Stereoscopic workflow

Ben Kitching explains how to create a stereoscopic camera rig in your 3D modelling app of choice, so that you can create a stereoscopic 3D film.

We see the world in three dimensions because the separation between our eyes (our binocular disparity) means each of them sees the world from a slightly different viewpoint. Our brains use this disparity between these two images to judge depth. Creating a 3D film, be it CG or live action, involves using two cameras to capture a scene from two separate viewpoints, which are then shown independently to each eye fooling the brain into perceiving depth. This tutorial shows you the ins and outs of creating a stereoscopic camera rig in Maya, but the aim is to concentrate on the theory of creating such a rig so you can apply this to your own projects.

Useful resources

While we’ve tried to cover as much of the theory as possible, there’s plenty of stereoscopic resources worth checking out...

- Louis Marcoux’s Blog – focused on 3ds Max. Louis Marcoux’s blog has some very useful information on stereoscopic workflow along with a downloadable stereoscopic camera rig for 3ds Max.
- Sebastian Schneider’s blog contains a wealth of information on stereo camera rigs along with his own stereo rig for Blender and a tutorial on its use.

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// you can download the 3D4VF Stereoscopic Player from the 3ds Max site. There you’ll find a free version available which is capable of playing back a maximum of five minutes of footage.
// you can also find the camera rig settings for the 3ds Max rig (shown in figure top right). You will find film offset controls in the camera settings within Cinema 4D, Maya, and modo. Similar settings are available in 3ds Max (skew modifier), Softimage (optical center shift) and Blender (camera shift).
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1. Image distortion with converged cameras: the projected image is incorrect

**STAGE ONE**

Anatomy of a stereoscopic rig

The first instinct, knowing what we already know, is to take two cameras and have them converge on the subject of our animation. To realise why this approach won’t work we need to consider how the image will look when projected onto a screen. The image below shows an exaggeration of this effect with the image projected onto the white screen being distorted to the actual object...

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1. Convergence of projection planes using film offset, note the skewed frustums

2. Image distortion with converged cameras: the projected image is incorrect
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**STAGE TWO**

Building a stereoscopic rig

Sebastian Schneider has scripted a rig for Blender along with a tutorial on its use on his blog. The script is based on the below theories and includes controls for the zero parallax and interaxial separation, as well as anaglyph previewing. Before we dive into the tutorial, we need to define a few key terms...

- **Zero Parallax Plane** – This is effectively the screen placed on the zero parallax plane will appear to float outside of the screen and anything behind it will appear inside the screen.
- **Interocular Distance** – This is the distance between the viewer’s eyes. Commonly referred to as the IDD, the average for humans is 6.5 centimetres.
- **Interaxial Distance** – This is the distance between two stereoscopic cameras and is generally set to match the IDD. The interaxial distance can be raised or lowered to exaggerate or decrease the depth effect.

- **Parallel** – The apparent displacement or difference in the apparent position of an object viewed along two different lines of sight.

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2. Setting up the stereoscopic camera rig quickly in six steps

A place a single camera into your scene and set the target distance of the camera to your intended zero parallax plane. You should also set the focal length if you intend to use any depth of field effects. This centre camera will be used to help compose your shot.

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3. Applying film offset

One way to correct this is to keep the cameras parallel but skew the frustums so that both camera projection planes occupy the same area.

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3. Image distortion with converged cameras: the projected image is incorrect

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Now we need to set up the left and right cameras that will give us our stereoscopic effect. To start you should separate your left and right cameras by 6.3cm. To do this copy your original camera twice, moving one copy 3.15cm to the left and the other 3.15cm to the right.

You should then create an expression so that moving one of these new cameras will move the other in the opposite direction. This will help later on when we need to play with the interaxial distance to optimize the 3D effect.

Next you should name your cameras left, right and centre according to their position and group all of them within a null object so that you can move or animate them as one.

Next use the Film Offset on the left and right cameras so that their projection planes overlap (as shown in the figure on page 59).

Finally, you should create an expression between the left and right Film Offset values so that moving one will move the other in the opposite direction. This will save you from having to adjust the two values independently whenever you change the interaxial distance.

We now have an optimally configured camera rig. However there are a few things to consider before outputting our scene, you will have to experiment with separation between the cameras and the placement of objects in your scene to achieve a stereo effect that works with your particular scene.

Before committing to the final output you should preview your work. Export full resolution images at strategic points – for example when objects are at their closest or farthest away from the zero parallax plane or at points along a camera’s animated path. You should render a separate image out from each camera and use 3dtv.at.com’s stereoscopic player (Windows only) to view your stereo effect without a special screen.

If you’re on a Mac, just use Photoshop instead.

If you are working on a Mac, you can still preview your image by creating an anaglyph from your left and right images using this method in Photoshop... Open both the left and right images together. Using the channels palette select the red channel of the left image. Select >All and copy this entire channel. Now simply select the red channel of the right image and then paste the copied channel from the left image into it. Finally switch back to the RGB view and you should see your anaglyph image.

The comfortable scene layout

Our eyes can only focus within a limited depth range – the ‘depth of field’. In the real world anything in front of or behind this depth of field appears out of focus. In a 3D scene it is entirely possible to have objects in focus exceeding this range. This will cause our eyes to try and focus on too large a depth range causing discomfort and loss of the stereo effect. A good rule of thumb is that no object should be further from the zero parallax plane in either direction than half way between the camera and the zero parallax plane.

Use the comfortable viewing areas as a guide

The comfortable viewing area should only be thought of as a guideline. You can get away with objects being outside this area especially if they move quickly through it and then out of shot. Problems occur if you have static objects outside of this given range. A good way to check this effect is to look at the separation between the left and right images of your anaglyph – generally if the separation on objects at the very front or back of your scene is more than around 6cm it will be uncomfortable to view. This constraint varies with screen size and if you set a particular object to the limits of its separation on a small screen, blowing it up to a larger screen will increase this separation and could break your 3D effect. Ideally you should be conservative with the separation to ensure comfort on a range of screen sizes.

Handling depth

If you have a scene that is very deep you may need to render the background off on a separate layer with different stereo parameters or even use your centre camera for no stereo effect at all to ensure comfortable viewing. The area outside the screen (in front of the zero parallax plane) should also be used with care. Ideally no object should stay in this area for too long. One way to increase the comfortable viewing distance is to use depth of field to blur the areas outside of the comfort zone.

The stereoscopic window

The display screen is the window into your stereoscopic world. You should not let anything that is outside this window touch its edges. Your eyes will tell you that it is outside the screen due to its parallax, but your common sense will tell you it is inside the screen because it is occluded by the edge of the screen. This conflict of information will ruin the illusion of depth. You should trim any continuous surfaces such as ceilings or floors to the zero parallax plane for the same reason. You can see the right and wrong effects with your anaglyph glasses in figure 6. The satellite appears outside the screen on the left, to get a final size of 1,920 x 1,080 (see image 2D above). Note how each image is squashed horizontally – this is done so that stereoscopic video can fit in the same bandwidth as standard HD video. On playback the images will be expanded to fill the entire 1,920 x 1,080 frame.

Outputting the final animation

The final render can be thought of as two separate animations, one for each eye. If your software contains tools for batch rendering you can save out two copies of your scene, one with the left camera active and the other with the right camera active and batch render these two files together. For the Sony competition you should render out either a TIFF or Targa image sequence for each eye at a resolution of 1,920 x 1,080.

To prepare your initial entry you’ll need to use After Effects or similar compositing software to first horizontally compress each image sequence to a resolution of 960 x 1,080 then arrange the two sequences side by side, with the left image on the left, to get a final size of 1,920 x 1,080 (see image 2D above). Note how each image is squashed horizontally – this is done so that stereoscopic video can fit in the same bandwidth as standard HD video. On playback the images will be expanded to fill the entire 1,920 x 1,080 frame.

The final output

The left and right eye sequences have been horizontally compressed into a 1,920 x 1,080 frame to fit the same bandwidth as HD video for initial judging. Your entry should have stereo audio and use any codec that can be played back on a standard PlayStation 3. A list of compatible codecs can be found here: manuals.playstation.net/document/ps3/all/turned擢rofile/eppesa.html.

However, make sure you also keep the original image sequences, if your movie is chosen for inclusion on the 3D demo Blu-ray Disc, you will need to provide them so Sony’s engineers can generate the 5-3D master. Audio should be provided as a 48KHz WAV file in either stereo or surround format. For more information, helpful video tutorials and a forum, visit: 3dworldmag.com/sonyc ompetition

With thanks to...

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