



## Stereoscopic Workflows

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# Stereoscopic Workflows

DaVinci Resolve has robust support for a wide variety of stereoscopic workflows. Using the built-in tools of the full version of 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 Resolve.

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# 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 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 compatibility. Alternately, if you turn on the "Enable Dual SDI 3D Monitoring" checkbox in the Video Monitoring group of the Master 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 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 Project 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 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 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 Resolve can read CineForm files, CineForm files cannot be rendered out of Resolve unless you've purchased an encoding license for OS X or Windows from GoPro. Furthermore, 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

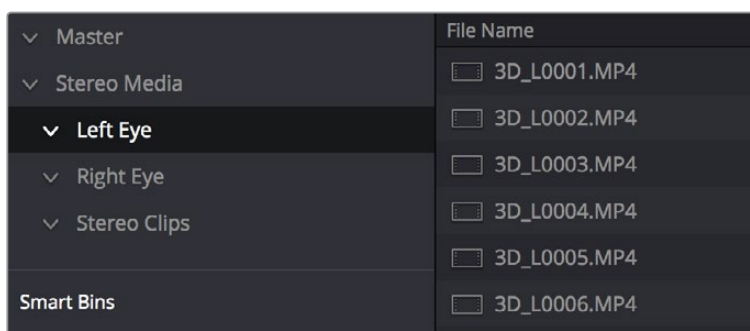
You need to import all of the left-eye and right-eye media into separate bins.

- 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.

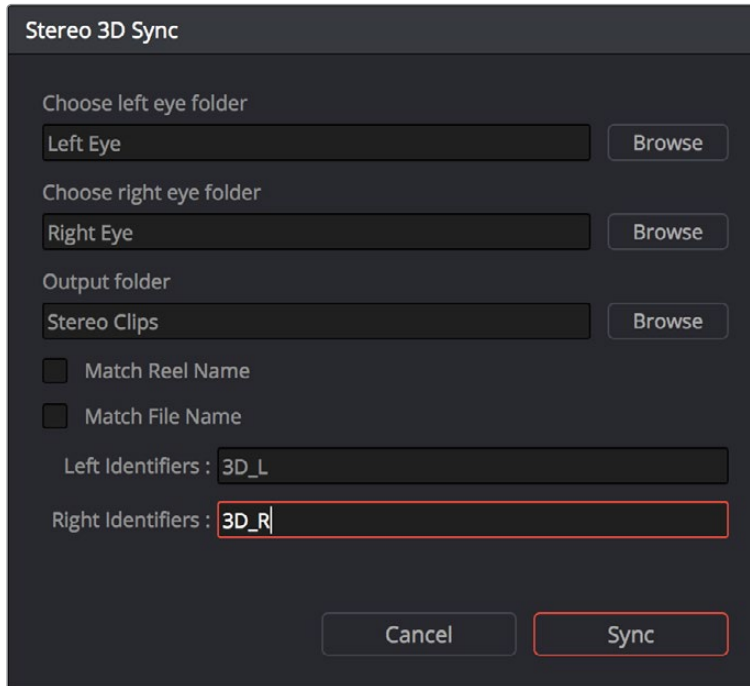


	File Name
Master	
Stereo Media	3D_L0001.MP4
Left Eye	3D_L0002.MP4
Right Eye	3D_L0003.MP4
Stereo Clips	3D_L0004.MP4
Smart Bins	3D_L0005.MP4
	3D_L0006.MP4

How to organize media for working in stereo 3D

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

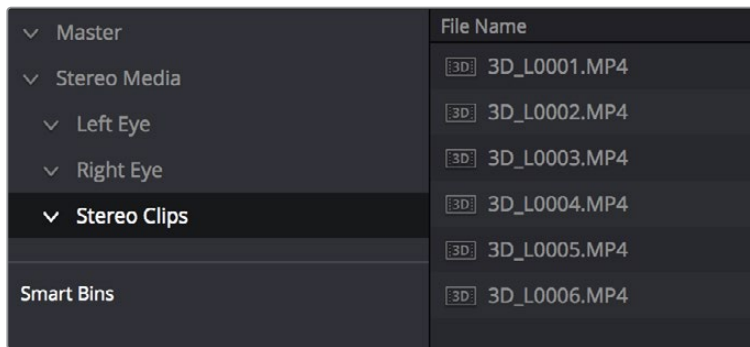
The Stereo 3D Sync dialog appears, with buttons for choosing the left-eye folder, choosing the right-eye folder, choosing the output folder, and checkboxes for specifying whether to match reel names and file names, and additional fields for entering characters that identify left- and right-eye clips.



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

## 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 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 group of the Master 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

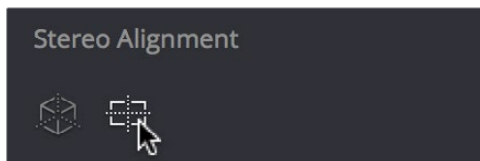
Now that you've created a set of Stereo 3D clips, you're ready to edit them into one or more Timelines for grading. You can do this by simply creating a new Timeline and deselect the “Empty Timeline” checkbox. A new Timeline will be created with the stereo 3D clips you created.



### 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.



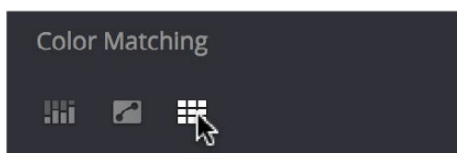
Controls for aligning the left and right eye media

### 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 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

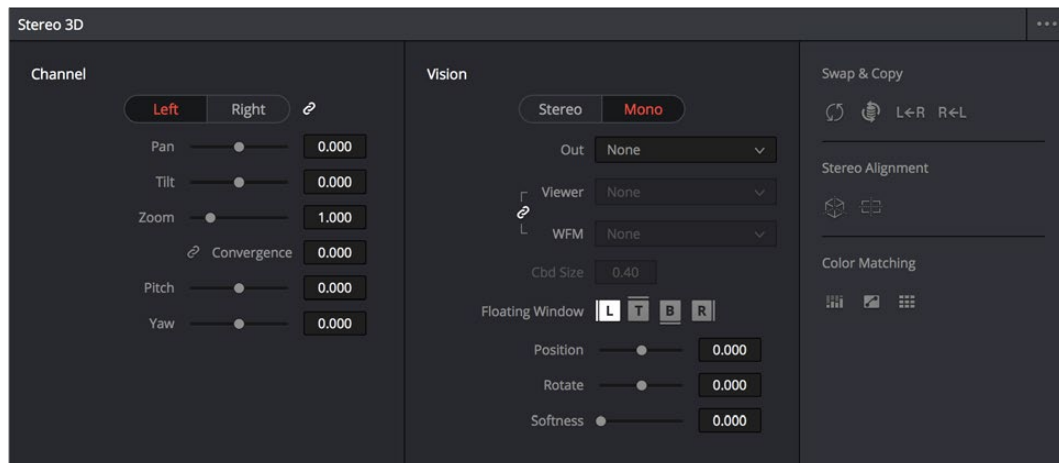
If you've been handed a stereo 3D muxed tape with a mastered program that needs to be graded, but you haven't been given a project file or EDL, you can ingest it as individual left- and right-eye media files with a supported VTR, such as HDCAM SR with 4:2:2 x 2 mode, by turning on the "Enable stereo video" checkbox in the Deck 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. 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 "Stereoscopic Workflows" section of Chapter 9, "Working with Media."

## 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:

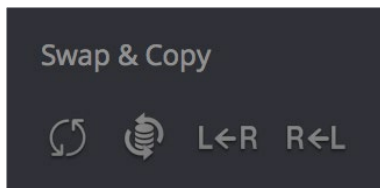
- Copy Grade: Preserve Convergence
- Copy Grade: Preserve Floating Windows
- Copy Grade: Preserve Auto Align

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 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

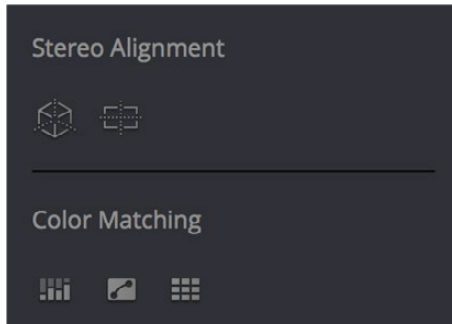
There are also a series of batch-processing commands that are useful for stereoscopic grading that are available when you right-click one or more selected clips in the Thumbnail timeline:

- **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.

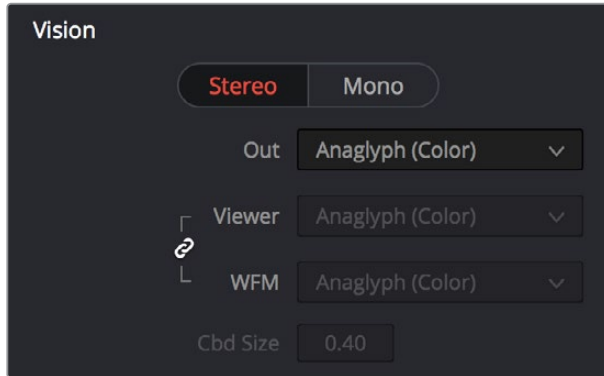
- 4 To make the match, do one of the following:
  - In the Stereo 3D palette, click one of the three color match controls.

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 Project 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 Project Settings of the Project Settings which, when turned on, outputs each eye to an individual HD-SDI output of your Blackmagic I/O card.



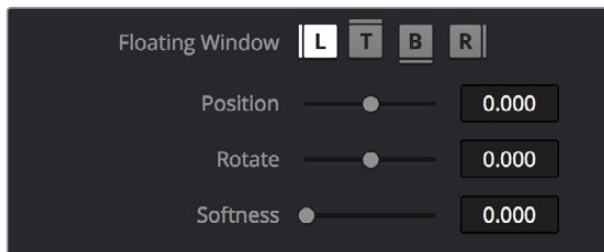
The Viewer set to display an anaglyph stereo image in color

## 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 31, “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:**

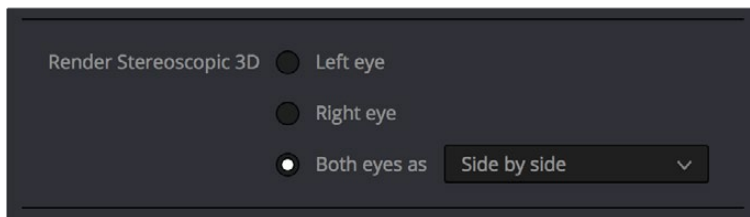
- 1** From the main page of the Center panel, press the 3D soft key. The Floating Windows, Auto Match, and Auto Align controls appear on the Center panel.
- 2** Press the 3D OVERLAY soft key to expose the Stereoscopic sizing controls on the Transport panel. Press 3D OVERLAY again to return to the ordinary 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

# 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.