PART 10

Chapter 79

Resolve Live

Resolve Live

The Color page has another mode available to aid you in using DaVinci Resolve in on-set grading workflows. Turning the Resolve Live option on puts DaVinci Resolve into a live grading mode, in which an incoming video signal from a camera can be monitored and graded during a shoot.

This chapter covers the following topics:

More About Resolve Live

Resolve Live has been designed to let you use all of the features of DaVinci Resolve to grade these on-set video previews, in the process saving video snapshots that contain a captured image, your grade, and reference timecode from the camera. The idea is that, using Resolve Live, you can work with the cinematographer to develop looks and test lighting schemes on the footage being captured during the shoot, and then later you can use those looks to build dailies, and as a starting point for the final grade once the edit has been completed.

Additionally, you can use Resolve Live in conjunction with other Color page features such as the Alpha Output to build test composites to check check green screen shots, comparing them against imported background images in order to aid camera positioning and lighting adjustments. The built-in video scopes can also be used to monitor the signal levels of incoming video. Finally, you can use 1D and 3D LUTs to monitor and grade log-encoded media coming off the camera.

Configuring Your System for Resolve Live

Setting up Resolve Live is straightforward. Whether your'e using a tower workstation or a laptop, any of the Blackmagic Design DeckLink or UltraStudio video interfaces can be used to connect your DaVinci Resolve workstation to a camera and external video display. The important thing to keep in mind is that, if you want to connect to a live incoming signal and output that signal for monitoring at the same time, you need to either use two separate DeckLink PCIe cards or UltraStudio Thunderbolt interfaces, or a single DeckLink Duo or DeckLink Studio card with multiple separate inputs and outputs on a single PCIe card.

The Video and Audio I/O panel of the System Preferences provides two sets of options for configuring video interfaces connected to your computer, one for capture and playback, and one for Resolve Live input. If you only have a single video interface, you can only do one or the other. If you have two interfaces, then you can use these options to use one interface for playback, and the other interface for Resolve Live.
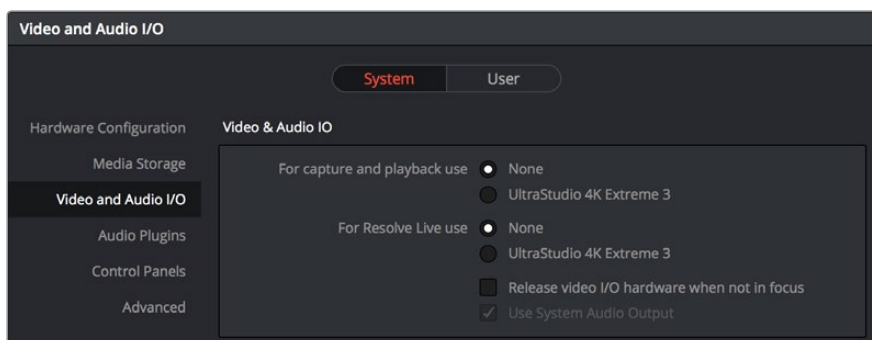
Video input/output options in the System Preferences

During the shoot, the digital cinema camera in use needs to be connected to your DaVinci Resolve workstation via HD-SDI, which must be configured to carry both the video image and timecode that mirrors the timecode being written to each recorded clip. Most cameras allow timecode output over HD-SDI, and both DeckLink and UltraStudio interfaces can pass this timecode to DaVinci Resolve. Without a proper timecode reference, you won't be able to take the shortcut of automatically syncing your saved Snapshots to recorded camera original media using ColorTrace, although you can always apply grades manually.

If you're shooting with any of the Blackmagic Design cameras, you also have the option of connecting the camera directly to your Resolve Live workstation using Thunderbolt, eliminating the need for a second video interface. In this configuration, Thunderbolt carries both video and timecode for easy capture by DaVinci Resolve.

Grading Live

Once your camera and computer are appropriately connected and configured, using Resolve Live is straightforward. This section describes the live grading workflow as it was designed to be used. Once you're familiar with the capabilities of Resolve Live, you may find your own ways of working that are more in tune to the needs of your particular project.

Getting Started

When working with Resolve Live on a new shoot, you should begin with an empty project and a new empty timeline, since the live grading workflow involves capturing live graded snapshots to an otherwise unoccupied timeline. One recommended way of organizing the live grades of a shoot is to create one new project per day of shooting. This way, snapshots captured during shoots using all 24 hours of time-of-day timecode won't conflict with one another. Also, separate projects can make it easier to use ColorTrace to copy grades from your live grade snapshots to the camera original media you'll be creating dailies from, eventually.

> **TIP:** Having an empty Media Pool and timeline doesn't mean you can't install useful LUTs and pre-import reference stills and saved grades to the Gallery, as these can be valuable tools for expediting your on-set grading.

Once you've created your new project, you also need to choose the disk where all snapshots you take will be saved. By default, snapshots are saved on the scratch disk at the top of the Scratch Disks list in the Media Storage panel of the System Preferences. They're automatically saved in a folder named identically to the current project.
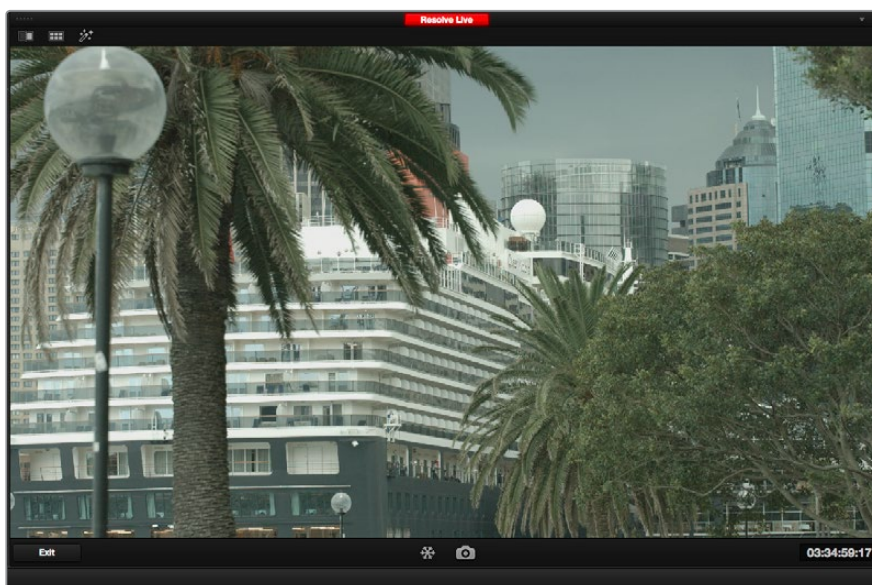
Going Live

Once you've created your day's project, you need to turn on Resolve Live to begin work.

To turn on Resolve Live:

1   Open the Color page.

2   Choose Color > Resolve Live (Command-R).

    A red Resolve Live badge at the top of the Viewer indicates that Resolve Live is turned on, and the transport controls are replaced by the Freeze and Snapshot buttons.

A red badge shows that Resolve Live is active and showing incoming video from the camera

At this point, the video from the connected camera should become visible within the Viewer, the camera timecode should be displayed in the Viewer's timecode window, and you can begin using all of the capabilities of the Color page to begin grading whatever is onscreen, including Gallery split-screens for matching and comparing. The current color adjustments in all palettes are automatically applied to both the image in the Viewer and the video output to an external display (if there is one).

While Resolve Live is on, much of DaVinci Resolve's non-grading functionality is disabled, so when you're finished, be sure to turn Resolve Live off.

**To turn off Resolve Live, do one of the following:**

- Click the Exit button at the bottom left-hand corner of the Viewer.
- Choose Color > Resolve Live (Command-R).

Using Freeze

In Resolve Live mode, the Freeze button (it looks like a snowflake) freezes the current incoming video frame, so you can grade it without being distracted by motion occurring during the shoot. When you've made the adjustment you need, you can unfreeze playback in preparation for grabbing a snapshot.

To freeze incoming video:

- Click the Freeze button (that looks like a snowflake).
- Choose Color > Resolve Live Freeze (Shift-Command-R).
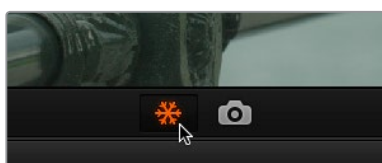
The snowflake button freezes the image so you can grade a particular frame

Using Snapshot

Once you're happy with a grade, clicking the Snapshot button saves a snapshot of the current still in the Viewer, the incoming timecode value, and your grade into the Timeline. Snapshots are simply one-frame clips. They use grades and versions just like any other clip. In fact, ultimately there's no difference between the timeline created by a Resolve Live session and any other timeline, other than that the Resolve Live timeline only has a series of one frame clips, which appear in the Timeline of the Edit page as s series of 1-frame stills.

To save a Snapshot, do one of the following:

- Click the snapshot button (with a camera icon).
- Choose Color > Resolve Live Snapshot (Command-Option-R).
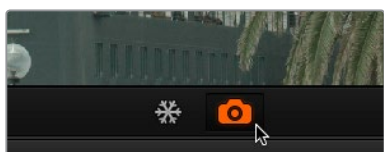
The snapshot button saves a frame and the grade for future use

For example, you may begin the process of building and refining a grade for a particular scene during an unrecorded run-through. Then, once shooting starts, you may take snapshots of each shot's slate, and then of significant takes that follow, tweaking where necessary and in conjunction with the DP's feedback once things get going. New camera setups may require further tweaks, which you'll save as snapshots for those shots, and as you work in this way you'll find yourself building up a timeline of snapshots that correspond to that day's shoot.

As you work, keep in mind that you must temporarily turn Resolve Live off in order to open a grade from a previous snapshot in the Timeline, in order to use it as a starting point for another shot. You can also save grades into the Gallery.

Using Resolve Live Grades Later

Since each Snapshot you capture during a Resolve Live session contains timecode that was captured from the camera, grades from snapshots with timecode that overlaps recorded camera original media can be synced using ColorTrace when the time comes to start making dailies.

Keep in mind that snapshot grades correspond to the monitored output of the camera during the shoot. If you shot using a raw format, you'll need to use whatever in-camera debayering settings were used for monitoring during the shoot if you want the grades from your snapshots to produce the same result.

For more information on using ColorTrace, see Chapter 54, "Copying and Importing Grades Using ColorTrace."

Using LUTs in Resolve Live Workflows

Many on-set workflows use Look Up Tables (LUTs) to calibrate displays, normalize log-encoded media for monitoring, and preview looks in the video village to test how the current lighting scheme will work with the intended grade. You can apply LUTs using the Look Up Table panel of the Settings window, or within a grade as part of a node tree.

However, you can also export LUTs, if necessary for monitor previewing, that you can apply by loading them into a compatible LUT box of some kind, connected in-between the camera's video output and a display, or using a display capable of loading LUTs internally.

If you're exporting LUTs using the Generate 3D LUT command of the Thumbnail timeline's contextual menu, you should limit yourself to using only Primaries palette and Custom Curves palette controls within a single node. These are the only grading controls that can be mathematically converted into a LUT.

When exporting a LUT, any nodes that use Windows or OpenFX will be ignored along with all corrections made within these nodes. All other nodes with Primaries palette and Custom Curves palette adjustments that can be translated into a LUT will have their combined result translated into a LUT. For any nodes that mix supported and unsupported adjustments for LUT export (such as sharpening or blur filtering operations), the unsupported adjustments will simply be ignored. For more information on exporting LUTs, see "Exporting Grades and LUTs" in Chapter 48, "Grade Management."

NOTE: DaVinci Resolve exports LUTs in the .cube format, which is a DaVinci-developed LUT format, with no relation to the Adobe SpeedGrade.cube format..

Chapter 80

Stereoscopic Workflows

Stereoscopic Workflows

DaVinci Resolve has robust support for a wide variety of stereoscopic workflows. Using the built-in tools of the full version of DaVinci Resolve, you can edit using stereoscopic clips, grade the resulting program, adjust each clip's stereo-specific properties such as convergence and floating windows, and master stereoscopic output, all within DaVinci Resolve.

This chapter has the following topics:

Stereoscopic Workflows

Creating a stereo 3D project is a multi-step process that benefits from careful media organization. This chapter covers how to set up for working on stereoscopic projects, how to import stereoscopic projects, and how to export stereoscopic media. Incidentally, if you're used to how DaVinci Resolve used to handle stereo timelines and media in past versions, be aware that DaVinci Resolve versions 10.1 and later simplify the way stereo is handled, making the overall process easier to manage.

First, stereoscopic pairs of clips, i.e., the individual left- and right-eye media files, are imported into the Media Pool, organized, and then linked together using the "Stereo 3D Sync" command to create a new set of linked stereo clips. Then, these clips stereo clips can be either edited or conformed to imported project data using a single Timeline. DaVinci Resolve lets you manage left- and right-eye grades and sizing in the Color page using the controls found in the shortcut menu of the Thumbnail timeline, and in the Stereo 3D palette.

If you're using stereoscopic CineForm media, which contains muxed left-eye and right-eye image data that can be decoded by DaVinci Resolve, you still need to go through this process, although you'll be using duplicate clips to populate Left and Right folders with matching sets of clips.

Hardware Requirements for Working in Stereo 3D

With DaVinci Resolve on Mac systems, dual 4:2:2 Y'CbCr stereoscopic video streams are output via SDI from a compatible Blackmagic Design video interface. You can select either Side-by-Side or Line Mesh output to be fed to your stereo 3D-capable display, depending on its compatibly. Alternately, if you turn on the "Enable Dual SDI 3D Monitoring" checkbox in the Video Monitoring group of the Master Settings panel of the Project Settings, your compatible Blackmagic Design video interface outputs full resolution 4:2:2 Y'CbCr for each eye to compatible displays.

When setting up a 3D-capable DaVinci Resolve workstation, keep in mind that the dual video streams of 3D projects make greater demands on disk bandwidth, media decoding via your workstation's CPU or via RED ROCKET-X cards, and effects processing via your workstation's available GPU cards.

Setting Up to Display Stereo 3D via SDI

All DaVinci Resolve systems can output a side-by-side frame-compatible signal that can be viewed on a stereo 3D-capable display via a single SDI connection, output from a DeckLink HD Extreme card or better. For higher-quality monitoring, two SDI signals can be used to output the left-eye and right-eye images separately at full resolution using one of the following Blackmagic Design video interfaces:

- DeckLink HD Extreme 3D+
- DeckLink 4K Extreme
- DeckLink 4K Extreme 12G
- UltraStudio 4K
- UltraStudio 4K Extreme
- UltraStudio 4K Extreme 3

Legacy systems accomplish this via NVIDIA dual SDI monitoring outputs.

NOTE: If your stereo display is not capable of multiplexing the two incoming SDI signals by itself, you can accomplish this using an external device to multiplex both SDI signals into a single stereo 3G signal that will be compatible. Check with your display manufacturer in advance to see if this is necessary.

The following procedures describe how to set up stereo 3D monitoring in two different ways.

Monitoring via dual SDI to dual SDI:

1   Open the Master Settings panel of the Project Settings, then do the following:
    - Make sure Video Connection is set to YUV 4:2:2 SDI.
    - Turn on the "Use left and right eye SDI output" checkbox.

2   Open the Stereo 3D palette, and do the following:
    - Set Vision to Stereo.
    - Set the Out pop-up menu to None.

NOTE: When "Enable dual SDI 3D monitoring" is turned on, split-screen wipes and cursors will not be visible on the grading monitor, nor will you be able to view image resizing.

Setting Up to Display Stereo 3D via HDMI

If your stereo-capable display only has HDMI input, you'll need to use the HDMI output of a compatible Blackmagic Design video interface that has HDMI 1.4 or better to output stereo 3D signals; see the documentation accompanying your video interface for more information.

Supported Stereo 3D Media

When importing stereo 3D media from other applications, there are two types of media that are compatible with DaVinci Resolve stereoscopic workflows.

Using Dual Sets of Media in Any Supported Format

When originally shot, the media corresponding to stereo 3D workflows consists of two directories, one for the left-eye media, and one for the right-eye media. For the most automated workflow possible, this media must be tightly organized. Each pair of left-eye and right-eye media files in both directories should have matching timecode, and reel numbers that clearly indicate which are the left-eye shots, and which are the right-eye shots.

Using CineForm Media

CineForm stereo QuickTime files are compatible with DaVinci Resolve. CineForm clips encode the media corresponding to both eyes and mux (multiplex) it together in such a way so that CineForm files may output either a single frame of image data, if used in an application that is not capable of stereoscopic processing, or stereo 3D media when used with an application that is, such as DaVinci Resolve. This means that you can edit CineForm media using nearly any NLE, export a project via whatever workflow is convenient, and end up with a stereoscopic project that can be graded in DaVinci Resolve.

There are two ways of creating CineForm files. One is by using a camera or recording system that processes dual synchronized video signals to create a single set of CineForm media. The other is to use the CineForm conversion tools that come with GoPro CineForm Studio to reprocess dual sets of stereo 3D assets into the CineForm format.

The CineForm codec itself encodes full-frame image data using wavelet compression, at any resolution, at up to 12-bits, in a choice of RGB, Y'CbCr, or RAW color spaces. DaVinci Resolve is compatible with CineForm in a QuickTime wrapper using any supported color space, allowing access to the dual streams of image data that are provided.

When the time comes to output your program, keep in mind that while DaVinci Resolve can read CineForm files, CineForm files cannot be rendered out of DaVinci Resolve unless you've purchased an encoding license for OS X or Windows from GoPro. Furthermore, DaVinci Resolve cannot render Stereoscopic CineForm files.

Creating Stereo 3D Clips

The very first thing you need to do when working on any stereo 3D project is to create the stereo 3D clips that you'll be using. This is a two-step procedure.

Step 1—Import and Organize Your Media

You need to import all of the left-eye and right-eye media into separate bins.

1   Open the Media page, and create three Media Pool bins named "Left," "Right," and "Stereo Clips." The exact names are not important, but the way the media is organized is.

2   Import all left-eye media into the "Left" bin, and all right-eye media into the "Right" bin. If you're importing stereoscopic Cineform media, you still need to create this kind of organization, which requires you to place duplicates of each clip into each of the "Left" and "Right" bins.

Step 2—Generate 3D Stereo Clips

Once you've organized your media appropriately, you're set up to synchronize the left- and right-eye clips using timecode.

1   Create a new bin in the Media Pool, and name it "Stereo Clips." This is the bin that will eventually contain the linked stereo clips you're about to create.
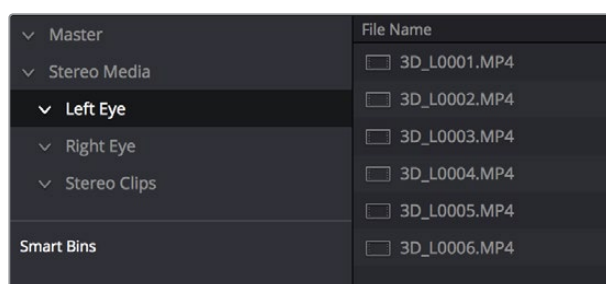
How to organize media for working in stereo 3D

2   Right-click anywhere within the Media Pool and choose Stereo 3D Sync.

The Stereo 3D Sync dialog appears, with buttons for choosing the left-eye folder, choosing the right-eye folder, choosing the output folder, and checkboxes for specifying whether to match reel names and file names, and additional fields for entering characters that identify left- and right-eye clips.
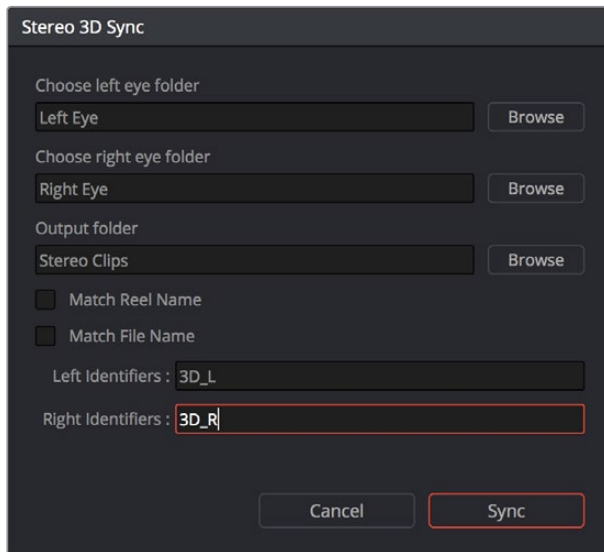
The Stereo Media Sync window

3   Click the Browse button corresponding to "Choose left eye folder" and then use the hierarchical list of bins that appears to choose the bin you named "Left." Follow the same procedure to choose the right-eye media.

4   Click the Browse button corresponding to "Output folder" and then use the hierarchical list of bins that appears to choose the bin you named "Stereo Clips."

5   Choose which matching criteria to use. Ideally, you only need to use whichever one of the three criteria that apply. The three options are:

- **Match Reel Name:** If the reel names of the left- and right-eye media match, turn this checkbox on.

- **Match File Name checkbox:** If the file names of the left- and right-eye media match, turn this checkbox on.

- **Left Identifiers and Right Identifiers fields:** If the left- and right-eye clips are identified by a special subset of characters within the file name (for example, "3D_R" and "3D_L") then you can type each into the appropriate field, and these characters will be used to match the left and right eyes together.

6   Click OK.

The original clips in the Left and Right bins disappear, and a full set of Stereo 3D clips appear in the output bin you selected in step four.
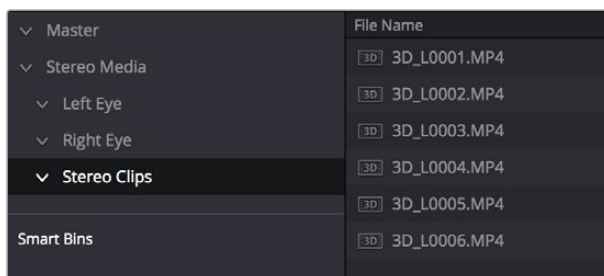
Final stereo clips, ready to be edited and graded

If your stereo media is excessively large, you can create optimized media starting with DaVinci Resolve 14.

1 Select the stereo clips you've created.

2 Right-click one of the selected clips, and choose Generate Optimized Media from the contextual menu. A window appears showing you how long it will take to finish creating optimized media.

Converting Clips Between Stereo and Mono

You also have the option of converting clips between mono and stereo 3D using a pair of commands in the Media Pool.

Converting Stereo Clips Back to Mono

If necessary, you can split one or more stereo clips into mono clips using a single command.

To convert stereo clips into mono clips:

1 Select one or more stereo clips in the Media Pool.

2 Right-click one of the selected clips and choose Split Stereo 3D Clips from the contextual menu.

Afterwards, two new bins are created named Left and Right, containing the individual left and right-eye clips that you've split apart.

Converting Mono Clips or an Entire Timeline to Stereo

Non-stereo clips (for which there are are not separate left and right eye media files) can be converted into stereo clips either individually or throughout an entire timeline for one of two different reasons:

- You can convert non-stereo clips into stereo for use in a stereo project, so they output properly along with the rest of a stereo timeline, albeit without adjustable convergence or depth effects.

- If you want to grade an HDR and non-HDR version of your program at the same time, converting non-stereo clips to stereo makes it possible for you to a) manage two separate SDR and HDR grades for each clip in a timeline using the left and right-eye channels, and b) output the SDR and HDR signals separately via your compatible Blackmagic Design interface's left- and right-eye SDI outputs when you turn on the "Enable Dual SDI 3D Monitoring" checkbox in the Video Monitoring section of the Master Settings panel of the Project Settings.

To convert mono clips into stereo clips:

1 Select one or more non-stereo clips in the Media Pool.

2 Right-click one of the selected clips and choose Convert to Stereo from the contextual menu.

Afterwards, that clip appears in the Media Pool as a Stereo 3D clip, and when edited into a timeline, can expose its controls in the 3D Stereo palette in the Color page.

If you have a timeline full of clips that you've just converted into stereo using the above procedure, you need to take the additional step of setting the Timeline to stereo in order to create stereo grades for each clip.

To convert a timeline to have stereo grades for simultaneous HDR/SDR output while grading:

Right-click a timeline in the Media Pool and choose Timelines > Set Timeline to Stereo

For more information about using stereo timeline workflows for simultaneous HDR and SDR grading, see Chapter 6, "Data Levels, Color Management, ACES, and HDR."

Attaching Mattes to Stereo 3D Clips

If you have left- and right-eye mattes that need to be attached to stereo clips, the process works identically to importing mattes for regular clips, except that when you've selected a stereo 3D clip in the Media Pool, you have two matte import commands, "Add As Left Eye Matte," and "Add As Right Eye Matte."

Organizing and Grading Stereo 3D Dailies

A common workflow is the creation of digital dailies within DaVinci Resolve before editing in an NLE. This provides the editors, director, and producers with the advantage of having more attractive media to work with, that's also more comfortable to view if handled with the automatic geometry and color-matching functions that match the media of each pair of shots together for a preliminary left- and right-eye balance. The resulting Timelines can then be output to whichever media format is most convenient to use.

Step 1—Create 3D Stereo Clips

The very first step in the process of creating dailies is to import all of the left-eye and right-eye media into individually organized bins, and to then link them together to create stereo 3D clips, as described in the previous section.

Step 2—Edit the New Stereo Clips Into One or More Timelines for Grading

Now that you've created a set of Stereo 3D clips, you're ready to edit them into one or more Timelines for grading. You can do this by simply creating a new Timeline and deselect the 'Empty Timeline" checkbox. A new Timeline will be created with the stereo 3D clips you created.

Step 3—Align Your Media

For the stereoscopic effect to work without causing headaches, it's critical that both eyes are aligned. This can be tricky to adjust using manual controls, but is something that can be automatically analyzed. You can perform stereo 3D alignment to a single clip using the Stereo 3D Palette controls, or you can select a range of clips to align all of them automatically at once. There are two methods of alignment; which is more appropriate depends on the type of geometry issues you have to address.

- **Transform Alignment:** Analyzes the image and makes vertical and rotational adjustments to line up the left- and right-eye images as closely as possible.
- **Vertical Skew:** Analyzes the images and makes a vertical-only adjustment to line up the left- and right-eye images.
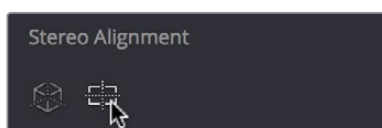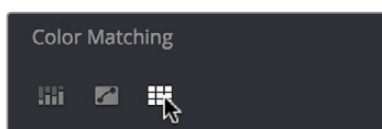
Controls for aligning the left and
right eye media

Step 4—Grade Your Media

Grade the clips in the Timeline as you would any other digital dailies, with the sole addition of using the controls in the Stereo 3D palette to control monitoring and manage the adjustments made to each eye as necessary. As when creating any other kind of dailies, you can use LUTs, the Timeline Grade, and individual clip grading to make whatever adjustments are necessary to create useful media for editing.

To help you manage the visual differences between left- and right-eye clips, there are also two automatic color matching commands that can be used to batch process as many clips as you need to adjust at once.

- **Stereo Color Match (Primary Controls):** Uses the Lift/Gamma/Gain controls to match one eye to the other. The result is a simple adjustment that's easy to customize, but may not work as well as Custom Curves in some instances.
- **Stereo Color Match (Custom Curves):** Uses the Custom Curves to create a multipoint adjustment to match one eye to the other. Can be more effective with challenging shots.
- **Stereo Color Match (Dense Color Match):** Performs a pixel by pixel, frame by frame color match that is incredibly accurate. This operation is processor intensive, so if you're going to batch process many clips, or if you're matching long clips, you'll want to make sure you have adequate time. Because this is so precise match, it's recommended to use Dense Color Match after you've used one of the stereo alignment commands.

Controls for matching the grade of
the left and right eye media

Step 5—Output Offline or Online Media for Editing

When you're done applying whatever grading is necessary to make the media suitable for editing, you'll need to export each clip as separate left- and right-eye clips using the controls of the Deliver page.

1   Open the Deliver page, and set up your render to output the format of media you require. Be sure to do the following:
    - Set Render Timeline As to Individual source clips.
    - Turn on the Use Source Filename checkbox.
    - To render both eyes' worth of media, choose "Both eyes as" from the Render Stereoscopic 3D option, and choose Separate Files from the accompanying pop-up menu. Optionally, you could also choose to render only the left-eye or right-eye media.

2   Choose how much of the Timeline to render from the Render pop-up menu in the Timeline toolbar; to render everything, choose Entire Timeline.

3 Click "Add Job to Render Queue."

4 Click Start Render.

DaVinci Resolve will now render either two sets of left- and right-eye clips, or one set of media corresponding to the eye you chose.

To make sure that the resulting edited project conforms easily to the originating DaVinci Resolve project, it's important to be sure that you render individual source clips, and that you turn on the Use Source Filename checkbox, in order to clone the timecode, reel numbers, and file names of the source media.

Conforming Projects to Stereo 3D Media

Since DaVinci Resolve manages stereo via a single set of specially created stereo 3D clips, you can use the same project import methods to import stereo 3D projects as you would for any other project. Only a single imported timeline is necessary.

This also means that you can edit stereo projects in NLEs that aren't otherwise stereo-aware, and finish them in full stereo 3D in DaVinci Resolve. To do this, you need to make sure that you edit the left-eye media in your NLE, and then export either an EDL or XML file to conform in DaVinci Resolve.

To conform an EDL to stereo 3D media:

1 Open the Media page, and create the necessary set of stereo 3D clips that will correspond to the project you're going to import, as described previously.

Open the Edit page, and then use the Import AAF/EDL/XML command to import your edit.

2 When the Load EDL/XML dialog appears, do the following:

- If importing an EDL, verify that the frame rate is correct, and click OK.
- If importing XML, make sure you turn off the "Automatically import source clips into Media Pool" checkbox, since you want to relink the imported project to the stereo 3D clips you created in step one.

The left-eye media timecode and reel information that's embedded within each stereo 3D clip will be used to conform the stereo 3D clips with the imported EDL, and you should be ready to work.

Grading Mastered Stereoscopic Media From Tape

If you've been handed a stereo 3D muxed tape with a mastered program that needs to be graded, but you haven't been given a project file or EDL, you can ingest it as individual left- and right-eye media files with a supported VTR, such as HDCAM SR with 4:2:2 x 2 mode, by turning on the "Enable stereo video" checkbox in the Capture and Playback panel of the Project Settings. When muxed stereoscopic signals are ingested, each eye is separated into individual left-eye and right-eye image files

Once ingested, you can use Scene Detection to split the left-eye media in one bin, and to create an EDL, you can use to split the right-eye media in the same way in another bin, so that you can create a sequential set of stereo clips for grading.

Adjusting Clips Using the Stereo 3D Palette

Once you've either created or imported a stereoscopic 3D-identified timeline, you're ready to begin grading. The left eye will be displayed in the Edit and Color pages by default; however, you can right-click on the Timeline and select to view the other eye. Most colorists work by grading one eye first (typically the left), and rippling their grades to the other eye, making separate adjustments to each eye's clips when necessary to match undesirable variation between cameras. DaVinci Resolve lets you do this automatically.

Setting up stereo 3D media enables the Stereo 3D palette on the Color page. This palette contains all the controls necessary for working on stereoscopic projects. It provides controls for choosing which eye to grade, adjusting convergence, swapping and copying grades and media between matching left- and right-eye clips auto-processing the color and geometry of left- and right-eye clips to match, stereo 3D monitoring setup, and controls for floating windows.
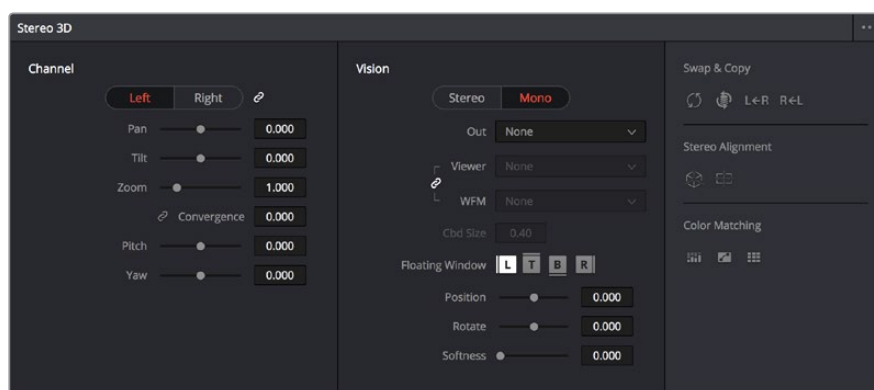

Stereoscopic 3D palette

Your project must contain stereo 3D clips in order to open this palette. For more information on setting up a stereo 3D project, see the "Creating Stereo 3D Clips" section of this chapter.

Stereo Eye Selection

Most colorists work by grading one eye first (typically the left), and rippling their grades to the other eye, making separate adjustments to each eye's clips when necessary to match undesirable variation between cameras.

The first three buttons in the Stereo 3D palette let you choose which eye to grade while you're working, as well as whether or not to ripple each clip's grade to the matching opposite-eye clip. Whenever you switch eyes, the 3D badge above each clip's thumbnail changes color (blue for right, red for left) and the thumbnails themselves update to show that eye's media.
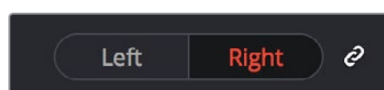
The Left eye is master and ganged with the right

- **Left button:** Displays the left-eye image and grade.
- **Ripple Link button:** When enabled (orange), all changes you make to the grade of the currently selected eye are automatically copied to the correspondingly opposite eye. When disabled (gray), grades made to the currently selected eye are made independently.
- **Right button:** Displays the right-eye image and grade.

You can also choose which eye you're viewing and grading by right-clicking a clip's thumbnail and choosing Stereo > Switch Eye or by choosing View > Switch Eye To > Left Eye or Right Eye.

### Using Ripple Link When Grading Stereo 3D Clips

You would turn Ripple Link off to suspend rippling when you want to make an individual adjustment to the grade of one eye to obtain a better match between the two. When you're finished matching the two clips, you can turn it back on to resume automatic grade rippling.

Stereo 3D grade rippling is always relative, so differences between the grades that are applied to the left- and right-eye clips are preserved. In fact, when you add or remove nodes to or from one eye, the same nodes are automatically added to or removed from the corresponding clip it's paired with, regardless of whether or not Ripple Linked is enabled.

> **IMPORTANT:** Regardless of whether or not Ripple Link is enabled, local versions created for one stereo 3D-identified clip are automatically available to the paired timeline.

Stereo 3D Geometry Controls

The next group of parameters lets you adjust the geometry of stereo 3D clips. The Pan, Tilt, and Zoom controls are provided as a convenience, and simply mirror the same parameters found in the Transform palette's Input mode, but made specific to the geometry of the Left and Right eye media. Convergence, Pitch, and Yaw are the three parameters that are unique to the Stereo 3D palette.
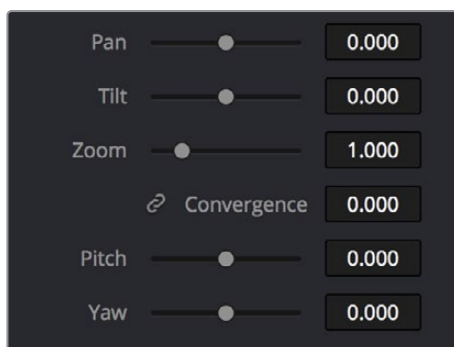
Stereoscopic 3D Geometry controls

- **Convergence:** Adjusts the disparity between the left and right eyes, to define the point of convergence (POC), or the region within the image where the left- and right-eye features are in perfect alignment. If necessary, Convergence can be animated using the Stereo Format parameter group in the Sizing track of the Keyframe Editor. If you want to adjust convergence in pixels, open the Stereo 3D palette option menu, and turn on "Show convergence in pixels."

  Features that overlap perfectly in both right- and left-eye clips are at zero parallax, putting that feature's depth at the screen plane. Matching features that are divergent in the left- and right-eye clips have increasingly positive parallax, and appear to be farther away from the audience. Matching features that are divergent and reversed in the left- and right-eye clips have increasingly negative parallax, and appear to be closer to the audience than the screen plane.

- **Linked Zoom button:** When enabled (orange), both the left- and right-eye clips are automatically zoomed whenever Convergence is adjusted so that both eyes always fill the screen. When disabled (gray), changes to Convergence will cause the opposing left and right edges of each eye's clip to have blanking intrude.
- **Pitch:** Pivots the image around the horizontal center plane of the frame.
- **Yaw:** Pivots the image around the vertical center plane of the frame.

Sizing Repositioning in Stereo 3D

Generally, you'll want to reposition stereo 3D clips with Ripple Link turned on, but you may occasionally find yourself needing to make a manual adjustment to one eye in particular with Ripple Link disabled. As with color adjustments, Sizing adjustments made with Ripple Link disabled are only applied to the clip in the current Timeline. When Ripple Link is turned on, all Sizing adjustments are automatically copied to the correspondingly numbered shot of the other stereo 3D timeline.

> **WARNING:** It is not advisable to use the Rotate parameter when transforming stereo 3D clips. Geometrically, rotation tilts a stereo pair of clips inappropriately, and ruins the "side-by-side" convergence that's necessary to create the stereoscopic illusion.

Protecting Stereo Adjustments When Copying Grades

Each version of a grade has independent stereo adjustments stored along with the Sizing settings. To prevent accidental overwrite of convergence and alignment data when copying grades from one clip to another, you can right-click within the Gallery and choose one of the following options to turn them on:

- **Copy Grade:** Preserve Convergence
- **Copy Grade:** Preserve Floating Windows
- **Copy Grade:** Preserve Auto Align

When enabled, these options lets you overwrite a clip's grade without overwriting specific Stereo 3D parameters.

> **TIP:** Stereo 3D and Sizing settings are processed before node-based corrections in the DaVinci Resolve image processing pipeline.

Swap and Copy Controls

Another set of controls at the right of the Stereo 3D palette lets you swap and copy grades, and swap clips, in situations where you need to reverse what's applied to a pair of left- and right-eye clips.
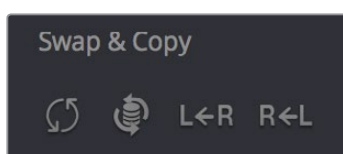
Swap and Copy grades between eyes

- **Swap Grade:** Exchanges the grades that are applied to the left- and right-eye clips.
- **Swap Shot:** A checkbox that, when enabled, switches the actual media used by two corresponding left- and right-eye clips. Useful in situations where the eyes of a stereo 3D clip were mislabeled, and you want to switch the clips without rebuilding both EDLs.
- **Copy Right to Left:** Copies the right-clip grade to the corresponding left-eye clip.
- **Copy Left to Right:** Copies the left-clip grade to the corresponding right-eye clip.

Batch Grade Management for Stereo 3D Projects

There are also a series of batch-processing commands that are useful for stereoscopic grading that are available when you right-click one or more selected clips in the Thumbnail timeline:

- **Stereo 3D Batch Copy:** Copies every grade from the left-eye clips to the right-eye clips.
- **Stereo 3D Batch Sync:** Copies grades from one eye to the other only when their node graphs have the same number of nodes. This prevents you from accidentally overwriting a custom grade with a different node structure that was necessary to match two eyes for a problem shot.

The Copy Grade, Swap Grade, Swap Shots, Ripple Link, and Switch Eye commands are also available from the Stereo submenu of the Timeline contextual menu.

Automatic Image Processing for Stereo 3D

It's common during stereoscopic shoots for minor divergences in geometry and color to appear in the source footage. To make the process of grading stereo 3D media less onerous, DaVinci Resolve provides a set of auto-adjustment controls at the right of the Stereo 3D palette that gives you a starting point for matching left- and right-eye clips together.
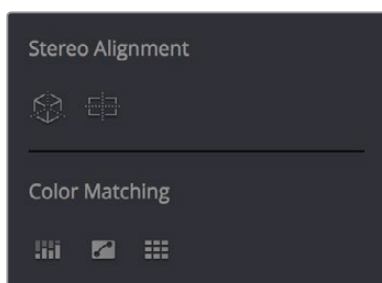
Auto align and color match buttons

Options for Auto Processing

You can choose which frame should be used to automatically analyze and process stereo clips using the Alignment and Matching controls from the Stereo 3D palette option menu. You can choose Auto Process > First or Middle, depending on what works best for your media.

Auto Process—Stereo Alignment

For the stereoscopic effect to work without causing headaches, it's critical that both eyes are aligned. This can be tricky to adjust using manual controls, but is something that can be automatically analyzed. You can perform stereo 3D alignment to a single clip, or you can select a range of clips to align all of them automatically at once. There are two options. Which is more appropriate depends on the type of geometry issues you're needing to address.

- **Transform Alignment:** Analyzes the image and makes vertical and rotational adjustments to line up the left- and right-eye images as closely as possible.
- **Vertical Skew:** Analyzes the images and makes a vertical-only adjustment to line up the left- and right-eye images.

To align one or more clips automatically:

1 Select one or more stereo clips in the Thumbnail timeline of the Color page.

2 Choose which frame of each clip you want to use for the analysis by opening the Stereo 3D palette, clicking the Option menu, and choosing Auto Process > First or Auto Process > Middle.

3 Click either of the Stereo Alignment buttons. The button to the left is for Automatic Transform, while the button to the right is for Automatic Vertical Skew.

If you selected multiple clips, then the Stereo Alignment window appears, and a progress bar shows the remaining time this operation will take.

Auto Process—Color Matching

Due to the design of different stereo 3D rigs, sometimes the color and contrast of one eye's media doesn't precisely match that of the corresponding eye. DaVinci Resolve provides two commands for quickly and automatically matching two eyes together.

- **Stereo Color Match (Primary Controls):** Uses the Lift/Gamma/Gain controls to match one eye to the other. The result is a simple adjustment that's easy to customize, but may not work as well as Custom Curves in some instances.
- **Stereo Color Match (Custom Curves):** Uses the Custom Curves to create a multipoint adjustment to match one eye to the other. The result can be more effective with challenging shots.
- **Stereo Color Match (Dense Color Match):** Performs a pixel by pixel, frame by frame color match that is incredibly accurate. This operation is processor intensive, so if you're going to batch process many clips, or if you're matching long clips, you'll want to make sure you have adequate time. Because this is so precise match, it's recommended to use Dense Color Match after you've used one of the stereo alignment commands.

TIP: For the best results, it's recommended to use automatic color matching in a separate node, independent of other corrections.

Stereo 3D color match works differently depending on whether or not one of the stereo 3D-paired clips has already been graded. The following procedure shows how to match a pair of left- and right-eye clips before you make any manual adjustments of any kind.

To match a pair of left- and right-eye clips automatically:

1 Select one or more clips in the Thumbnail timeline of the Color page.

2 Open the Stereo 3D palette, and click one of the three Color Match controls.

The Color Matching window appears, and a progress bar shows the remaining time this operation will take. You can also use automatic color matching to match an ungraded clip to a paired clip that's already been graded. This only works for grades consisting of one or more primary corrections; secondary corrections cannot be auto-matched.

To match an ungraded clip automatically to a paired stereo clip that's graded:

1 To suspend stereo grade linking temporarily:
- Open the Stereo 3D palette, and turn off the Ripple Link button
- Right-click the Thumbnail timeline, and choose Stereo 3D > Ripple Link > Solo.

2   Make a primary adjustment to a clip in the left-eye timeline to create a simple base grade. The left-eye clip now has a grade, and the right-eye clip does not.

3   Do one of the following to switch eyes:

- In the Stereo 3D palette, click Right.
- Right-click the Thumbnail timeline again, and choose Stereo 3D > Switch Eye.

This procedure only works when you use the Stereo Color Match commands on the ungraded clip of a left- and right-eye stereo pair, to match it to the graded clip.

4   To make the match, do one of the following:

- In the Stereo 3D palette, click one of the three color match controls.

Both clips should match one another very closely.

Stereo 3D Monitoring Controls

To output both eyes to a stereo 3D display, you need to click the Vision: Mono or Stereo button, and then choose a display mode from the Out pop-up menu.
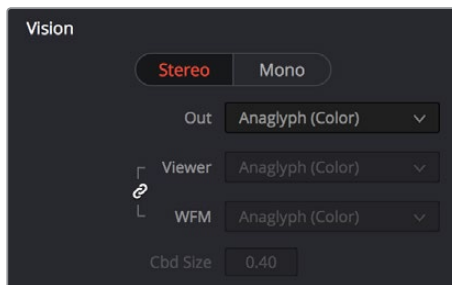
Monitoring controls for Stereo 3D

- **Vision:** Click a button to choose between Stereo, where both eyes can be displayed in the Viewer and output to video in a variety of different formats, and Mono, where only one eye is monitored in the Viewer and your video output interface.
- **Out:** A pop-up menu that provides different stereo viewing options for previewing stereo 3D signals in different ways. By default, this option is also linked to the Viewer display Internal Video Scope options. For detailed descriptions of each stereo 3D viewing mode, see the following section, "Stereo 3D Output Options."
- **Link button:** When enabled, the Viewer and internal video scopes both use the Out pop-up menu's option for stereo 3D viewing. When disabled, you can choose different stereo 3D viewing options for the Viewer and internal video scopes.
- **Viewer:** Lets you choose a stereo 3D viewing option for the Viewer.
- **WFM:** Lets you choose a stereo 3D viewing option for the internal video scopes.
- **Cbd Size:** If any stereo 3D viewing options are set to Checkerboard, this parameter becomes enabled, and lets you define the size of the checkerboard boxes, in pixels.

Dual 4:2:2 Y'CbCr stereoscopic video streams are output via HD-SDI on selected Blackmagic I/O devices when you turn on the "Use left and right eye SDI output" checkbox on the Master Settings panel of the Project Settings. You can select either Side-by-Side or Line-by-Line output to be fed to your stereo-capable display, depending on your display's compatibility.

Stereo 3D Output Options

Additionally, the Viewer and video scopes can be set to display both "eyes" in one of a variety of different modes.

- **Side by Side:** Displays both images side by side. Each eye is squeezed anamorphically to fit both eyes into the same resolution as the GUI viewer.

- **Top and Bottom:** Displays both images one over the other. Each eye is squeezed vertically to fit both eyes into the same resolution as the GUI viewer.

- **Line by Line:** An interlaced mode where each eye is displayed on alternating lines. The thickness of the lines as seen in the Viewer depends on how zoomed in you are.

- **Checkerboard:** Displays both eyes via an alternating checkerboard pattern. This is an excellent mode for identifying regions of the image where there's variation in color or geometry between the two eyes.

- **Anaglyph (B/W):** Each eye is desaturated and superimposed via Red/Cyan anaglyph to show the disparity between both eyes in different regions of the image. Left-eye divergence is red, and right-eye divergence is cyan. Regions of alignment between both eyes appear grayscale.

- Anaglyph modes are useful for evaluating the geometric differences between both eyes, as well as for identifying the point of convergence (where both eyes align most perfectly) that places a region of the image at the screen plane.

- Red/cyan color coding also identifies the direction of parallax. For any given feature, disparity such that red is to the right and cyan is to the left indicates positive parallax (backward projection away from the audience). Red to the left and cyan to the right indicates negative parallax (forward projection towards the audience).

- **Anaglyph (Color):** Similar to Anaglyph (B/W), except that regions of close alignment are shown in full color. Incidentally, both anaglyph modes can be previewed on ordinary displays using old-fashioned red/cyan anaglyph glasses, enabling stereo 3D monitoring on non-stereo 3D-capable displays.

- **Difference:** Superimposes grayscale versions of both eyes using the difference composite mode. Corresponding left/right-eye pixels that are perfectly aligned appear black, while pixels with disparity appear white. This mode is extremely useful for evaluating geometric differences between both eyes, as well as for identifying the point of convergence, without the distraction of color that the anaglyph modes present.

- **None:** Only displays the eye corresponding to the currently selected timeline in the Viewer. However, this option also works in conjunction with the "Enable dual SDI 3D monitoring" checkbox in the Master Settings of the Project Settings which, when turned on, outputs each eye to an individual HD-SDI output of your Blackmagic I/O card.


The Viewer set to display an anaglyph stereo image in color

Floating Windows

Floating Windows are meant to correct for "Window violations," where elements of the image with negative parallax, that project forward from the screen plane towards the audience, are cut off by the edge of the frame. In these instances, differences between the images being shown to the left and right eyes can result in a visual paradox that's difficult for viewers to reconcile. Specifically, when a forward-projecting element is cut off by the left or right edge of the frame, one eye sees things that the other eye does not.

If the subject is moving quickly, this may not be an issue, but if the cut off (or occluded) element lingers onscreen, it causes problems for viewers that defeat the stereo 3D illusion. The viewer's binocular vision (or stereopsis) is providing one depth cue, while occlusion is providing a completely different depth cue.

To fix this, you can use Floating Windows to crop the cut off object from the eye on the side of the object that's cut off, thus eliminating the portion of the stereo image that is unseen to the other eye that causes the problem.
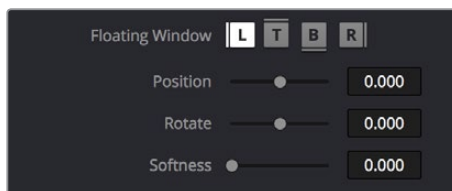
Floating Window controls

The objective of using Floating Windows is to manipulate the illusion of the viewer's "window into the scene." In addition to fixing Window violations, it has been proposed that Floating Windows can be used as a creative tool by manipulating the geometry of this Window to alter subtly the viewer's perception of the screen orientation.

- By cropping the right-hand side of the right-eye frame, you also create the illusion that the right edge of the "window into the image" is tilted farther forward toward the viewer.
- By cropping the left-hand side of the left-eye frame, you create the illusion that the left edge of the Window is tilted toward the viewer.
- If you crop both the left-hand side of the left-eye frame and the right-hand side of the right-eye frame, you create the illusion that the entire plane of the "virtual screen" is coming toward you.
- If you apply opposite-angled Windows to the left- and right-eye clips at one or both of the edges of the frame, it appears to "tilt" the screen toward or away from the viewer.

Animating Floating Windows

Floating Windows can be animated using the Float Window keyframing track, found within the Sizing track of the Keyframe Editor, to push the edge of the frame in as needed, and then pull it back out when the partially occluded subject has moved fully into the frame. For more information about animating keyframing tracks, see Chapter 53, "Keyframing in the Color Page."

Floating Windows have the following controls and parameters.

- **L/R/T/B buttons:** Lets you choose an edge to which to apply a Floating Window. Click the button corresponding to the edge you want to adjust. Each edge has its own position, rotate, and softness settings.
- **Position:** Adds masking to the currently selected edge.
- **Rotate:** Rotates the currently selected edge, letting you create an angled Window.
- **Softness:** Feathers the edge of the currently selected edge, letting you create a soft Window that can be less noticeable to viewers.

To add a Floating Window to fix a Window violation:

1 Choose to which eye you want to add the Floating Window.

- To apply a Floating Window to eliminate a Window violation on the right-hand side of the screen, click the right eye view.
- To apply a Floating Window to eliminate a Window violation on the left-hand side of the screen, click the left eye view.

2 Choose which edge you want to adjust by clicking the L or R buttons.

- To eliminate a Window violation on the right-hand side, click R.
- To eliminate a Window violation on the left-hand side, click L.

3 Adjust the Position parameter as necessary to crop the portion along the edge of the selected eye that's not visible in the other.

4 Optionally, if you feel that the Window adjustment you've just made is too obvious, increase the Softness parameter to make that edge less noticeable.

Stereo Controls on the DaVinci Control Panel

If you're doing convergence adjustments and stereographic work throughout a program, you can use many of the controls described in this section from the DaVinci control panel.

To show the Stereo Transform Controls page on the Transport panel:

1 Press the 3D soft key. The Transport panel's knobs and soft keys are remapped with all available Stereoscopic commands.

2 When you're finished, press MAIN.

To show the Floating Windows controls on the Center panel:

1 From the main page of the Center panel, press the 3D soft key. The Floating Windows, Auto Match, and Auto Align controls appear on the Center panel.

2 Press the 3D OVERLAY soft key to expose the Stereoscopic sizing controls on the Transport panel. Press 3D OVERLAY again to return to the ordinary sizing controls.

3 When you're finished, press the MAIN soft key to exit the 3D control page.

Outputting Stereo 3D Media in the Deliver Page

To render full frame media, you'll need to render each stereo 3D eye separately using the controls of the Deliver page, outputting whatever media format is required by the client.

Rendering Frame-Compatible Media

Frame-compatible media has both the left- and right-eye images squeezed anamorphically into a single media file. To create frame-compatible media, choose the "Both eyes as" option from the Render Stereoscopic 3D controls at the bottom of the File output options of the Deliver page, and then choose a method of output from the Mesh Options pop-up menu.
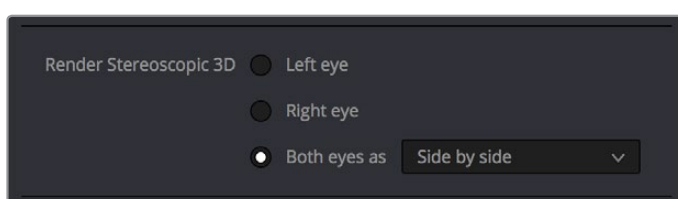
Stereoscopic 3D mesh render options on the Deliver page

You can choose Side-by-Side, Line-by-Line, or Top-Bottom. You can also choose Anaglyph if you want to output a traditional anaglyph red/cyan stereo 3D image for viewing on any display.

Rendering Individual Left and Right-Eye Clips

If your workflow requires you to deliver separate sets of left- and right-eye media, this is easily accomplished by either setting up a render job with "Render Stereoscopic 3D" set to either "Right eye" or "Left eye," or selecting "Both eyes as" and choosing the "Separate files" option.

Chapter 81

Using Variables and Keywords

Using Variables and Keywords

This chapter describes how to use metadata variables and keywords to help you manage your clips.

Using Metadata Variables

If you're an enthusiastic user of clip metadata (and you should be), you can use "metadata variables" that you can add into supported text fields that let you reference other metadata for that clip. For example, you could add the combination of variables and text seen in the following screenshot. Variables, once they've been entered, are represented as graphical tags shown with a background, while regular text characters that you enter appear before and after these tags.
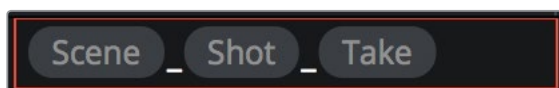
Variables and text characters entered to create a
display name based on a clip's metadata

As a result, that clip would display "12_A_3" as its name if scene "12," shot "A," and take "3" were its metadata. When you do this, you can freely mix metadata variables with other characters (the underscore, as in the example above) to help format the metadata to make it even more readable.

Be aware that, for clips where a referenced metadata field is empty, no characters appear for that corresponding metadata variable's tag wherever it happens to be used.

Where Variables Can Be Used

Metadata variables are extremely flexible, and can be used to procedurally add metadata to several functions in DaVinci Resolve. Here's a partial list of where you can use variables.

- **Display names:** You can use variables in the Display Name column of the Media Pool in List view, or in the Display Name field of the Clip Attributes window's Clip Name panel, to use each clip's metadata to generate a more readable and useful display name.
- **Other metadata fields in the Metadata Editor:** You can use variables to reference metadata in other fields.
- **Custom Text in the Data Burn palette:** You can use variables to automatically populate metadata in different combinations as a window burn.
- **The Filename field of the Render Settings in the Deliver page:** Using variables, you can automatically set the name of rendered clips to follow any metadata that's associated with a timeline or individual clip. This is especially useful when you want to generate specific file names when rendering individual source clips.

How to Edit Metadata Variables

Every single item of metadata that's available in the Metadata Editor can be used as a variable, and several other clip and timeline properties such as the version name of a clip's grade, a clip's EDL event number, and that clip's timeline index number can be also referenced via variables.

To add a variable to a text field that supports the use of variables:

1. Type the percentage sign (%) and a scrolling list appears showing all variables that are available.

2. To find a specific variable quickly, start typing that variable's name and this list automatically filters itself to show only variables that contain the characters you've just typed.

3. Choose which variable you want to use using the Up and Down Arrow keys, and press Return to choose that variable to add.
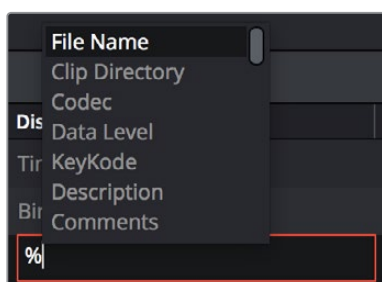
The variable list that appears
when you type the % character

As soon as you add one or more metadata variables to a field and press return, the string is
replaced by its corresponding text. To re-edit the metadata string, simply click within that field
to edit it, and the metadata variables will re-appear as the graphical tags that they are.

To remove a metadata variable:

> Click within a field using variables to begin editing it, click a variable to select it, and
> press Delete.

Available Variables in DaVinci Resolve

The following list describes what metadata variables are available to add.

Clip Metadata

> File Name
>
> Directory
>
> Codec
>
> Data Level
>
> Key Kode

Metadata Editor Metadata

> All Shot Scene metadata
>
> All Clip Details metadata (see Metadata Editor for more information)
>
> All Camera metadata (see Metadata Editor for more information)
>
> All Tech Details metadata (see Metadata Editor for more information)
>
> All Stereo 3D VFX metadata (see Metadata Editor for more information)
>
> All Audio metadata (see Metadata Editor for more information)
>
> All Audio Tracks metadata (see Metadata Editor for more information)
>
> All Production metadata (see Metadata Editor for more information)
>
> All Production Crew metadata (see Metadata Editor for more information)
>
> All Reviewed By metadata (see Metadata Editor for more information)

Media Pool Metadata

File name

Reel name

File path

Codec

IDT

Input LUT

PAR

Data Level

Description

Comments

Keyword

Shot

Scene

Take

Roll/Card

Input Color Space

Input Sizing Preset

Start Keykode

Optimized Media

Timeline Metadata

Group

Legacy Metadata

EDL Tape Number: Tape number extracted from imported EDL

Render Resolution: Resolution of the rendered file

EDL Event Number: DaVinci Resolve-generated index number of the clip in the timeline

Version: Version Name of the rendered file

Eye: Stereo session, "Left" or "Right"

Reel Number: Reel Name extracted by DaVinci Resolve from source filename
or clip name

Timeline Index: Event number from imported EDL

Using Keywords

While most metadata in the Metadata Editor is edited via text fields, checkboxes, or multiple button selections (such as Flags and Clip Color), the Keyword field is unique in that it uses a graphical "tag" based method of data entry. The purpose of this is to facilitate consistency with keyword spelling by making it easy to reference both a built-in list of standardized keywords, as well as other keywords that you've already entered to other clips.

Once added, keywords are incredibly useful for facilitating searching and sorting in the Media Pool, for creating Smart Bins in the Media and Edit pages, and for use in Smart Filters on the Color page. Reaping these benefits by adding and editing keywords is simple and works similarly to the method of entering metadata variables that's described above.

To add a keyword:

1   Select one or more clips, then click in the Keyword field of the Metadata Editor, and begin typing the keyword you want to use. As you begin typing, a scrolling list appears showing all keywords that are available using the string of characters you've just typed.

2   To find a specific keyword in the list, start typing that keyword's name and this list automatically filters itself to show only keywords that contain the characters you've just typed. Choose which keyword you want to use in the list using the Up and Down Arrow keys, and press Return to choose that keyword to add.

3   If you selected multiple clips, don't forget to click Save or you'll lose your changes. If you only selected a single clip, your changes will be saved automatically.
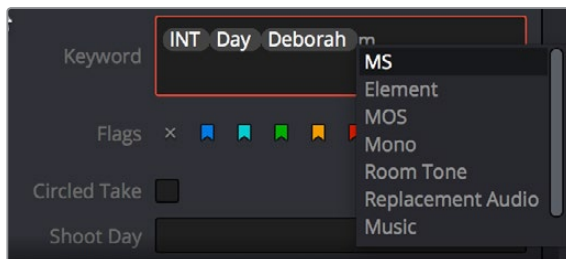
The keyword list that appears when you type
within the Keyword field

As soon as you add one or more keywords, they appear as a graphical tag. To re-edit any keyword, simply click anywhere within the Keyword field to edit it.

To edit a keyword:

Double-click any keyword to make it editable, then edit it as you would any other piece of text, and press Return to make it a graphical keyword tag again.

To remove a keyword:

Click any keyword to select it, and press Delete.

Chapter 82

Creating DTCL LUTs

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This chapter describes how to create DTCL LUTs to perform your own custom mathematical transformations in DaVinci Resolve.

About DCTL

DCTL files are actually color transformation scripts that DaVinci Resolve sees and applies just like any other LUT. Unlike other LUTs, which are 1D or 3D lookup tables of values that approximate image transformations using interpolation, DCTL files are actually comprised of computer code that directly transforms images using combinations of math functions that you devise. Additionally, DCTL files run natively on the GPU of your workstation, so they can be fast.

Anyone with the mathematical know-how can make and install a DCTL. Simply enter your transformation code, using a syntax that's similar to C (described in more detail below), into any text editor capable of saving a plain ASCII text file, and make sure its name ends with the ".dctl" (DaVinci Color Transform Language) file extension. Once that's done, move the file to the LUT directory of your workstation. Where that is depends on which OS you're using:

> **On Mac OS X:** Library/Application Support/Blackmagic Design/DaVinci Resolve/LUT/
>
> **On Windows:** C:\ProgramData\Blackmagic Design\DaVinci Resolve\Support\LUT
>
> **On Linux:** /home/resolve/LUT

When DaVinci Resolve starts up, assuming the syntax of your .dctl is correct, they appear in the Color page Node contextual menu within the DaVinci CTL submenu.

DCTL Syntax

Users need to put __DEVICE__ in front of each function they write. For example:

```
__DEVICE__ float2 DoSomething()
```

The main entry function (transform) should come after all other functions, with the following format argument:

```
__DEVICE__ float3 transform(float p_R, float p_G, float p_B)
```

The main entry function must also have a float3 return value.

For the following floating point math functions, please use the described syntax:

```
float _fabs(float)                 // Absolute Value

float _powf(float x, float y)      // Compute x to the power of y

float _logf(float)                 // Natural logarithm

float _log2f(float)                // Base 2 logarithm

float _log10f(float)               // Base 10 logarithm

float _exp2f(float)                // Exponential base 2

float _expf(float)                 // Exponential base E

float _copysignf(float x, float y) // Return x with sign changed to sign y

float _fmaxf(float x, float y)     // Return y if x < y

float _fminf(float x, float y)     // Return y if x > y

float _saturatef(float x, float    // Return min(max(x, minVal), maxVal)
minVal, float maxVal)
```

```
float _sqrtf(float)                     // Square root

int   _ceil(float)                      // Round to integer toward + infinity

int   _floor(float)                     // Round to integer toward - infinity

float _fmod(float x, float y)           // Modulus. Returns x — y * trunc(x / y)

float _fremainder(float x, float y)     // Floating point remainder

int   _round(float x)                   // Integral value nearest to x rounding

float _hypotf(float x, float y)         // Square root of (x^2 + y^2)

float _atan2f(float x)                  // Arc tangent of (y / x)

float _sinf(float x)                    // Sine

float _cosf(float x)                    // Cosine

float _acosf(float x)                   // Arc cosine

float _asinf(float x)                   // Arc sine

float _fdivide(float x, float y)        // Return (x / y)

float _frecip(float x)                  // Return (1 / x)
```

The following functions support integer type:

```
min, max, abs, rotate
```

Other supported C Math functions include:

```
acosh, acospi, asinh, asinpi, atan, atanh, atanpi, atan2pi, cbrt, cosh,
cospi, exp10, expm1, trunc, fdim, fma, lgamma, log1p, logb, rint, round,
rsqrt, sincos, sinh, sinpi, tan, tanh, tanpi, tgamma
```

We support vector type float2, float3 and float4. The data fields are:

```
float x

float y

float z

float w
```

To generate a vector value, use make_floatN() where N = 2, 3 or 4.

Users can define their own structure using "typedef struct." For example:

```
 typedef struct

    {

        float c00, c01, c02;

        float c10, c11, c12;

    } Matrix;
```

To declare constant memory, use __CONSTANT__. For example:

```
__CONSTANT__ float NORM[] = {1.0f / 3.0f, 1.0f / 3.0f, 1.0f / 3.0f};
```

To pass the constant memory as a function argument, use the __CONSTANTREF__ qualifier, e.g.:

```
__DEVICE__ float DoSomething(__CONSTANTREF__ float* p_Params)
```

A float value must have the 'f' character at the end (e.g. 1.2f).

A Simple DCT LUT Example

The following code shows an example of how to create a simple color gain transformation using the DCT LUT syntax.

```
// Example to demonstrate simple color gain transformation

__DEVICE__ float3 transform(float p_R, float p_G, float p_B)

{

    const float r = p_R * 1.2f;

    const float g = p_G * 1.1f;

    const float b = p_B * 1.2f;

    return make_float3(r, g, b);

}
```

A Matrix DCT LUT Example

The following code shows an example of creating a matrix transform using the DCT LUT syntax.

```
// Example to demonstrate the usage of user defined matrix type to
transform RGB to YUV in Rec. 709


__CONSTANT__ float RGBToYUVMat[9] = { 0.2126f ,  0.7152f , 0.0722f,

                                     -0.09991f, -0.33609f, 0.436f,

                                      0.615f  , -0.55861f, -0.05639f };


__DEVICE__ float3 transform(int p_Width, int p_Height, int p_X, int
p_Y, float p_R, float p_G, float p_B)

{

    float3 result;


    result.x = RGBToYUVMat[0] * p_R + RGBToYUVMat[1] * p_G +
RGBToYUVMat[2] * p_B;

    result.y = RGBToYUVMat[3] * p_R + RGBToYUVMat[4] * p_G +
RGBToYUVMat[5] * p_B;

    result.z = RGBToYUVMat[6] * p_R + RGBToYUVMat[7] * p_G +
RGBToYUVMat[8] * p_B;


    return result;

}
```

A More Complex DCT LUT Example

The following code shows an example of creating a mirror effect, illustrating how you can access pixels spatially.

```
// Example of spatial access for mirror effect


__DEVICE__ float3 transform(int p_Width, int p_Height, int p_X, int
p_Y, __TEXTURE__ p_TexR, __TEXTURE__ p_TexG, __TEXTURE__ p_TexB)
{
    const bool isMirror = (p_X < (p_Width / 2));

    const float r = (isMirror) ? _tex2D(p_TexR, p_X, p_Y) : _tex2D(p_
TexR, p_Width - 1 - p_X, p_Y);

    const float g = (isMirror) ? _tex2D(p_TexG, p_X, p_Y) : _tex2D(p_
TexG, p_Width - 1 - p_X, p_Y);

    const float b = (isMirror) ? _tex2D(p_TexB, p_X, p_Y) : _tex2D(p_
TexB, p_Width - 1 - p_X, p_Y);

    return make_float3(r, g, b);
}
```

TCP Protocol for DaVinci Resolve Transport Control

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This chapter describes how to create third party utilities that use Transport Control with DaVinci Resolve.

About the TCP Protocol Version 1.2

This protocol defines the communication standard between third party applications ("Client") and DaVinci Resolve ("Server") using the TCP protocol.

Port number 9060 will be used by the server. SSL will not be used in this protocol. Communication takes the form of request-response messages, where the Client initiates a command, and the Server responds appropriately.

To use this protocol, you must first type the following string into the Advanced panel of the DaVinci Resolve System Preferences:

```
System.Remote.Control = 1
```

Data Types

The following data types are used in this protocol:

- **float (f):** A 4-byte IEEE 754 single precision float
- **int (i):** A 4-bytes signed int
- **unsigned char (uc):** A 1-byte unsigned char (0-255)
- **string (s):** A UTF-8 encoded string. No terminator is specified. The string is a composite type, transmitted as a single int (i) specifying the number of characters in the string (N), followed by N unsigned chars (uc) containing the letters of the string.

> **NOTE:** The bytes of the float and int types are transmitted in little endian order.

Command Format

Commands are transmitted as a single string (using characters a-z (0x61 – 0x7A) only), followed by any additional payload required by the command in the definition.

Response Format

The response to any command is composed of a status byte (unsigned char), followed by any additional payload required by the response.

Communication Delays

Once the first byte of the command string is sent, the rest of the command string and the payload data must follow without delay. At the end of COMMAND, the server must respond immediately. If there is a delay of more than 5 seconds during this process, the party waiting for data may drop the connection assuming that the peer has become unresponsive.

There is currently no limit on the delay between two consecutive commands. (NOTE: Alternatively, a maximum allowable delay may be defined, in which case, the client may issue periodic 'connect' commands to keep the connection alive.)

Status Response Values

The meaning of the status values are as follows:

- **0x00:** Command was executed successfully. Any additional payload is sent as expected.
- **0xFF:** Command could not be executed successfully. No additional payload will follow.

TCP Protocol Stream

The following commands can be sent over the protocol stream.

connect

The client initiates the stream by sending a connect command string. There is no payload. The server responds with a status value of 0x00.

goto

The client sends a goto command string followed by four unsigned chars representing the hour, minute, second, and frame of the timecode.

The server responds with an appropriate status byte based on the execution of the command.

play

The client sends a play command string followed by a floating point value. Play in real-time is 1.0, stop is 0.0, reverse is -1.0, 2x is 2.0, etc.

The server responds with an appropriate status byte based on the execution of the command.

gettc

The client sends a gettc command string.

The server responds with an appropriate status byte (status byte may be 0xFF if no timeline exists, for instance). If the status byte is 0x00, it is followed by four unsigned chars representing the hour, minute, second, and frame of the timecode.

getframerate

The client sends a getframerate command string.

The server responds with an appropriate status byte. If the status byte is 0x00, it is followed by a floating point value for the frame rate.