the input is blended with the output. White means full effect, black means no effect (though the mask can be inverted to reverse the effect).

This is a collapsable pixel operation. When placed in sequence with other collapsable pixel operations, the operations are combined into one operation at the final node in the sequence. This only quantizes the data once and allows the intermediate operations to produce and carry values outside the normal range of the pixels' data format, reducing quantization error and clipping.

53.2 PARAMETERS – QUANTIZE PAGE

PIXEL STEP

The intensity spacing between quantized levels.

PIXEL OFFSET

The offset of the quantized levels.

QUANTIZE

If this node is in the middle of a collapsable pixel chain, you can force this node to quantize and store the images as if it were the final node.

OPERATION MASK

Normally the mask is specified by the second input, however, you can also pick a mask from the first input as well.

INVERT MASK

If enabled, the operation mask is inverted before the operation is performed.

PLANE SCOPE

Selects the planes or components to modify.

53.3 PARAMETERS – FRAME SCOPE PAGE

Planes remain unaffected if they are not scoped. The Frame Scope page has parameters for modifying a subrange of the frame range. Frames and planes that are not scoped are passed through the COP without modification.

FRAME SCOPE

Applies the operation to only some frames in the sequence – either All, Inside Range, Outside Range, Even Frames, Odd Frames or Custom.

FRAME RANGE

Specifies the frame range for Inside/Outside Range.

FRAME DROPOFF

Defines transition ranges for before and after the range, which ramp from zero effect to full effect. This controls the amount of the operation applied.

NON-SCOPED EFFECT

Normally the effect on non-scoped frames is zero (bypass frame), but it can be set to non-zero values to produce a reduced or increased effect on non-scoped frames.

FRAME LIST

Allows manual scoping using frame patterns.

```
(e.g. "1 5 10", "[1-20]", "[1-20:2]", "[1-10] [40-50]" )
```

AUTOMATICALLY ADJUST FOR LENGTH CHANGES

If enabled, this will stretch or compress the frame ranges and transistion ranges if the sequence length grows or shrinks.

53.4 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W, H	Width and height of image.
I	Image index (0 at start frame).
IT	Image time (0 at start frame).
AI	Current plane array index.
PI	Current plane index.
PC	Number of channels in current plane.

54 RADIAL BLUR COP

This operation does a radial or angular blur on the input image.

A Radial blur appears to blur away or towards a central point. An angular blur blurs around a central point. Both operations can be done simultaneously to produce a corkscrew-like effect.

This operation is implemented in VEX.

54.1 PARAMETERS

QUALITY

Affects the smoothness of the blur. Higher qualities take more samples per pixel to blur.

RADIAL BLUR

The amount of radial blur to apply. 1 = half the diagonal length of the image, 0 = none.

ANGULAR BLUR

The amount of angular blur to apply, in degrees.

ANGULAR BIAS

The bias of the rotation. '0' blurs the image from the current orientation N degrees. '1' blurs the image from the current orientation minus N degrees to the current orientation. '0.5' centers the blur around the current orientation.

CENTER

The center point of the blur.

START BLUR SCALE

The start blur factor. The first blurred pixel is multiplied by this value.

END BLUR SCALE

The end blur factor. The last blurred pixel is multiplied by this value.

BLUR DROPOFF

The interpolation function for pixel samples in between the start and end pixels.

FILTERING

The pixel sampling filter.

None	Quick, low quality filter.
Bilinear	Medium quality filter.
Full Filtered	Slow, high quality filter.

CORRECT FOR IMAGE ASPECT

If on, the blur is adjusted so it appears circular if the image aspect ratio isn't square.

OUTSIDE BOUNDS

Specifies the sampling method for pixels outside the image.

54.2 PARAMETERS – FRAME SCOPE PAGE

Planes remain unaffected if they are not scoped. The Frame Scope page has parameters for modifying a subrange of the frame range. Frames and planes that are not scoped are passed through the COP without modification.

FRAME SCOPE

Applies the operation to only some frames in the sequence – either All, Inside Range, Outside Range, Even Frames, Odd Frames or Custom.

FRAME RANGE

Specifies the frame range for Inside/Outside Range.

FRAME DROPOFF

Defines transition ranges for before and after the range, which ramp from zero effect to full effect. This controls the amount of the operation applied.

NON-SCOPED EFFECT

Normally the effect on non-scoped frames is zero (bypass frame), but it can be set to non-zero values to produce a reduced or increased effect on non-scoped frames.

FRAME LIST

Allows manual scoping using frame patterns.

```
(e.g. "1 5 10", "[1-20]", "[1-20:2]", "[1-10] [40-50]" )
```

AUTOMATICALLY ADJUST FOR LENGTH CHANGES

If enabled, this will stretch or compress the frame ranges and transistion ranges if the sequence length grows or shrinks.

54.3 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W, H	Width and height of image.
I	Image index (0 at start frame).
IT	Image time (0 at start frame).
AI	Current plane array index.
PI	Current plane index.
PC	Number of channels in current plane.

55 RAMP COP

55.1 DESCRIPTION

This COP generates a variety of linear and radial ramps, which are fully keyframable. If an input is attached, it will add a new plane to the sequence or modify an existing plane.

55.2 PARAMETERS – RAMP PAGE

RAMP

The type of ramp to generate:

Horizontal	Ramp is linear with points horizontally.
Vertical	Ramp is linear with points vertically.
Radial	Ramp is circular with points extending radially.
Concentric	Ramp is circular with points at varying distances from the center.

GLOBAL INTERPOLATION

The interpolation between ramp point which is used by default. Individual points may override this interpolation (see Segment Interpolation).

Step	The segment is constant valued.
Linear	The segment is linearly interpolated between the two point colors.
Ease In	The segment drops off quickly from the first value and eases into the second.
Ease Out	The segment eases out of the first value and drops quickly to the second.
Ease In Ease Out	The segment eases into both values.

NUMBER OF CYCLES

The number of cycles to repeat the ramp for.

PHASE

The phase (0-1) to offset the ramp.

ROTATION

Rotates the ramp.

CENTER

Specifies the center of the ramp for radial and concentric ramps.

WRAP FIRST TO LAST

If on, an implicit segment is created between the last and first points. Otherwise, the value of the first and last ramp points is help before or after the ramp point range.

REPEAT RAMP

For a concentric ramp, this will repeat the ramp continually if on. Otherwise, only 1 cycle is used.

55.3 PARAMETERS – POINTS PAGE (40 POINTS)

Note: The individual values of ramp keys are specified explicitly here. However, you generally don't need to use the parameters on this page to set the Points – instead, click in the Viewport to set new ramp keys, and double-click a ramp key to edit its colour.

POINT N

If on, this point is included in the ramp at the U coordinate specified.

COLOR

The color of the ramp point. Values may be less than zero or greater than 1.

SEGEMENT N INTERPOLATION

By default, the global interpolation is used. This can override the interpolation to give a segement a specific interpolation.

55.4 IMAGE AND SEQUENCE PAGES

See Color COP > *Parameters – Image Page* p. 547
and *Parameters – Sequence Page* p. 548.

55.5 LOCAL VARIABLES

See Color COP > *Local Variables* p. 549.

56 REFERENCE COP

DESCRIPTION

Copies the sequence information from its input. This gets the frame range, resolution, and the extent conditions (but not the image planes).

This is used for grabbing ‘everything but the picture’ – useful if you want to create a template which matches the frame range and resolution.

56.1 PARAMETERS

None.

57 RENAME COP

57.1 DESCRIPTION

This operation allows you to change the name a plane.
This operation does not use any cache memory.

57.2 PARAMETERS

RENAME PLANES FROM

The input planes to rename.

RENAME PLANES TO

The new plane names, which should have a one to one correspondence to the input planes.

58 REVERSE COP

58.1 DESCRIPTION

This operation simply reverses the frames in the sequence. Frame 1 becomes the last frame, and vice versa.

This operation does not use any cache memory.

58.2 PARAMETERS

No Parameters

59 ROTOSPLINE COP

59.1 DESCRIPTION

This COP generates free form bezier or polygonal shapes. Adding and modifying points is done completely interactively. Each point is animatable. Use the handles in the Viewport to directly maipulate Rotospline parameters.

To create a rotospline, follow the prompts on the message line at the top of the Houdini window. Also see the Rotospline Operation help in the toolbox.

If an input is attached, this COP will add a new plane to the sequence or modify an existing plane.

59.2 PARAMETERS – SPLINE PAGE

SPLINE TYPE

Select Bezier or Polygon rotosplines.

FIT TOLERANCE

The tolerance applied to the bezier spline fit when the rotospline is first created. It has no effect once the spline is created.

LEVEL OF DETAIL

The level of detail used when converting bezier rotosplines to polygons before rendering.

Fill	The type of spline rendered.
Closed	A solid filled spline.
Hollow	An outlined closed spline.
Open	An open sline.

FILL OUTSIDE

If on, the 'outside' region is filled instead of the interior (for hollow and open splines, the outside region is the region not included by the line thickness).

THICKNESS

For Hollow and Open splines, the thickness of the lines to use, in UV space.

FEATHER / FEATHER WIDTH

Allows you to add per-point feathering widths to the rotospline. You can also use handles in the Viewport to manipulating them.

COLOR

The color to render the spline with.

59.3 PARAMETERS – TRANSFORM PAGE

A 2D animated transform can be applied to the spline. All units are in UV space.

59.4 IMAGE AND SEQUENCE PAGES

See Color COP > *Parameters – Image Page* p. 547 and *Parameters – Sequence Page* p. 548.

59.5 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W, H	Width and height of image.
I	Image index (0 at start frame).
IT	Image time (0 at start frame).
AI	Current plane array index.
PI	Current plane index.
PC	Number of channels in current plane.

60 SCALE COP

This operation changes the resolution of the image. The contents of the image are scaled appropriately. The aspect ratio may be optionally preserved.

Scale does not affect the cook resolution of its Inputs.

60.1 PARAMETERS

SCALE

Specifies the scaling method:

To Resolution Scales to the specified number of pixels.

To Fraction Scales to a fraction (e.g. 0.5 = 50%)

To Aspect Ratio Scales to a given Pixel Aspect ratio.

To Second Input's Resolution
Scales to match the resolution of the second input.

To a Fraction of the Second Input
Scales to match the resulotion of the second input scaled by a fraction (e.g. 0.5 = 50%).

To Second Input's Aspect Ratio
Scales to match the second input's aspect ratio.

IMAGE SIZE

Specify the size the image should be scaled to (in Pixels).

IMAGE FRACTION

Specify the size you'd like to scale the image as a fraction (e.g. 0.5 = 50%).

PIXEL ASPECT

Pixel Aspect is the ratio of the width to the height.
Specify the pixel aspect ratio to scale the image by here.

PRESERVE ASPECT RATIO

When enabled, it preserves the ratio of the image width to height when scaling.

IMAGE FILTER

Specifies the type of filter to use when scaling. The *Box* filter is the fastest; for almost all uses, the *Gaussian* is the best choice; use *Catmull* when you need something a bit sharper than Gausian.

61 SCREENKEY COP

This operation does blue and green screen removal and colour correction. It will key-out colours which lie in the hue, saturation and luminance ranges specified.

If simple colour masking is required, use *Chromakey COP* p. 544 or *LumaKey COP* p. 631 instead.

61.1 PARAMETERS

HUE / SATURATION / LUMINANCE

The hue, saturation and luminancy ranges of colors to key (i.e. the first value is the 'from' and the second value is the 'to').

HUE / SATURATION / LUMINANCE SPILL

The *Spill* parameters allows you to remove the colour saturation of the surroundings from the edges of the keyed area.

edge spill distance

How many pixels away from the edge the spill should affect.

spill correction / correction samples

A bias adjustment for the spill correction – how many samples it should use.

DISCARD KEYED REGION

If on, the keyed region is masked out (black). Otherwise the rest of the image is masked out.

SUPERSAMPLE

The number of subpixels sampled per pixel in one direction (2 samples 4 pixels, 3 samples 9). More subsamples produce finer edges, at the cost of performance.

KEY PLANE

Specifies the plane to key. All scoped planes will be masked based on the result of the Chromakey on this plane.

OPERATION MASK

This operation is a scopable operation that may be masked.

Operation Masking is done with the use of a mask plane (typically M). A mask plane controls which areas of the image are affected by this operation. Where the mask is between 0 (black) and 1 (white), the input is blended with the output. White

means full effect, black means no effect (though the mask can be inverted to reverse the effect).

The mask plane can 1 or 3 channels. A single channel mask plane affects all components, whereas a 3 channel mask plane affects each component separately. The mask may be in the first input's plane or attached as a second input.

operation mask

The mask is specified in the first input or the mask input. The mask plane can then be selected from this input's planes. If a component is selected, it is a single channel mask. If a multi-channel plane is selected, it acts a multi-channel mask.

invert mask

If enabled, the mask is inverted so that areas outside the mask are affected instead.

plane scope

Selects the planes or components to modify. If a plane is scoped, all of its components are. i.e.:

`C A`	Color and alpha are scoped.
`C.r A`	The red component of color and alpha are scoped.
`C.r C.g`	The red and green components of color are scoped.
`*`	All planes are scoped.

61.2 PARAMETERS – FRAME SCOPE PAGE

Planes remain unaffected if they are not scoped. The Frame Scope page has parameters for modifying a subrange of the frame range. Frames and planes that are not scoped are passed through the COP without modification.

FRAME SCOPE

Applies the operation to only some frames in the sequence – either All, Inside Range, Outside Range, Even Frames, Odd Frames or Custom.

FRAME RANGE

Specifies the frame range for Inside/Outside Range.

FRAME DROPOFF

Defines transition ranges for before and after the range, which ramp from zero effect to full effect. This controls the amount of the operation applied.

NON-SCOPED EFFECT

Normally the effect on non-scoped frames is zero (bypass frame), but it can be set to non-zero values to produce a reduced or increased effect on non-scoped frames.

FRAME LIST

Allows manual scoping using frame patterns.

(e.g. "1 5 10", "[1-20]", "[1-20:2]", "[1-10] [40-50]")

AUTOMATICALLY ADJUST FOR LENGTH CHANGES

If enabled, this will stretch or compress the frame ranges and transistion ranges if the sequence length grows or shrinks.

61.3 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W, H	Width and height of image.
I	Image index (0 at start frame).
IT	Image time (0 at start frame).
AI	Current plane array index.
PI	Current plane index.
PC	Number of channels in current plane.

62 SEQUENCE COP

62.1 DESCRIPTION

This operation sequences two or more inputs end to end. This operation does not use any cache memory if all the input resolutions match; otherwise for inputs that do not match the output resolution must be scaled or cropped.

62.2 PARAMETERS

PLANE MERGE

If the planes in the inputs differ, this specifies what the output planes should be.

RASTER DEPTH

If the raster depth for a given plane differs between inputs, this specifies when the output raster depth for the plane should be.

RESOLUTION MATCH

If the image resolutions do not match, this parameter specifies what the output resolution should be.

SIZE

If 'Resolution Match' is set to 'Specify Resolution', this parameter specifies the image size.

SCALE TO NEW SIZE

If an input's resolution differs from the output, it will be cropped or extended with black unless this option is selected.

SCALE FILTER

The filter to use when scaling.

FRAME RATE

If the frame rates of the inputs differ, this determines what the output frame rate should be.

63 SHAPE COP

63.1 DESCRIPTION

This COP generates simple shapes, such as circles, stars and regular N-sided polygons. The shape will automatically expand to the largest size possible in the given resolution. Use the transform handle or the transform parameters in the transform page to move and size the shape as needed.

If an input is attached, this COP will add a new plane to the sequence or modify an existing plane.

63.2 PARAMETERS – SHAPE PAGE

SHAPE TYPE

Specifies the shape:

Regular N-sided	Regular polygons, like triangles, pentagons and octagons.
Star	N-pointed stars.
Circle	A perfect circle.
Ring	A circular ring.
Equilateral Triangle	A triangle with all sides equal.
Isosceles Triangle	A triangle with two sides equal.
Rectangle	A rectangle.
Parallelogram	A slanted rectangle.

NUMBER OF SIDES

The number of sides in a Regular N-sided shape.

NUMBER OF POINTS

The number of points in a star.

INNER RADIUS

The inner radius of a star and a ring.

CORNER ANGLE

The slant angle of a parallelogram.

USE SWEEP ANGLES

If on, the start and end sweep angles of circles and rings.

PRESERVE ASPECT RATIO

If on, the 1:1 aspect ratio of the shape is kept even if the image resolution is not 1:1.

63.3 PARAMETERS – FILL PAGE

FILL

The render mode, Solid (filled) or Hollow (outlined).

LEVEL OF DETAIL

The level of detail used when converting circles and rings to polygons before rendering.

FILL OUTSIDE

If on, the 'outside' region is filled instead of the interior (for hollow shapes, the outside region is the region not included by the line thickness).

THICKNESS

For hollow shapes, the thickness of the lines to use, in UV space.

COLOR

The color to render the shape.

63.4 PARAMETERS – TRANSFORM PAGE

A 2D animated transform can be applied to the spline. All units are in UV space.

63.5 IMAGE AND SEQUENCE PAGES

See Color COP > *Parameters – Image Page* p. 547
and *Parameters – Sequence Page* p. 548.

63.6 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W, H	Width and height of image.
I	Image index (0 at start frame).
IT	Image time (0 at start frame).
AI	Current plane array index.
PI	Current plane index.
PC	Number of channels in current plane.

64 SHARPEN COP

64.1 DESCRIPTION

This operation sharpens an image by enhancing the contrast of edges. Increasing the size of the sharpen kernel reduces the pixel noise that a sharpen operation enhances.

64.2 PARAMETERS

SIZE

Increases the size of the areas over which it performs the sharpen (in pixels).

EFFECT

Intensity of the shapen effect.

SHOW EDGES

Only displays the edges.

OPERATION MASK

This operation is a scopable operation that may be masked.

Operation Masking is done with the use of a mask plane (typically M). A mask plane controls which areas of the image are affected by this operation. Where the mask is between 0 (black) and 1 (white), the input is blended with the output. White means full effect, black means no effect (though the mask can be inverted to reverse the effect).

The mask plane can 1 or 3 channels. A single channel mask plane affects all components, whereas a 3 channel mask plane affects each component separately. The mask may be in the first input's plane or attached as a second input.

operation mask

The mask is specified in the first input or the mask input. The mask plane can then be selected from this input's planes. If a component is selected, it is a single channel mask. If a multi-channel plane is selected, it acts a multi-channel mask.

invert mask

If enabled, the mask is inverted so that areas outside the mask are affected instead.

plane scope

Selects the planes or components to modify. If a plane is scoped, all of its components are. i.e.:

`C A`	Color and alpha are scoped.
`C.r A`	The red component of color and alpha are scoped.
`C.r C.g`	The red and green components of color are scoped.
`*`	All planes are scoped.

64.3 PARAMETERS – FRAME SCOPE PAGE

Planes remain unaffected if they are not scoped. The Frame Scope page has parameters for modifying a subrange of the frame range. Frames and planes that are not scoped are passed through the COP without modification.

FRAME SCOPE

Applies the operation to only some frames in the sequence – either All, Inside Range, Outside Range, Even Frames, Odd Frames or Custom.

FRAME RANGE

Specifies the frame range for Inside/Outside Range.

FRAME DROPOFF

Defines transition ranges for before and after the range, which ramp from zero effect to full effect. This controls the amount of the operation applied.

NON-SCOPED EFFECT

Normally the effect on non-scoped frames is zero (bypass frame), but it can be set to non-zero values to produce a reduced or increased effect on non-scoped frames.

FRAME LIST

Allows manual scoping using frame patterns.

`(e.g. "1 5 10", "[1–20]", "[1–20:2]", "[1–10] [40–50]" )`

AUTOMATICALLY ADJUST FOR LENGTH CHANGES

If enabled, this will stretch or compress the frame ranges and transistion ranges if the sequence length grows or shrinks.

64.4 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W, H	Width and height of image.
I	Image index (0 at start frame).
IT	Image time (0 at start frame).
AI	Current plane array index.
PI	Current plane index.
PC	Number of channels in current plane.

65 SHIFT COP

This operation shifts an image sequence in time. An optional second input can be used as a reference, so that this sequence becomes 'linked' to the start or end of the reference sequence and shifts if they change.

This operation does not use any cache memory.

65.1 PARAMETERS

SHIFT METHOD

Sequences can be shifted in several ways if no reference input is connected:

Relative Shift	Shifts the amount specified by the Shift Value.
Shift Start to Shift Value	Starts at the point specified by Shift Value
Shift End to Shift Value	Shifts the image sequence such that it ends at the point specified by the Shift Value.

INPUT SHIFT

If a reference input is connected, several ways of linking the two sequences together can be used. The sequence will always follow any changes in the reference sequence's start or end time.

- Align Start with 2nd Input's Start
- Align End with 2nd Input's End
- Shift To Precede 2nd Input
- Shift To Follow 2nd Input

SHIFT VALUE / UNITS

The amount to shift by (in either frames or seconds).

65.2 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate..
NP	Number of planes in sequence.
W,H	Width and height of image.

66 SHUFFLE COP

66.1 DESCRIPTION

This operation allows you to shuffle frames around to do out-of-order editing. It does not use any cache memory.

This is intended to be an interactive operation, most easily manipulated in the timeline. Drag a frame handle to its new position to move it, and SHIFT-drag a handle to another frame to swap it with that frame.

66.2 PARAMETERS

SHUFFLE FRAMES

A string specifying how the frames are to be moved about.
The format is as follows:

A-B	Move frame A to frame B, moving all frames in between by 1.
A:B	Swap frames A and B.

67 SNIP COP

67.1 DESCRIPTION

This operation either removes frames from a sequence or allows you to order them in a user-defined order. This operation does not use any cache memory.

67.2 PARAMETERS

SNIP

Defines the snip operation, either snipping frames (i.e. cut frames out) or custom editting the sequence (e.g. 11 22 3233 4111...).

SNIP FRAMES

Specifies the frames to snip (if snipping), or the new order of frames (if editting).

DISCARD SNIPPED FRAMES

If on, this will remove the snipped frames; otherwise it will remove all non-snipped frames.

AUTOMATICALLY ADJUST FOR LENGTH CHANGES

If on, when the input sequence change its length, all the frame numbers will be adjusted.

68 SUBNET COP

68.1 DESCRIPTION

This COP contains networks of other COPs. To edit the COPNet contained in this COP, press 'Enter' when the COP is current. When down, press 'u' to jump out of the sub-network.

Selecting *Edit Sub-Network...* from the OP's pop-up menu presents you with a new Network Editor with four sub-network inputs. These four inputs are connected directly to the four inputs on the Sub-net OP in your original network. Proceed by attaching OPs as required to these four sub-network inputs. The display OP will be wired back to the output connector of the Sub-net OP in your original OP network. To get back to the original OP network, go up a level (type U).

The output of the subnet COP is the output of the contained COP with its render flag on. The image data is fetched from that COP; it is not copied again.

68.2 PARAMETERS

INPUT LABELS

The label strings that are seen when clicking on the subnet COP tile's inputs.

69 SWAP COP

69.1 DESCRIPTION

This operation allows you to swap any two channels. These channels can be located in different planes, as long as the data format of both planes match.

69.2 PARAMETERS

SWAP (MULTIPLE ENTRIES)

The first menu allows you to pick a channel from the input image.
The second menu is the channel that it should become.

Cr = Red; Cg = Green; Cb = Blue; and A = Alpha (transparency).

70 SWITCH COP

This COP passes the input of one of its connected inputs through, acting like an exclusive switch. It does not use any image cache space, nor does it cook anything.

70.1 PARAMETERS

INPUT INDEX

The index of the input to pass through.

71 SYSTEM COP

71.1 DESCRIPTION

This operation runs an external program and writes the image data to its STDIN. It reads the data back from the program's STDOUT into the output image. See the *Stand Alone* tools section for more information on the external programmes included with Houdini (i.e. *iTools*).

Note: This command may not work on some configurations.

Tip: If you are on a Windows system, you will need to have *cygwin* installed.

71.2 PARAMETERS

COMMAND

The shell command to be executed.

BACKWARDS COMPATIBLE MODE

Makes the command compatible with the methods used with the former *unix* COP.

PROCESS SINGLE PANES

Allows colour panes to be specified separately.

PLANE SCOPE

Allows you to specify which image planes get processed by the command.

71.3 PARAMETERS – FRAME SCOPE PAGE

Planes remain unaffected if they are not scoped. The Frame Scope page has parameters for modifying a subrange of the frame range. Frames and planes that are not scoped are passed through the COP without modification.

FRAME SCOPE

Applies the operation to only some frames in the sequence – either All, Inside Range, Outside Range, Even Frames, Odd Frames or Custom.

FRAME RANGE

Specifies the frame range for Inside/Outside Range.

FRAME DROPOFF

Defines transition ranges for before and after the range, which ramp from zero effect to full effect. This controls the amount of the operation applied.

NON-SCOPED EFFECT

Normally the effect on non-scoped frames is zero (bypass frame), but it can be set to non-zero values to produce a reduced or increased effect on non-scoped frames.

FRAME LIST

Allows manual scoping using frame patterns.

```
(e.g. "1 5 10", "[1-20]", "[1-20:2]", "[1-10] [40-50]" )
```

AUTOMATICALLY ADJUST FOR LENGTH CHANGES

If enabled, this will stretch or compress the frame ranges and transistion ranges if the sequence length grows or shrinks.

71.4 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W, H	Width and height of image.
I	Image index (0 at start frame).
IT	Image time (0 at start frame).
AI	Current plane array index.
PI	Current plane index.
PC	Number of channels in current plane.

72 TILE COP

This operation tiles the image sequence with multiple copies of the input image.

72.1 PARAMETERS

TILING

Specify the number of copies of the input image to tile here.

TILE OFFSET

Allows you to set the origin of the tiling (uses UV 0-1 ranges)

TILE METHOD

Allows you to mirror the copies you're tiling.

73 TIME FILTER COP

This operation applies a blur filter to a series of frames around the current frame. It produces a time smoothing effect.

This operation is implemented in VEX. Right click ( ) on the '?' at the top of the parameters for VEX help.

73.1 PARAMETERS

FILTER WIDTH

The size of the filter, in frames.

BLUR EFFECT

The amount of blur to apply (0 = none, 1 = full effect).

FILTER TYPE

The type of blur filter to apply - box, hanning (triangle) or Gaussian.

FILTER RANGE

What frames are filtered:

Before Current	The frames from '*current*' to '*current - filterwidth*' are filtered.
Centered About Current	The frames from '*current - filterwidth/2*' to '*current - filterwidth/2 + filterwidth*' .
After Current	The frames from 'current' to 'current + filterwidth' .

BEFORE START

If a filtered frame is before the beginning of the sequence, this determines what frame to use:

Black	A black frame.
Cycle	Cycle back into the sequence from the end (so two frames before the start will use frame '*end-2*').
Mirror	Mirror back into the sequence (so 2 frames before will use frame '*start+2*').
Hole	Use the first frame.

AFTER END

Similar to *Before Start*, except this parameter determines what frame to use if filtering goes past the last frame of the sequence.

73.2 PARAMETERS – FRAME SCOPE PAGE

Planes remain unaffected if they are not scoped. The Frame Scope page has parameters for modifying a subrange of the frame range. Frames and planes that are not scoped are passed through the COP without modification.

FRAME SCOPE

Applies the operation to only some frames in the sequence – either All, Inside Range, Outside Range, Even Frames, Odd Frames or Custom.

FRAME RANGE

Specifies the frame range for Inside/Outside Range.

FRAME DROPOFF

Defines transition ranges for before and after the range, which ramp from zero effect to full effect. This controls the amount of the operation applied.

NON-SCOPED EFFECT

Normally the effect on non-scoped frames is zero (bypass frame), but it can be set to non-zero values to produce a reduced or increased effect on non-scoped frames.

FRAME LIST

Allows manual scoping using frame patterns.

```
(e.g. "1 5 10", "[1-20]", "[1-20:2]", "[1-10] [40-50]" )
```

AUTOMATICALLY ADJUST FOR LENGTH CHANGES

If enabled, this will stretch or compress the frame ranges and transistion ranges if the sequence length grows or shrinks.

73.3 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W, H	Width and height of image.
I	Image index (0 at start frame).
IT	Image time (0 at start frame).
AI	Current plane array index.
PI	Current plane index.
PC	Number of channels in current plane.

73.4 SEE ALSO

- *Time Warp COP* p. 693
- *Time Machine COP* p. 689
- *Time Scale COP* p. 687
- *Shift COP* p. 675
- *Trim COP* p. 696

74 TIME SCALE COP

74.1 DESCRIPTION

This operation stretches or compresses a sequence in time. Frames are either dropped, doubled or interpolated. If interpolation is not used, this operation will not use any cache memory.

74.2 PARAMETERS

SCALE METHOD

Select a method for changing the timing:

Modify Sequence Length Only
: Changes the length of the sequence without changing the frame rate; the sequence will be longer or shorter in time.

Modify Sequence Length, Same Time Span
: Changes the length of the sequence and adjusts the frame rate so the sequence is the same time length.

Modify Frame Rate Only
: Only changes the frame rate. The sequence becomes longer or shorter, but the number of frames stays the same.

Modify Frame Rate, Same Time Span
: Changes the frame rate and increases or decreases the number of frames to keep the sequence the same time length.

INTERPOLATION

When increasing or decreasing the number of frames in the sequence, this parameter determines the frame(s) to use for the output frames.

Previous Frame
: Uses the input frame exactly at or before the time of the output frame.

Closest Frame
: Uses the input frame exactly at or closest to the time of the output frame.

Next Frame
: Uses the input frame exactly at or after the time of the output frame.

Blend Nearest Frames
: Picks the two closest frames and linearly blends them together, weighting them with how close each input frames' time is to the output frame.

FRAME RATE

The frame rate, for methods that require it.

LENGTH METHOD

Specifies how to changes the length of the sequence, for Scale Methods that require it (see below).

LENGTH SCALE

Changes the length of the sequence by a scale factor.
Scales greater than 1 increase the length, scales less than 1 decrease it.

SEQUENCE LENGTH

Specifies the new length of the sequence, in frames.

LENGTH DIFFERENCE

Specifies how many frames to add or subtract from the input sequence length.

74.3 LOCAL VARIABLES:

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W,H	Width and height of image.

75 TIME MACHINE COP

This operation uses a second input to time warp the first input on a per pixel basis. The second input image is interpreted as a ramp, where black pixels adjust the frame by 'Black Pixel Frame' and white pixels adjust the frame by 'White Pixel Frame'. Grey values linearly interpolate between these two frame values.

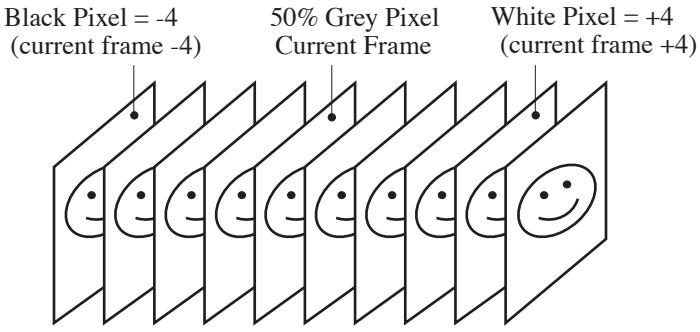
For Veterans: This performs the same function as the old Tima COP if you turn off the *Relative to Current Frame* button.

FEATURES OF THE TIME MACHINE

- Simple setups produce interesting imagery quickly.
- Effects that are not possible or practical on current video hardware include: Corkscrew twists, Slit-scan, Live-action squash and stretch, simultaneous front and back viewing, and eerie time delays.
- Time blurring produces forward and backward blurred trails.
- Non-linear timing changes give effects like smooth back and forth motion.
- Built-in temporal anti-aliasing creates smoother looking rapid transitions.

HOW IT WORKS

A pixel at location XY in the output is made of pixels from the same XY location of any of the input images. To determine which frame is used to supply the pixel at the XY location, the number of frames forward or backwards relative to the current frame is made dependent on the greyscale value of the shifter image at that same XY location. As long as the Blend Frames button is checked, the results will be temporally anti-aliased so that no spatial distortion occurs.



In creating an output image, you can compose things that are physically impossible because you are sampling from many input images. For example, you can see the front side and the back side of an object simultaneously if it is rotating in the shot. This is a similar to the classic film slit scan technique, yet is highly interactive.

The Time Machine samples a range of images from the Input 1 sequence based on time shifter images (Input 2). The output will have the same number of frames as the time shifter. The black intensities in the shifter will output source pixels at the first time range offset, while the white shifter intensities generate source pixels from the second time range offset. If the black and white pixels are set to the same amount forwards and backwards, then a 50% grey time shifter will not shift time (otherwise it is linearly interpolated between the two extents).

75.1 PARAMETERS

BLACK / WHITE PIXEL FRAME

The expressions in this field designates the number of frames (forward or backward) Houdini will look for the black/white pixel value to insert into the current frame. In the example above, the black pixel value from the frame 10 behind the current one will be used.

For Veterans: This performs the same function as the old Tima COP if you turn off the *Relative to Current Frame* button.

RELATIVE TO CURRENT FRAME

If enabled, the pixel values will be relative to current frame (e.g. -4 means black pixels will look back four frames). If disabled, you would have to use: $F-4 instead.

BLEND FRAMES

Performs temporal anti-aliasing – blending the values of past and present pixels if you go back a fractional frame in time.

BEFORE START/ AFTER END

When there are no more frames to sample, these parameters tell Houdini to either hold, cycle, mirror, or use black for frames that are out of range.

OPERATION MASK

This operation is a scopable operation that may be masked.

Operation Masking is done with the use of a mask plane (typically M). A mask plane controls which areas of the image are affected by this operation. Where the mask is between 0 (black) and 1 (white), the input is blended with the output. White means full effect, black means no effect (though the mask can be inverted to reverse the effect).

The mask plane can 1 or 3 channels. A single channel mask plane affects all components, whereas a 3 channel mask plane affects each component separately. The mask may be in the first input's plane or attached as a second input.

operation mask

The mask is specified in the first input or the mask input. The mask plane can then be selected from this input's planes. If a component is selected, it is a single channel mask. If a multi-channel plane is selected, it acts a multi-channel mask.

invert mask

If enabled, the mask is inverted so that areas outside the mask are affected instead.

plane scope

Selects the planes or components to modify. If a plane is scoped, all of its components are. i.e.:

`C A`	Color and alpha are scoped.
`C.r A`	The red component of color and alpha are scoped.
`C.r C.g`	The red and green components of color are scoped.
`*`	All planes are scoped.

75.2 PARAMETERS – FRAME SCOPE PAGE

Planes remain unaffected if they are not scoped. The Frame Scope page has parameters for modifying a subrange of the frame range. Frames and planes that are not scoped are passed through the COP without modification.

FRAME SCOPE

Applies the operation to only some frames in the sequence – either All, Inside Range, Outside Range, Even Frames, Odd Frames or Custom.

FRAME RANGE

Specifies the frame range for Inside/Outside Range.

FRAME DROPOFF

Defines transition ranges for before and after the range, which ramp from zero effect to full effect. This controls the amount of the operation applied.

NON-SCOPED EFFECT

Normally the effect on non-scoped frames is zero (bypass frame), but it can be set to non-zero values to produce a reduced or increased effect on non-scoped frames.

FRAME LIST

Allows manual scoping using frame patterns.

`(e.g. "1 5 10", "[1–20]", "[1–20:2]", "[1–10] [40–50]" )`

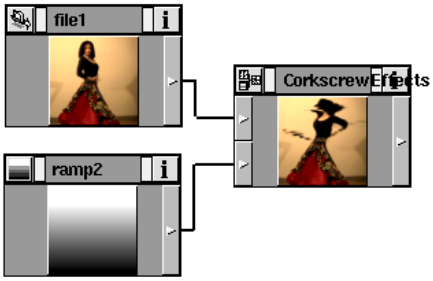
AUTOMATICALLY ADJUST FOR LENGTH CHANGES

If enabled, this will stretch or compress the frame ranges and transistion ranges if the sequence length grows or shrinks.

75.3 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W, H	Width and height of image.
I	Image index (0 at start frame).
IT	Image time (0 at start frame).
AI	Current plane array index.
PI	Current plane index.
PC	Number of channels in current plane.

75.4 EXAMPLE – CORKSCREW



By using a ramp image as an input for the time shifter images, and setting the Black Pixels to: -10 and the White Pixels to: +10, you will get an effect where the dancer – who turns 360˚ in the live footage – appears to be become twisted like a corkscrew.

76 TIME WARP COP

76.1 DESCRIPTION

This operation warps time by speeding up or slowing down the apparent playback rate of the sequence.

This operation does not use any cache memory as long as 'Frame Round' is not set to 'Blend Frames'.

76.2 PARAMETERS

WARP METHOD

Allows you to control the warping using either an expression or a CHOP channel.

INDEX

The expression to control the amount of warping.

Tip: Try an index expression of: *$I + sin($I*5)*

CHOP / NET

If you've set the Warp Method to CHOP, you should specify the CHOP here.

FRAME ROUND

Rounds to the: *Nearest*, *Previous*, or *Next Frame*.

If you select *Blend Frame*, it will perform the necessary temporal aliasing to provide a smooth result.

77 TRANSFORM COP

77.1 DESCRIPTION

This operation translates, rotates and/or scales the input image without changing the image resolution. The transform is anti-aliased, and done in Translate, Scale, Rotate order (TSR).

77.2 PARAMETERS – TRANSFORM PAGE

UNITS

Selects pixels or UV units for the transforms.

TRANSLATE

The UV translation, in pixels or UV units.

ROTATE

The rotation to apply to the image.

SCALE

The scale to apply to the image.

PIVOT

The pivot offset from the newly translated image origin, around which the image is rotated and scaled.

X/Y FILTERS

The filter(s) to use when transforming.

FILTER SIZE

The size of the filter (normally 1). Larger values produce a more blurred transform, while smaller values do less anti-aliasing.

IMAGE WRAP

How to wrap the image when outside its bounds (repeat, clamp, decal, mirror)

77.3 PARAMETERS – FRAME SCOPE PAGE

Planes remain unaffected if they are not scoped. The Frame Scope page has parameters for modifying a subrange of the frame range. Frames and planes that are not scoped are passed through the COP without modification.

FRAME SCOPE

Applies the operation to only some frames in the sequence – either All, Inside Range, Outside Range, Even Frames, Odd Frames or Custom.

FRAME RANGE

Specifies the frame range for Inside/Outside Range.

FRAME DROPOFF

Defines transition ranges for before and after the range, which ramp from zero effect to full effect. This controls the amount of the operation applied.

NON-SCOPED EFFECT

Normally the effect on non-scoped frames is zero (bypass frame), but it can be set to non-zero values to produce a reduced or increased effect on non-scoped frames.

FRAME LIST

Allows manual scoping using frame patterns.

```
(e.g. "1 5 10", "[1-20]", "[1-20:2]", "[1-10] [40-50]" )
```

AUTOMATICALLY ADJUST FOR LENGTH CHANGES

If enabled, this will stretch or compress the frame ranges and transistion ranges if the sequence length grows or shrinks.

77.4 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W, H	Width and height of image.
I	Image index (0 at start frame).
IT	Image time (0 at start frame).
AI	Current plane array index.
PI	Current plane index.
PC	Number of channels in current plane.

78 TRIM COP

78.1 DESCRIPTION

This operation trims an input sequence in time by adjusting the beginning or the end of the sequence. If the start time is moved beyond the beginning of the sequence, the pre-extend option of the sequence is used to determine the image (similarly with the end, using post-extend).

Tip: This operation is best viewed in the Timeline.

78.2 PARAMETERS

TRIM

Relative to Current Start/End
Trim values represent start/end offsets.

Absolute Start/End Values Trim values are start/end frames.

Single Image Trim a single image out of the sequence by specifying the frame.

Single Image Relative to Start
Trim a single image out of the sequence by an offset from the start.

Single Image Relative to End
Trim a single image out of the sequence by an offset from the end.

UNITS

Specify Frames or Seconds.

START / END

The beginning and ending of the trimmed portion.

78.3 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W,H	Width and height of image.

79 VECTOR COP

79.1 DESCRIPTION

This operation performs vector operations on the input. The input planes are considered to be arbitrary vectors (either 2, 3 or 4 elements). Scalar planes (like alpha) are treated like 1 element vectors.

The second input is an optional mask for the operation. A mask is a single component of a plane which determines which areas of the image are affected by this operation. Where the mask is between zero and one, the input is blended with the output. White means full effect, black means no effect (though the mask can be inverted to reverse the effect).

This is a collapsable pixel operation. When placed in sequence with other collapsable pixel operations, the operations are combined into one operation at the final node in the sequence. This only quantizes the data once and allows the intermediate operations to produce and carry values outside the normal range of the pixels' data format, reducing quantization error and clipping.

79.2 PARAMETERS – VECTOR PAGE

OPERATION

Specifies the operation to perform:

Normalize Vectors	Scales all components so the magnitude is exactly 1.
Transform Points	Transforms the vectors as if they were points by the following Transform parameters.
Orient Vectors	Rotates the vectors as if they were normals.

TRANSFORM

(Order, Translate, Rotate, Pivot, Uniform Scale)

Defines the transformation for transforming the vectors.

QUANTIZE

If this node is in the middle of a collapsable pixel chain, you can force this node to quantize and store the images as if it were the final node.

OPERATION MASK

Normally the mask is specified by the second input, however, you can also pick a mask from the first input as well.

INVERT MASK

If on, the operation mask is inverted before the operation is performed.

PLANE SCOPE

Selects the planes or components to modify.

79.3 PARAMETERS – FRAME SCOPE PAGE

Planes remain unaffected if they are not scoped. The Frame Scope page has parameters for modifying a subrange of the frame range. Frames and planes that are not scoped are passed through the COP without modification.

FRAME SCOPE

Applies the operation to only some frames in the sequence – either All, Inside Range, Outside Range, Even Frames, Odd Frames or Custom.

FRAME RANGE

Specifies the frame range for Inside/Outside Range.

FRAME DROPOFF

Defines transition ranges for before and after the range, which ramp from zero effect to full effect. This controls the amount of the operation applied.

NON-SCOPED EFFECT

Normally the effect on non-scoped frames is zero (bypass frame), but it can be set to non-zero values to produce a reduced or increased effect on non-scoped frames.

FRAME LIST

Allows manual scoping using frame patterns.

```
(e.g. "1 5 10", "[1-20]", "[1-20:2]", "[1-10] [40-50]" )
```

AUTOMATICALLY ADJUST FOR LENGTH CHANGES

If enabled, this will stretch or compress the frame ranges and transistion ranges if the sequence length grows or shrinks.

79.4 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W, H	Width and height of image.
I	Image index (0 at start frame).
IT	Image time (0 at start frame).
AI	Current plane array index.
PI	Current plane index.
PC	Number of channels in current plane.

80 VEX GENERATE COP

This COP runs a VEX script on the planes it generates. The VEX script should not read from R,G,B,A, C1,C2,C3 or C4. The VEX script should write to C1, C2, C3 and C4 (components 1 to 4 of each vector).

80.1 PARAMETERS – VEX GENERATE PAGE

VEX FUNCTION

The VEX script to run, with any parameter arguments you wish to override.

RELOAD VEX FUNCTIONS

Reloads the VEX script. Useful if the script has been modified and re-compiled.

80.2 PARAMETERS – IMAGE PAGE

SIZE

The resolution of the image.

ASPECT RATIO

The ratio of width to height of the image.

IMAGE PLANES

If there is no input attached, this menu allows you to quickly generate different types of planes.

ADD PLANE

If an input is attached, this menu allows you to choose which plane to generate, modify or replace.

CUSTOM PLANES

This string parm allows you to specify your own plane formats. The syntax is:

```
planename(arraysize){comp1,comp2,comp3,comp4}:format(black,white)
```

All parts are optional except for planename. arraysize is optional and must be 1 or greater. comp1-4 are arbitrary strings representing the component names. 'format' is either i8, i16, i32 or f32. black and white are integers representing the black and white points for integer formats.

RASTER DEPTH

The depth of the planes generated.

BLACK/WHITE POINTS

Enable this to specify black and white points.

INTERLACING

Allows you to generate interlaced images:

None	Normal image.
Black Interlaced	Black scanlines are inserted.
Half Res Interlaced	Image is compressed vertically by 1/2.
Line Doubled	Same as *Half Res*, only two lines are used for each halved scanline.

The second menu controls the field dominance of the sequence.

80.3 PARAMETERS – SEQUENCE PAGE

SINGLE IMAGE

If enabled, it overrides everything, and there will be only 1 image and it exists at all frames; the frame range and rate are not used.

START FRAME

The start of the sequence.

LENGTH

The length of the sequence.

FRAME RATE

Enable this to set the frame rate of the sequence.

PRE/POST EXTEND

How the sequence behaves outside its frame range:

Black Frames	Frames are black (zero).
Cycle	The sequence is cycled, 1,2,3,4 / 1,2,3,4.
Mirror	The sequence is mirrored, 1,2,3,4 / 3,2,1.

Hold	The first/last frame is held forever.
Hold for N Frames	The first or last frame is held for some number of frames, before or after which black frames are used.

PRE/POST HOLD

If Extend is set to 'Hold for N Frames', then this speficies the number of frames for which to hold.

80.4 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W, H	Width and height of image.
I	Image index (0 at start frame).
IT	Image time (0 at start frame).
AI	Current plane array index.
PI	Current plane index.
PC	Number of channels in current plane.

81 VEX FILTER COP

81.1 DESCRIPTION

This operation runs a VEX script on its input planes.

81.2 PARAMETERS - VEX FILTER PAGE

VEX FUNCTION

The VEX script to run, with any parameter arguments you wish to override.

RELOAD VEX FUNCTIONS

Reloads the VEX script. Useful if the script has been modified and re-compiled.

OPERATION MASK

Normally the mask is specified by the second input. However, you can also pick a mask from the first input as well.

INVERT MASK

If on, the operation mask is inverted before the operation is performed.

PLANE SCOPE

Selects the planes or components to modify.

81.3 PARAMETERS – FRAME SCOPE PAGE

Planes remain unaffected if they are not scoped. The Frame Scope page has parameters for modifying a subrange of the frame range. Frames and planes that are not scoped are passed through the COP without modification.

FRAME SCOPE

Applies the operation to only some frames in the sequence – either All, Inside Range, Outside Range, Even Frames, Odd Frames or Custom.

FRAME RANGE

Specifies the frame range for Inside/Outside Range.

FRAME DROPOFF

Defines transition ranges for before and after the range, which ramp from zero effect to full effect. This controls the amount of the operation applied.

NON-SCOPED EFFECT

Normally the effect on non-scoped frames is zero (bypass frame), but it can be set to non-zero values to produce a reduced or increased effect on non-scoped frames.

FRAME LIST

Allows manual scoping using frame patterns.

```
(e.g. "1 5 10", "[1-20]", "[1-20:2]", "[1-10] [40-50]" )
```

AUTOMATICALLY ADJUST FOR LENGTH CHANGES

If enabled, this will stretch or compress the frame ranges and transistion ranges if the sequence length grows or shrinks.

81.4 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W, H	Width and height of image.
I	Image index (0 at start frame).
IT	Image time (0 at start frame).
AI	Current plane array index.
PI	Current plane index.
PC	Number of channels in current plane.

82 VELOCITY BLUR COP

82.1 DESCRIPTION

This operation blurs an image by using pixel velocity to produce a motion blur effect. The velocity is read from the velocity plane. Velocity planes can be output by surface shaders which export the geometry's velocity attribute.

This operation is implemented in VEX.

82.2 PARAMETERS

QUALITY

Affects the smoothness of the blur. Higher qualities take more samples per pixel to blur.

VELOCITY SCALE

Uniformly scales velocity to change the amount of blur.

PER PIXEL VELOCITY

If on, the velocity plane is used to determine the blur on a per-pixel basis. If off, a global velocity vector is used.

VELOCITY PLANE

The name of the velocity plane.

ACCURATE VELOCITY LOOKUPS

If on, the velocity is "followed" by sampling the velocity at each point, resulting potentially curved blur streaks. If off, only the initial velocity is used and the blur streaks are straight.

VELOCITY VECTOR

If Per Pixel Velocity if off, this is the global velocity vector that is used to produce a streaking blur.

START BLUR SCALE

The start blur factor. The first blurred pixel is multiplied by this value.

END BLUR SCALE

The end blur factor. The last blurred pixel is multiplied by this value.

BLUR DROPOFF

The interpolation function for pixel samples in between the start and end pixels.

FILTERING

The pixel sampling filter.

None	Quick, low quality filter.
Bilinear	Medium quality filter.
Full Filtered	Slow, high quality filter.

CORRECT FOR IMAGE ASPECT

If on, the blur is adjusted so it appears circular if the image aspect ratio isn't square.

OUTSIDE BOUNDS

Specifies the sampling method for pixels outside the image.

OPERATION MASK

This operation is a scopable operation that may be masked.

Operation Masking is done with the use of a mask plane (typically M). A mask plane controls which areas of the image are affected by this operation. Where the mask is between 0 (black) and 1 (white), the input is blended with the output. White means full effect, black means no effect (though the mask can be inverted to reverse the effect).

The mask plane can 1 or 3 channels. A single channel mask plane affects all components, whereas a 3 channel mask plane affects each component separately. The mask may be in the first input's plane or attached as a second input.

operation mask

The mask is specified in the first input or the mask input. The mask plane can then be selected from this input's planes. If a component is selected, it is a single channel mask. If a multi-channel plane is selected, it acts a multi-channel mask.

invert mask

If enabled, the mask is inverted so that areas outside the mask are affected instead.

plane scope

Selects the planes or components to modify. If a plane is scoped, all of its components are. i.e.:

`C A`	Color and alpha are scoped.
`C.r A`	The red component of color and alpha are scoped.
`C.r C.g`	The red and green components of color are scoped.
`*`	All planes are scoped.

82.3 PARAMETERS – FRAME SCOPE PAGE

Planes remain unaffected if they are not scoped. The Frame Scope page has parameters for modifying a subrange of the frame range. Frames and planes that are not scoped are passed through the COP without modification.

FRAME SCOPE

Applies the operation to only some frames in the sequence – either All, Inside Range, Outside Range, Even Frames, Odd Frames or Custom.

FRAME RANGE

Specifies the frame range for Inside/Outside Range.

FRAME DROPOFF

Defines transition ranges for before and after the range, which ramp from zero effect to full effect. This controls the amount of the operation applied.

NON-SCOPED EFFECT

Normally the effect on non-scoped frames is zero (bypass frame), but it can be set to non-zero values to produce a reduced or increased effect on non-scoped frames.

FRAME LIST

Allows manual scoping using frame patterns.

`(e.g. "1 5 10", "[1-20]", "[1-20:2]", "[1-10] [40-50]" )`

AUTOMATICALLY ADJUST FOR LENGTH CHANGES

If enabled, this will stretch or compress the frame ranges and transistion ranges if the sequence length grows or shrinks.

82.4 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W, H	Width and height of image.
I	Image index (0 at start frame).
IT	Image time (0 at start frame).
AI	Current plane array index.
PI	Current plane index.
PC	Number of channels in current plane.

83 WIPE COP

83.1 DESCRIPTION

This operation does a wipe between two input sequences.
This operation is implemented in VEX.

83.2 PARAMETERS – WIPE PAGE

OPERATION

The wipe to perform:

- Cross Dissolve
- Per Pixel Flip
- Vertical Wipe
- Horizontal Wipe
- 4 Corner Shrink
- Circular Shrink
- AA Circular Shrink

AMOUNT

The wipe position. Zero is fully input 1, one is fully input 2.

DRAW LINE

If on, a line is drawn at the wipe border.

LINE WIDTH

The width of the line drawn (fraction of the height/width).

LINE COLOR

The color of the line drawn.

OPERATION MASK

Normally the mask is specified by the second input, however, you can also pick a mask from the first input as well.

INVERT MASK

If on, the operation mask is inverted before the operation is performed.

PLANE SCOPE

Selects the planes or components to modify.

83.3 PARAMETERS – FRAME SCOPE PAGE

Planes remain unaffected if they are not scoped. The Frame Scope page has parameters for modifying a subrange of the frame range. Frames and planes that are not scoped are passed through the COP without modification.

FRAME SCOPE

Applies the operation to only some frames in the sequence – either All, Inside Range, Outside Range, Even Frames, Odd Frames or Custom.

FRAME RANGE

Specifies the frame range for Inside/Outside Range.

FRAME DROPOFF

Defines transition ranges for before and after the range, which ramp from zero effect to full effect. This controls the amount of the operation applied.

NON-SCOPED EFFECT

Normally the effect on non-scoped frames is zero (bypass frame), but it can be set to non-zero values to produce a reduced or increased effect on non-scoped frames.

FRAME LIST

Allows manual scoping using frame patterns.

```
(e.g. "1 5 10", "[1–20]", "[1–20:2]", "[1–10] [40–50]" )
```

AUTOMATICALLY ADJUST FOR LENGTH CHANGES

If enabled, this will stretch or compress the frame ranges and transistion ranges if the sequence length grows or shrinks.

83.4 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W, H	Width and height of image.
I	Image index (0 at start frame).
IT	Image time (0 at start frame).
AI	Current plane array index.
PI	Current plane index.
PC	Number of channels in current plane.

84 Z COMP COP

84.1 DESCRIPTION

This operation does a Z composite of two images. At least one image should have a depth or point plane containing depth information.

84.2 PARAMETERS

FOREGROUND OFFSET

Allows you to specify an offset Z-depth for the foreground image.

USE DEPTH PLANE FOR BACKGROUND

The background will use a depth plane.
Specify this depth with the *Background Depth* parameter.

USE DEPTH PLANE FOR FOREGROUND

The foreground will use a depth plane.
Specify this depth with the *Foreground Depth* parameter.

DEPTH / POINT PLANE

Specify the plane to use for the depth (typically 'P').

SUPERSAMPLE

To get higher quality, you can supersample the image.

OPERATION MASK

This operation is a scopable operation that may be masked.

Operation Masking is done with the use of a mask plane (typically M). A mask plane controls which areas of the image are affected by this operation. Where the mask is between 0 (black) and 1 (white), the input is blended with the output. White means full effect, black means no effect (though the mask can be inverted to reverse the effect).

The mask plane can 1 or 3 channels. A single channel mask plane affects all components, whereas a 3 channel mask plane affects each component separately. The mask may be in the first input's plane or attached as a second input.

operation mask

The mask is specified in the first input or the mask input. The mask plane can then be selected from this input's planes. If a component is selected, it is a single channel mask. If a multi-channel plane is selected, it acts a multi-channel mask.

invert mask

If enabled, the mask is inverted so that areas outside the mask are affected instead.

plane scope

Selects the planes or components to modify. If a plane is scoped, all of its components are. i.e.:

`C A`	Color and alpha are scoped.
`C.r A`	The red component of color and alpha are scoped.
`C.r C.g`	The red and green components of color are scoped.
`*`	All planes are scoped.

84.3 PARAMETERS – FRAME SCOPE PAGE

Planes remain unaffected if they are not scoped. The Frame Scope page has parameters for modifying a subrange of the frame range. Frames and planes that are not scoped are passed through the COP without modification.

FRAME SCOPE

Applies the operation to only some frames in the sequence – either All, Inside Range, Outside Range, Even Frames, Odd Frames or Custom.

FRAME RANGE

Specifies the frame range for Inside/Outside Range.

FRAME DROPOFF

Defines transition ranges for before and after the range, which ramp from zero effect to full effect. This controls the amount of the operation applied.

NON-SCOPED EFFECT

Normally the effect on non-scoped frames is zero (bypass frame), but it can be set to non-zero values to produce a reduced or increased effect on non-scoped frames.

FRAME LIST

Allows manual scoping using frame patterns.

`(e.g. "1 5 10", "[1-20]", "[1-20:2]", "[1-10] [40-50]" )`

AUTOMATICALLY ADJUST FOR LENGTH CHANGES

If enabled, this will stretch or compress the frame ranges and transistion ranges if the sequence length grows or shrinks.

84.4 LOCAL VARIABLES

L	Sequence length.
S	Start of sequence.
E	End of sequence.
IL	Input sequence length.
SR	Sequence frame rate.
NP	Number of planes in sequence.
W, H	Width and height of image.
I	Image index (0 at start frame).
IT	Image time (0 at start frame).
AI	Current plane array index.
PI	Current plane index.
PC	Number of channels in current plane.