

Workshop Notes - Digital Stereo Workshop; 25 May 2008. Malcolm McCormick

These notes are intended to provide some introductory help for people wanting to start taking stereo photos with a digital camera and are intended to supplement the workshop being conducted by the Victorian 3D Society on 25 May 2008. They represent the views of one person and should be taken only as a guide. There is much information in libraries, the internet and in the experience of other members of the Victorian 3D Society. I have tried to illustrate these notes with photos I have taken which are presented as parallel pairs. They have been selected merely to demonstrate the points being made and are not presented as examples of fine photographs.

What kind of camera do I need?

In reality, any camera can be used to take stereo photos. All that is needed is a device which can capture two images of the same object(s) to represent the left and right eye views required to see stereo.

The left and right eye images can be taken in the following ways:

- using two cameras separated by an appropriate distance
- taking two photos with the one camera shifting the camera an appropriate distance
- using a beam splitter fitted to a camera

Actually the device doesn't even need to be a camera; Jeffrey L. Cooper has some interesting stereo images captured by placing small objects on a flat bed scanner. His instructions are at <http://www.3dphoto.net/text/taking/scanner/scanner.html> and the rest of his site is worth a look too.

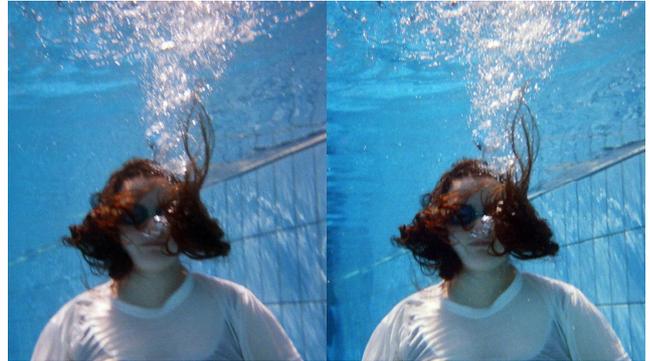
This paper assumes that the photos are available as digital images. These may be taken with a digital camera (compact or SLR) or taken with a film camera and scanned so that the digital images are available. The three photographs below were taken with (a) a film SLR camera, (b) a digital SLR camera and (c) a pair of disposable underwater cameras purchased for less than \$20 each.



(a) Taken with a Pentax MX film camera using the Pentax beam splitter



(b) Taken with a Pentax istDs digital camera using the same beam splitter



(c) Taken with two disposable underwater cameras mounted as shown in (b)

Most of the photos shown here were taken with a Pentax istDs digital SLR camera with 6.2 megapixel resolution. Cameras with up to 12 megapixels are now readily available but be careful as these will produce very large files. Provided you've got at least 6 megapixels, if you have to make a choice between a larger resolution and a better lens, I'd get the better lens every time.

Stereo cameras are available but so far none are digital. It is now possible however, to connect together two Canon digital cameras to make the equivalent of a digital stereo camera. This is still being developed but it looks quite exciting.

What should I photograph?

Almost any subject can make a good photo but most of the best stereos have something in the foreground, the middle ground and the background so that the stereo can be shown to full effect. The subject(s) however, can be anything, as you can tell by browsing the many stereo galleries on the internet. Exotic locations may be interesting but one of the acceptances in the 2008 Southern Cross completion was a terrific photo of a bowl of bread rolls beside a glass of red wine. In my opinion, the most important ingredient in a good photo is light and the next is imagination. One of the advantages of digital cameras is that you can experiment and see the results without having to pay for developing film. Browse all the galleries you can for ideas and inspiration; experiment as much as you can and work out what you like and what you're good at. There are many rules associated with lighting, composition, focussing etc., but these are documented in other places. Photography is highly subjective but in general, if you like the photo and you like to show it off, it's a good photo.

What is the ideal separation?

People can perceive stereo because they have two eyes; the brain receives the two images (which are slightly different because of the separation between them) and combines them so we can see in three dimensions. The differences are usually subtle. For example, in the pair below you can see that the drops of oil in the air appear closer to the cook's nose in the right hand image. This is because this image has been taken from a slightly different perspective. It is this difference that the brain interprets as depth and to the viewer, the drops appear closer than the cook.



Because the separation determines how your brain interprets the photo, it is important to get it right. The simplest rule is: the separation should be no more than $1/30$ times the distance to the closest object. Thus photos with a foreground object 2 metres away would need a separation of $2/30$ metres or around 6.5 centimetres. This is roughly the distance between your eyes. Separations much less than this would not show much depth; in the extreme where the separation was zero, the two halves would be the same and there would be no stereo effect at all. Separations much larger would make the object appear as though it was behind your eyes and a significant headache would result.

With digital cameras, it is easy to experiment. If you're not sure what separation to use, simply take several photos with different separations and then see which separation was the best. The photo below shows the small sphinx at Memphis in Egypt. The separation is too large and when you view it in stereo you can tell immediately that your brain is having trouble interpreting the stereo. Please don't try to look at it for very long.



Here is the same scene with a more appropriate separation. In fact, the left hand image in these two pairs is the same photo. Only the right hand image has changed. The one above was taken with a wider separation.



Beam Splitter

A beam splitter is a device which uses mirrors to split the image into two so that the two images can be taken simultaneously. It is fitted on to the lens of the camera and has a fixed separation determined by the position of the mirrors in the device. The Pentax beam splitter is shown below.



The advantage of the beam splitter is that it allows you to take a stereo photo of a moving subject with both halves of the pair being taken simultaneously using a single camera. The photo below, taken at Cowrie Beach on Phillip Island, is an example. Normally beam splitter shots are tall and narrow because they're a normal photo shape cut down the middle. The one below has been cropped at the top and bottom to give a better shape.



The disadvantages are not trivial however. Your choice of composition is quite limited because you shot has to fit into half the normal photo shape. Also, choice of aperture is limited to $f 4.6 - f 6.5$ so that depth of field can be a problem. Apertures smaller than these make the photo look like you're looking through a tunnel and wider apertures cause the two images to overlap.

Further, the separation in the beam splitter is usually fixed so the range of distances is also limited. If you try to photograph something too close, the background will look strange because the perspective is too different and if you photograph things too far away, the stereo will appear flat because the separation is too small to give enough perspective change. With the Pentax beam splitter, objects between 2 and 10 metres are ideal.

Cha-Cha

The cha-cha method involves taking two photos of the same scene with a small side step between them. Its name derives from the way you move when to take the photos. You simply stand with your legs slightly apart and frame your shot and then zoom out a little to make room for the movement you are about to make. Shift your weight onto your left foot and take the first photo; then shift the weight onto your right foot and take the other. It's a bit like dancing the cha-cha. That's all it takes to get a stereo photo. However, to get a good one you have to get the separation right, you have to keep the camera level when you move, you have to make sure you don't point the camera in different directions and you have to make sure that nothing moves in the scene between taking the two pictures. This is a lot to control but there are ways to manage all these things and with a digital camera you can experiment. There is good advice in what Neils Bohr said about being an expert; he won the Nobel Prize for Physics in 1922 and was a genuine expert. He said an expert is someone who has made all the mistakes that can be made in some narrow field. This means that getting your cha-chas wrong is only a problem if you can't recognise what went wrong and improve it next time. The other thing this means is that you shouldn't wait till you're overseas on a once-in-a-lifetime trip to begin practising. Practice with photos and scenes that won't matter much if you get them wrong. Then when it counts, you'll be ready.

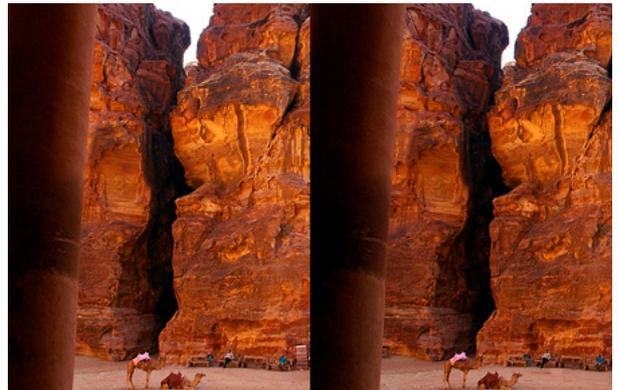
One way to make cha-chas is to mount the camera on a bar; take the first picture and slide the camera along the bar and take the second. This has the advantage of making sure the camera points in the same direction for both shots. It is very important to keep the back of the camera in the same plane as you move it. There's always a tendency to point it at a distant object and have this object in the middle of both photos; this will not give good stereo.

Moving objects

The photo below was taken using cha-cha at Petra in Jordan. Notice the person in black who has moved. He is behind the camel in the left hand picture. When you view the photo in stereo it becomes very obvious as your brain is trying to interpret something it can't. In such places its almost impossible to avoid people but if they're close to the background of the picture, it is possible to use photo editing software (such as Adobe Photoshop or even StereoPhotoMaker) to shift the people who have moved so they're back in the same position in both images or to remove them altogether. Sometimes, you have to crop the image to remove the moving objects and sometimes you have to just accept that you can't take a stereo of this scene using this technique.



Below is the same photo with the person removed using Photoshop.



Lighting with flash

Using the flash on top of a camera to light cha-cha stereos can be problematic. If the flash moves when the camera moves, the shadow patterns may be different in the two images and this can produce some strange effects or spoil the stereo completely. Some cameras have a hot shoe which can be used to connect an external flash unit. Using this and a flexible cable allows the external flash to be fixed on a tripod while the camera moves.

Hyperstereo and hypostereo

One advantage of using two cameras to take stereos is that you can choose any separation you like. Remembering that the separation should be $1/30$ of the distance to the closest object, the ability to shift a single camera very small distances allows stereo close ups to be taken. An example is shown below.



The separation here was only about 2 centimetres, much less than the 6 or 7 cm between your eyes and so the stereo you see here cannot be seen any other

way. One effect of the brain trying to interpret hypostereos (those with small separations) is that objects appear very large. The flower above looks like you could walk into it.

Conversely, hyperstereos (those with large separations) make objects appear smaller but you can see depth in objects that are too far away to see stereo normally because our eyes are too close together. An example is shown in the stereo below which was taken from the window of a plane. The motion of the plane can be used to create the separation; the time between the photos in this pair was just less than 1 second.



For the daffodil and the clouds I used the same technique to determine the correct separation. In summary, here's what I do.

- Guess the separation based on the 1/30 rule
- Make sure you have a way to shift the camera so that it points in the same direction. Pretend the camera is on a bar so it just moves sideways and doesn't tilt inwards as it moves. The daffodil was taken with the camera on a slide bar; the clouds used the fact that the plane was flying in a straight line and I held the camera tightly against the window to avoid getting reflections and window scratches in the photo.
- Take the first photo and move a small amount, take a second photo and move again and then take a third. For the daffodil I moved about 2 cm and 4 cm, if you're doing close up work, there's a limit to how much you can move because the object will not be in the frame if you move too far. For the clouds I set my camera on motor drive and just held the button down while it took several shots. If you don't have motor drive, take the shots as quickly as you can; planes move pretty fast.
- Use StereoPhotoMaker to align the photos in pairs and see which pair works. For the daffodil, I used the first and second shots and for the clouds I used the first and third. With a digital camera, all this costs is time; although the people sitting next to me in the plane sometimes get curious.
- When you've examined pairs that don't work, try to understand why. If the separation is too small, the pair will look flat. If it's too large, it will look strange. The good part is you don't have to show anyone the ones that don't work. Take plenty and only show off the good ones!

Using two cameras

This seems the most obvious way to take stereos without a dual-lens stereo camera. There are

however, several issues to consider. The first is cost; two cameras may be too expensive. The next is separation; there is a limit to how close you can have the cameras and it is impossible to take close ups unless you use mirrors and Physics. Two big cameras on a bar can also be quite cumbersome and heavy as the following photo will show.



If you look carefully at this photo you'll notice that the background seems a little strange, especially between the cameras. This is because I was too close to them when I took the photo using a beam splitter. The separation is a little too big and the background alignment suffers as a result.

In my opinion, the biggest problem associated with using two cameras is the difficulty in synchronising the two shutters.

The first pair below shows what can happen if the two shutters don't fire absolutely simultaneously. Look at the horse's front feet. I have a switch which is connected to both cameras so I only have to push one button. The exposures were set manually, the focus was set manually so there should be no reason why the two would not fire simultaneously. But they didn't; and with a fast moving horse a fraction of a second difference can ruin the photo.



However, when it works, they can look quite good.



StereoPhotoMaker

There is no doubt that StereoPhotoMaker, developed by stereo enthusiast Masuji Suto, is the most useful program for the alignment and presentation of digital stereo images. Not only is it incredibly useful, it is freeware and has been donated to the stereo community and we are all enormously grateful. It can be downloaded from <http://stereo.jpn.org/eng/stphmkr/> and there are only two files required.

- stphmkre.exe (the executable file; around 1Mb)
- stphmkr.chm (the help file; 10 Mb)

The program doesn't need to be installed and it doesn't copy files into system folders or affect the registry as many Windows programs do.

All you have to do is run the EXE file.

The help files on the StereoPhotoMaker website are excellent and you should have a look at these and practice.

The Stereo Window

When I first read about the stereo window, I didn't really understand it and I just ignored it. I looked at a web page which described how to mount slides and it gave the following explanation of how to mount slides to avoid stereo window violations. It said:

Simply select the closest item in the stereo, preferably near the right or left side. Fix the chips down so that a little more can be seen between this item and the left side of the right aperture than between this item and the left side of the left aperture, or similarly, so that a little more can be seen between the selected closest item and the right side of the left aperture than between this item and the right side of the right aperture. It is now only a question of degree as to how little is "little" etc. in order to place the item in question exactly where you want it relative to the window.

This confused me of course, but I remained curious because I could see that understanding the stereo window is important and fortunately I was able to play around with some digital images and come to grips with the principles of the window. I am hoping that the following explanation will be useful to those who have not yet mastered this concept.

Each photo has an edge around it and in stereo this looks like a window through which you are viewing the scene. We have already seen how your brain can have trouble interpreting things which can't be real: people being in different places in the two halves of the stereo; inappropriate separations which create impossible perspectives, etc. A stereo window violation occurs when your eyes see something in front of the window and your brain knows it's behind it. The pair below is an example.

The hand rail in the middle of the bottom looks like it's in front of the window; I did this by adjusting its position to be closer to the left hand edge in the right hand photo. However, your brain knows it's behind the window because the bottom of the window is cutting it off.



↑ ↑ ↑ ↑
← 2 cm → ← 1.6 cm →

In the pair below, I've adjusted it to push it all back behind the window and your eyes won't hurt to look at it any more.



↑ ↑ ↑ ↑
← 1.8 cm → ← 1.8 cm →

This is not easy to see in small pictures like these but please make sure don't let any object which intersects with the window appear as though it's in front of it. It's OK to have things in front of the window, but not if they intersect the window. The leading edge of the daffodil above is in front of the window and so is Laura's hand in the first photo at the start. Your brain can handle these because it's OK for something to come through the window. It's just not OK to come through the window and be behind it at the same time. Have fun, experiment lots, make lots of mistakes and learn something from each photo you take.

Malcolm McCormick 25 May 2008