

# 6A

## Using Stereoscopic Cameras

*In this bonus PDF, you learn the basics of making stereoscopic 3D animation, just like Hollywood.*

You will explore:

- ◆ The basics of stereoscopic camera work
- ◆ Building two different kinds of stereoscopic camera rigs
- ◆ Using the screen plane to control what is ahead or behind the screen when you show it

### Understanding stereoscopic animation

It was a **View-Master** that got me started towards 3D animation. I first looked through a View-Master as a little kid. It had a series of seven stereographic scenes that told a story. I couldn't believe the depth that I saw. I remember pulling it from my eyes and looking in the back to see if it was real. I couldn't believe how such a big and real scene could be in such a tiny place. From that moment on, I wanted to make scenes in 3D. You will investigate stereoscopic 3D a bit, and I have provided links for you to follow further as you like.

Basically, Stereoscopic 3D takes two images of a scene from two adjacent places representing where your eyes would be. When you show one to each eye, your brain will fuse the images into a single 3D scene.

## Spacing the cameras

With two eyes close together, you would see the world like a mouse. Farther apart, the scene would be like a person sees it. Even farther apart, the scene is as a giant would see it. This is the same for two cameras. The spacing between them has a lot of affect on how a stereo scene is perceived. But that is not the only factor in stereo 3D. Obviously, stereoscopic animation requires two cameras. The distance between these cameras is very important.

## Exploring convergence and divergence

Your eyes are not stuck in one position like the eyes of an owl. They move towards and away from each other to help you see in 3D. **Convergence** is when your eyes point towards each other, **Divergence** is when your eyes point away from each other.

### Time for action – watching your finger

The best way to understand how stereo cameras act is to use those that you were born with. This simple exercise shows you a bit about stereo images and how our eyes mix the two:

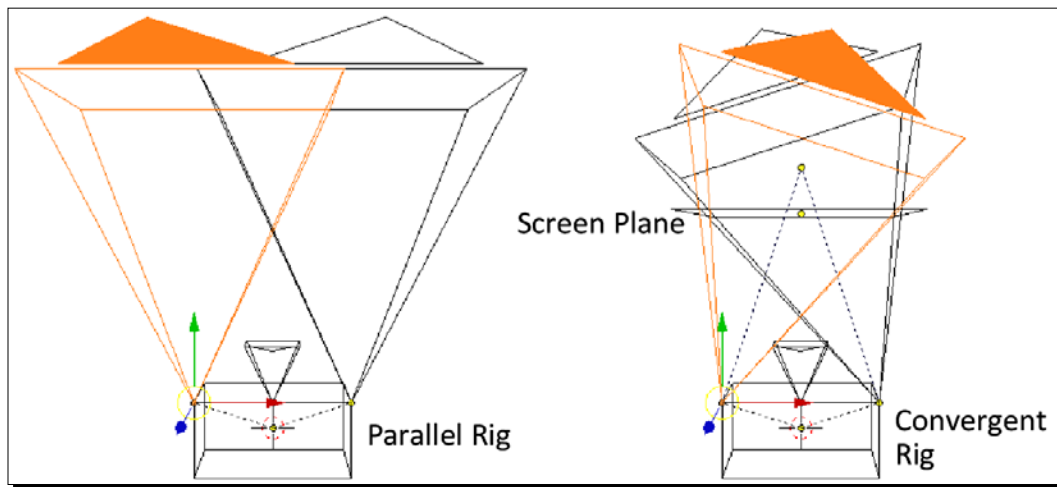
1. Touch the base of your left index finger to your nose.
2. Move your finger slowly out.
3. Look at your finger and observe the changes as your finger goes further out.

### What just happened?

As you moved your finger out, at first you saw two fingers. Then, at some point, suddenly you see one finger; in stereo. The farther your finger goes, the more comfortable it becomes. That's because you are not used to crossing your eyes so much. As your finger gets farther away, your eyes track the motion of your finger. If you could move your finger out to the horizon, your eyes would both be pointed straight ahead.

### Which way to point the cameras?

You've experimented a little to discover how your eyes see in stereo. Now you will learn how Blender replicates this.



There are three different ways that stereoscopic cameras can be set up. They can have the cameras pointing in the same direction, called a **Parallel** setup, as shown on the left of the previous screenshot. They can have the cameras both pointing to a certain point in space called a **Convergent** setup, as shown on the right above. There is also an **Off-Axis** setup which combines both the Parallel and the Convergent setups, but it is more difficult to do. You will look at the Parallel and Convergent setups and their use.

## Using the screen plane

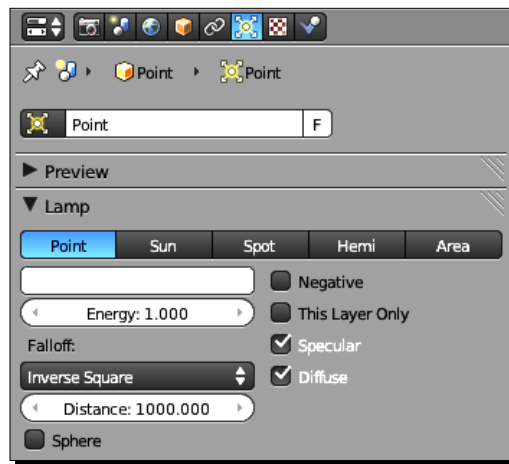
The **screen plane** is just what it sounds like. It's a plane that represents the screen you are watching the stereo image on. When you shoot stereo, you have to consider the distance between the viewer's eyes and the screen when people view your animation. Are they watching this on their laptop, an IMAX screen, or something in between? Action at the screen plane fills the screen. Action farther away than the screen plane seems to be behind the screen. Action closer than the screen plane seems to be closer to you than the screen.

The screen plane is important because all the action at the screen plane will naturally be seen in both cameras. You have to be very careful that all the action ahead and behind the screen plane can be seen by both cameras or the illusion of 3D will be destroyed.

## Time for action – making a parallel stereoscopic rig

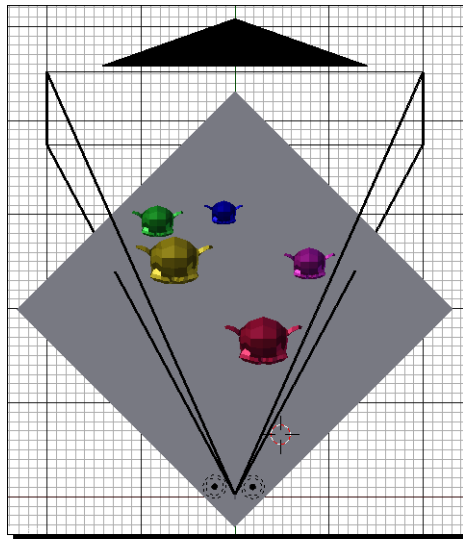
Now that you have studied the principles of stereoscopic 3D, it's time to make a camera rig that will let you record it:

1. Create a new file in Blender.
2. Switch to the **Top** view.
3. Press *N* to get the Properties panel in the 3D View. Set the dimensions of the cube to X: **0.208**, Y: **0.500**, Z: **0.050**
4. Name the cube **Rig**.
5. Zoom out and select the camera. Use the Properties panel in the 3D View to move the camera to location X: **-0.104**, Y: **0.25**, Z: **0.000**.
6. Set the rotation to X: **90**, Y: **0**, Z: **0**.
7. Scale the camera to X: **40**, Y: **40**, Z: **40**.
8. In the Properties window, name the camera **Camera-L**.
9. In the 3D View, press *Shift + D* to duplicate the camera. Press *Enter*. Set its location to X: **0.0**, Y: **0.25**, Z: **0.000** in the Properties panel of the 3D View.
10. In the Properties window, name the camera **Camera-C**.
11. In the 3D View, press *Shift + D* to duplicate the camera. Press *Enter* and set its location to X: **0.104**, Y: **0.25**, Z: **0.000** in the Properties panel of the 3D View.
12. Name the camera **Camera-R**.
13. Press the RMB to select **Camera-L**. Press *Shift + RMB* to select **Camera-C**. Press *Shift + RMB* to select **Camera-R**, then press *Shift + RMB* to select the rig. Press *Ctrl + P* to parent the Rig to **Camera-L**, **Camera-C**, and **Camera-R**.
14. Now it's time to make a scene to render, as shown in the next screenshot.
15. Press *A* to deselect everything.
16. Move the light to X: **-2.000**, Y: **1.000**, Z: **6.000**.
17. Because of the size of this scene, you need the light to go farther. With the light selected, go to the Properties window and select the **Object Data** button on the header. It has the glowing light with four small arrows, highlighted in blue in the following image. In the **Lamp** subpanel, as shown in the following screenshot, near the bottom is a button to enter the distance that it takes the light to fall off to darkness. You want the light to be bright. So enter **1000.00** for the distance.



- 18.** Duplicate the light and move it to X: **2.000**, Y: **1.000**, Z: **0.800**. Set the **Distance:** to **125.000**.
- 19.** Save the file as your `stereo_camera_rig-parallel`.
- 20.** Rotate the Rig **-20** degrees in X.
- 21.** Zoom out so you can see the cameras entirely.
- 22.** Press **A** to deselect everything.
- 23.** Press **Shift + A** to make a cube. Scale it to 16.5. Rotate it 45 degrees in Z.
- 24.** Press **2** on NumPad three times to rotate your view. Press **Tab** to get into **Edit Mode**. Delete the vertex in the center as you see it. Press **Tab** to get into **Object Mode**.
- 25.** Set the color of the cube to white; R: **1.000**, G: **1.000**, B: **1.000**.
- 26.** Move the cube to X: **0.000**, Y: **20.000**, Z: **0.000**.
- 27.** Press **7** on NumPad to get the *Top* view.
- 28.** Press **A** to deselect everything.
- 29.** Make Suzanne. Move her so she is within the cube and within the cone of the cameras.
- 30.** Use **Shift + D** to make a copy of Suzanne. Move it a bit so you can see both, staying within the cube and the cone of the cameras. Repeat this three more times.
- 31.** Move the five Suzannes roughly into a circle within the camera cones and the cube.

- 32.** In the Properties window, select the **Materials** button on the **Properties** window header.
- 33.** Create a new material as you did in the last chapter. Go down to the color button in the **Diffuse:** subpanel, click on it to get the color wheel as you did in the last chapter.
- 34.** Make each Suzanne a different color. An easy way to choose colors is to use the color wheel as your guide. Make the Suzanne at the top of the circle the color that is at the top of the color wheel. The Suzanne at the lower right becomes the color at the lower right of the color wheel, and so on.
- 35.** Rescale the Suzannes. Scale two to 3.0. Scale two to 2.0. Scale the other one to 1.5.
- 36.** Zoom into the Rig and select **Camera-C**.
- 37.** Make a second 3D View window by dragging the three diagonal lines in the bottom-left corner of the 3D View window.
- 38.** Move the cursor over the new window on the left. Press *T* and *N* to close the **Tool Shelf** and the Properties panels.
- 39.** In the left-hand 3D View header, select **View**, choose **Cameras** off the menu. Choose **Set Active Object as Camera**.
- 40.** Move the five Suzannes so they don't overlap, as seen in the camera view. Adjust their positions as seen from the top and move them in Z.



Now it's time to use it:

1. In the right-hand 3D View window, zoom into the Rig in the right-hand view and select **Camera-L**.
2. In the left-hand 3D View header, select **View**, choose **Cameras** off the menu. Choose **Set Active Object as Camera**.
3. Press *F12* to render the image.
4. With the cursor over the rendered image, press *F3* and save the image as *Suzanne-L.png*. Press *Esc* to close the image.
5. If you forget which camera you have active, go to **Select** on the 3D View header and select **Select Camera** from the menu. The current camera will become the active item.
6. Select **Camera-R** in the right-hand **3D View**.
7. In the left-hand 3D View header, select **View**, choose **Cameras** off the menu. Choose **Set Active Object as Camera**.
8. Press *F12* to render the image.
9. With the cursor over the rendered image, press *F3* and save the image as *Suzanne-R.png*. Press *Esc* to close the image.
10. Save the file to a unique name.

### ***What just happened?***

Well, you just made a simple stereoscopic rig. This style of stereoscopic rig is called a parallel rig because the cameras are pointed in the same direction.

This is used outside, where the cameras are pointed towards the horizon, or when a director doesn't know how the images are going to be used. This allows them to select particular parts of the image, say one of the Suzannes, and move them closer or farther apart in post-production or editing.



For your reference, the file *4909\_06\_Stereo Rig - Parallel.blend* has a parallel camera rig.

To move the cameras, you move the rig, and the rig can be set to track an object just like a camera can. **Camera-L** is the left-eye view. **Camera-C** is for general aiming. **Camera-R** is the right-eye view.

You can see the 3D already. Put the two images you rendered side-by-side, as shown in the following screenshot, in a photo program such as Photoshop, Gimp, or Paintshop Pro. Now, cross your eyes and slowly relax them. A third, three dimensional image will appear in the center. Give it a moment, your eyes will resolve it.



For your reference, the file 4909-06\_Stereo Rig w Scene .blend has the parallel camera rig and the Suzannes scene rig.

## Understanding the convergent rig

The convergent rig points the cameras in a slightly cross-eyed manner. It is often used when you are trying to match footage made with dual video cameras. The difference is that you add an object to control how, and at what point, the cameras overlap, and where the screen plane is.

### Time for action – making a convergent rig

Remember when you moved your finger away from your face? Your eyes were a convergent stereo rig. Now it's time to make one that will, like your finger, control the point where the cameras are both pointed at:

1. Open 4909\_06\_Stereo Rig - Parallel.blend or the stereo rig that you made.
2. In the 3D View window press *N* to get the Properties panel. Go down to the **3D Cursor** subpanel and set the 3D Cursor location to **X: 0.00, Y: 15.000, Z: 0.000**.
3. Press *A* to deselect everything.
4. Press *Shift + A* and scroll down the menu and choose **Empty**. Scale **Empty** to **3.000**. Name **Empty**, Empty-Zero Parallax.
5. Press *Shift + RMB* to also select the Rig. Press *Ctrl + P* to parent **Rig** to **Empty**.



6. Press **A** to deselect everything.
7. Press the RMB to select **Camera-L**. Press **Shift** + RMB to select **Camera-R**.
8. Press **Shift** + RMB to select **Empty**. Press **Ctrl** + **T** and choose **Track to Constraint**.
9. Select just **Empty**. Press **G** and move **Empty** to make sure that the cameras follow **Empty**. Press the RMB to release the motion.
10. In the Properties window, select the **Object** button in the header. It is the fifth button from the left, with the cube on it. The third subpanel down is the **Transform Locks** subpanel. Open it and lock the X and Z location.
11. Save the file as `stereo_camera_rig-convergent`.
12. Move **Empty** and note that you can only move **Empty** in Y. Also, **Camera-L** and **Camera-R** track it. Press the RMB to release the motion.

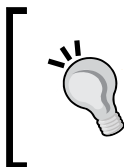
## What just happened?

You just finished the convergent rig. The two cameras will always point towards Empty. The Rig is the Parent Object. The three cameras are its children, as is Empty. The right and left cameras track the `Empty_Zero Parallax` point. Zero parallax is where the right and left eye see the same thing.

The Empty is an object without any vertices, edges, or faces. But it's very handy as a placeholder, it doesn't render, but you can use it as a parent or an object to track. In this case, you have the right and left cameras tracking it, so as it gets nearer to and further from the rig, the cameras cross, as your eyes did when you were following your finger.



For your reference, the file `4909_06_Stereo Rig - Converging.blend` has a converging camera rig.



### If you want more information about stereoscopic 3D:

Theory behind stereoscopic 3D  
[http://paulbourke.net/papers/vsimm2007/stereoscopy\\_workshop.pdf](http://paulbourke.net/papers/vsimm2007/stereoscopy_workshop.pdf)

## Have a go hero – exploring the screen plane

When you move Empty nearer and farther from the Rig, if you look in the **Top** view, you will notice that there is a distance from the cameras, where the field of view of the cameras cross each other. That point is the screen plane.

Move the Empty closer and farther from you. When you do, render a frame with the left and right camera and put them side-by-side in your photo program. How does this affect the image? Feel free to move the objects in the scene if you wish.

## **Time for action – tracking the boat in 3D**

Now you can set up the Rig to do the tracking. And then both right and left cameras can be recorded:

1. Open up your boat animation.
2. Append your convergent rig into the scene.
3. Set the rig to track the boat. Move Empty so it is near the boat in the middle of the animation.
4. Record frames for the left camera and copy them to a directory so you can use them in a later chapter.
5. Record frames for the right camera and copy them to a directory so you can use them in a later chapter.



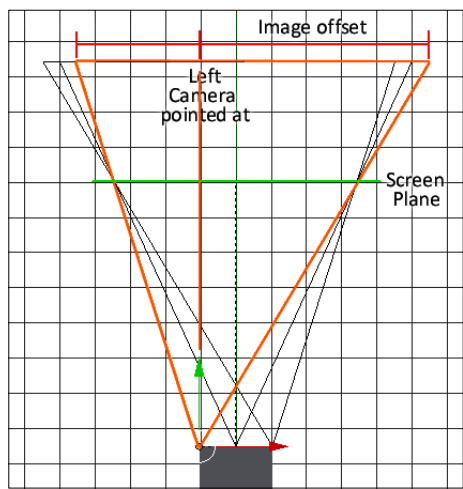
For your reference, the file `4909_06_Stereo Rig - Tracking boat.blend` has a converging camera rig tracking the rowboat.

## ***What just happened?***

You dropped the convergent camera rig into the rowboat animation. You set the rig to track the boat. You created a left-eye view and a right-eye view that you will learn to merge these into a stereographic 3D image in *Chapter 12, Rendering and Compositing*.

## **Have a go hero – exploring the off-axis rig**

The third kind of stereoscopic rig is the off-axis rig. It provides superior results to both the parallel rig and the convergent rig. With the off-axis rig, both cameras are pointed straightforward, as are the cameras in the parallel rig. But the field of views for the two cameras are shifted to one side. In the following screenshot, you can see that the triangle showing what the camera sees is not symmetrical:



You can find out more about the stereoscopic add-on at <http://www.noel.de/s3d/>. It also lets you create parallel and converging rigs, although at this time, it does not let you keyframe the zero parallax point to track items as the rig you built does. Also, the rig you made provides a small but important offset from the center of rotation to the cameras, just as your skull does.

Key	Function
<i>MMB</i>	Press it after starting to move, scale, or rotate an object and it locks the motion, scaling, or rotation to the nearest axis.
<i>Ctrl + Z</i>	Undoes a step.
<i>Ctrl + Shift + Z</i>	Redoes a previous step undone with <i>Ctrl + Z</i> .
<i>Alt + F</i>	Makes faces from selected vertices.
<i>Shift + Alt + F</i>	Done after using <i>Alt + F</i> , this makes a nicer set of faces.
<i>Tab</i>	When using a multi-set button, such as X, Y, Z or R, G, B, it allows you to move quickly between the buttons.
<i>B</i>	Does a border select in the Graph Editor.
<i>Ctrl + P</i>	Child a group of selected objects to the last object selected.
<i>Ctrl + T</i>	Sets an object(s) to track the last chosen object.
<i>Ctrl + NumPad 0</i>	Sets the active object as the active camera.

## **Pop quiz – getting set to make stereoscopic 3D**

Stereoscopic 3D depends on replicating sight. Simple things such as the distance between your eyes can matter a lot.

Q1. How far apart are people's eyes?

1. Approximately 1.75 inches or 44 mm
2. Approximately 2.5 inches or 65 mm
3. Approximately 4.0 inches or 102 mm

Q2. Why is that important in stereoscopic imagery?

1. That's as close as you can put two cameras.
2. The distance between the cameras affects whether the scene feels like it is scaled for a mouse, a person, or a giant.
3. You need to get the stereo glasses to fit right.

## **Summary**

In this bonus PDF, you learned the basics of stereoscopic camera work. You explored the underlying principles behind stereoscopic rendering. You discovered how to make stereoscopic rigs that you can control. You learned about the importance of the screen plane, and recorded a pair of 3D images that you can assemble in any painting program.