The Use of Stereo Photo Maker to Evaluate Stereo Pairs for Projection

Stereo Photo Maker (SPM) is the finest piece of software available for digital photographers wishing to process, align or project stereo pairs. It was written by Masuji Suto and he has made it available to stereo photographers around the world as a gift to our ever growing community. 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 and it's very easy to use and incredibly useful.

One of the issues associated with using SPM to automatically align stereo pairs is that it appears to make it very easy. Even bad pairs can still be aligned with SPM and it will do the best it can. However, there has been a tendency for novice stereo photographers to just accept the resulting aligned pair as being ready for projection simply because SPM has processed it.

Stereo Photo Maker was not designed to be used in this way. It is a tool for us to use and we need to have some input into the final result if we are to end up with the photos we want.

Stereo pairs always look better when they are small because our eyes can handle minor imperfections but if they are to be projected onto large screens there are a number of technical issues which need to be addressed. The two most important, which are the subject of this paper, are parallax problems and window violations.

Parallax Problems

When we look at objects close to us, we point our eyes inwards so that they converge at the point where the object is. The further away the object is the smaller the angle of convergence we need and to see objects in the far distance we need to align our eyes parallel to each other. In the real world, we never have to diverge our eyes beyond this point but in the artificial world of stereo photography it is possible to create a situation where this may be needed. When this occurs, our eyes are able to diverge by a small amount but if required to diverge too far, the brain finds it impossible to do and a significant headache can result. This is the parallax problem this paper is seeking to address and it is usually caused when the separation between the two photographs, which make up the stereo pair, is too large. Ideally, the separation will be 1/30 of the distance to the closest object in the picture and except for special circumstances this object should be in the plane of the stereo window.

The best way to illustrate this is with the following two photos in Figure 1. They are printed in anaglyph format to make it easy to see how the two photos overlap with each other.
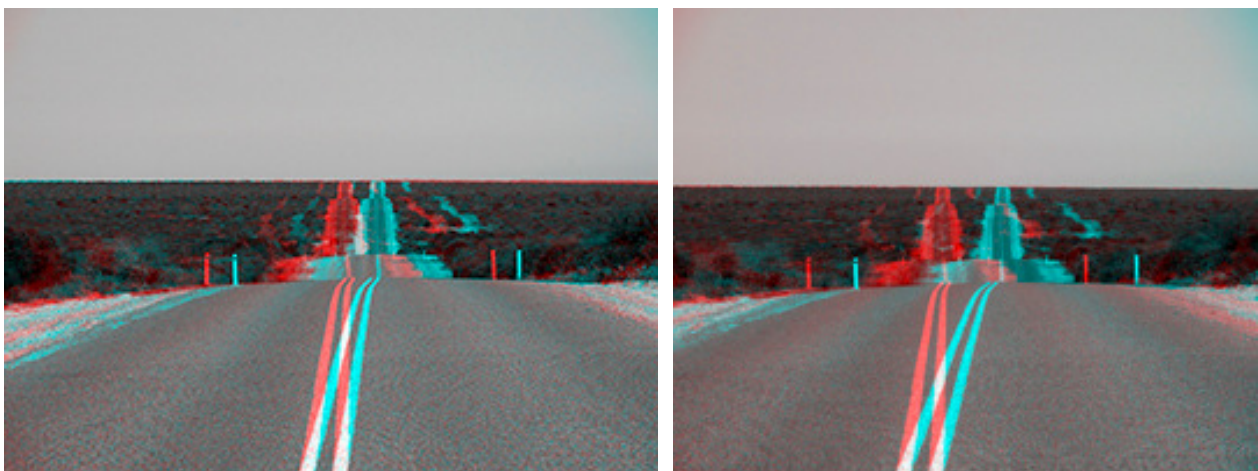

Figure 1.   Pair A   Pair B

These photos were taken at the same time but with different separations; the separation used for Pair B was much larger than that used for Pair A.

We can see that the whole scene is behind the stereo window in both photos because the point where the blue and red components overlap is at the very front of the photo.

When Pair A is projected onto a screen we can see the point where the road meets the horizon without having to diverge our eyes even though they appear to be apart. This is because our eyes are about 70mm apart so we can see points which are 70mm apart with our eyes parallel.

Pair B on the other hand, has these points much further apart; in fact they are 1/10 of the width of the photo.

The screen at the Victorian 3D Society is 2.5 metres wide and 70mm represents 1/35 of this distance. In practice having these far distance points less then 2/30 of the width of the photo will give a photo free of parallax problems. In Pair A the horizon points are 12mm apart on this screen but Pair B has these points 26mm apart.

These things are easy to confirm once the photos are projected onto the screen. Pair A looks quite good but as soon as you see Pair B it is immediately obvious that there's a problem as you instinctively want to close your eyes to avoid the conflict your brain feels.

However, both these photos look fine on a small computer screen because the absolute amount of divergence required is much smaller than when it's projected.

Fortunately, StereoPhotoMaker has features which can be used to identify and hopefully fix such problems, even on a small computer screen.

SPM allows a grid to be placed over the photo and the infinity points of two halves can be compared either by having the photo in anaglyph format (by pressing F6) or by having it in parallel mode (F9) and switching the photos by pressing X.

To access the grid, press Ctrl-G and the following small window will appear as shown below in Figure 2.
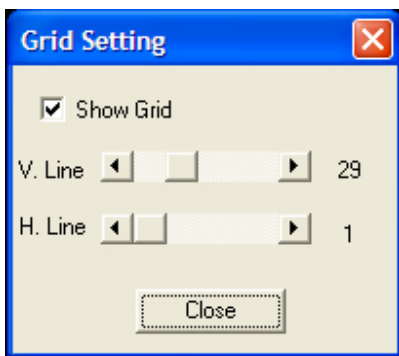
Make sure the Show Grid box is checked and then use the slide controls to choose 29 vertical lines and 1 horizontal line. This will place a grid over the photo which divides it into 30 vertical slices and two horizontal ones. Then click the Close button and the grid will remain.

In order to use this feature to look for parallax problems, simply choose a point in the far distance that you can recognise in both halves and use the grid to measure how far apart they are. This is usually easy when the pair is displayed side by side but sometimes difficult in anaglyph mode because some scenes appear confused when they are overlapped.

Figure 2.

The following example, again showing Pair A and Pair B, is an anaglyph in which it is easy to identify the infinity points.
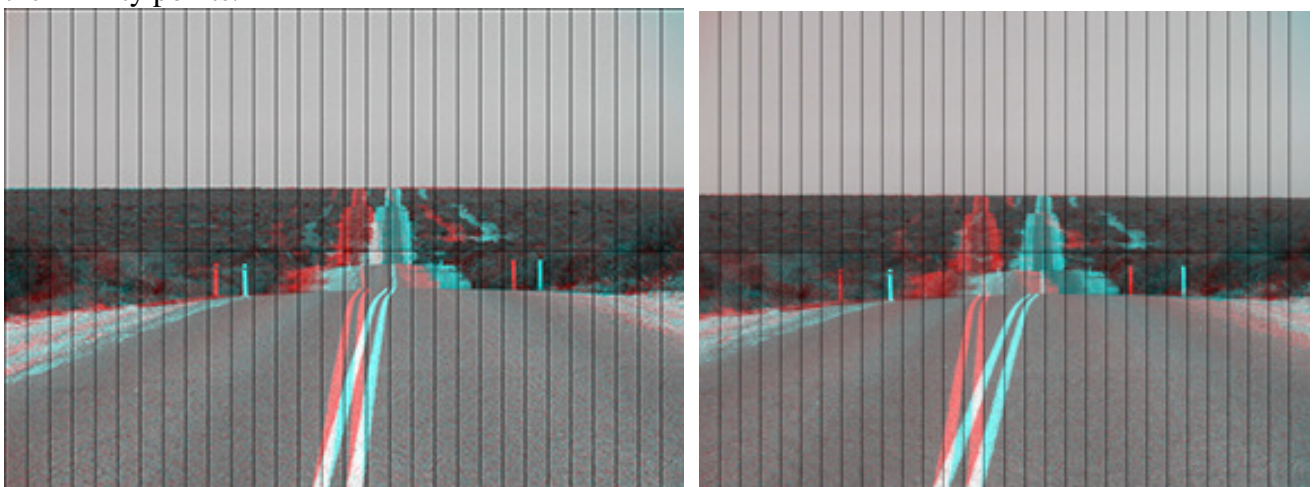

Figure 3.   Pair A (With Grid)   Pair B (With Grid)

The points where the road meets the horizon are 1.5 grid widths apart in Pair A but 3 grid widths apart in Pair B.

Any photo with infinity points which are 2 grid widths or more apart will show parallax problems when projected and will need to be addressed in some way.
There are three strategies which can be used to address this.

*Strategy 1: Bring the photo forward through the window.*
This will bring the infinity points closer together and hence resolve the parallax problem. However, this usually creates a window violation (see the discussion below) and this will spoil the photo.
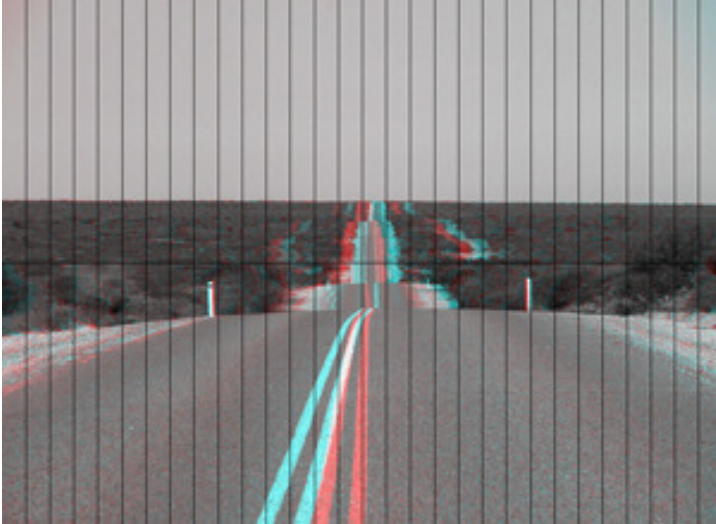
An example is given in Figure 4. This is Pair B, the one with the parallax problem, but it has been brought forward so that the infinity points are now less than one grid width apart so the parallax problem is solved. It can be seen that the closest white post on the side of the road is now in the plane of the stereo window because here the red and blue components are overlapped. This means that everything closer than this will be in front on the window. In this case therefore, Strategy 1 will produce an image unsuitable for projection because of the window violation this has caused.

Figure 4.

In fact, the view shown in Figure 4 is also the view that SPM produces when the auto-align feature is used. SPM will always ensure that the infinity points avoid parallax but in some cases, such as Pair B, this means that some of the scene will project through the window. SPM has to decide whether avoiding parallax or keeping everything behind the window will take precedence and it's programmed to avoid parallax. However, it usually gives a warning when it has had to make this compromise. This is shown in Figure 5 which shows the results of a typical auto alignment when the separation is too large.
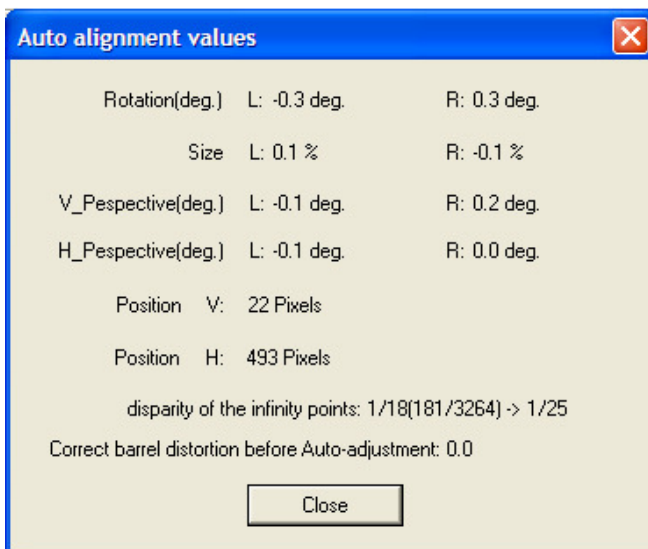
The warning is contained in the line labelled "disparity of the infinity points" and values higher than 1/25 should flag a warning. In this case 1/18 is problematic but in some cases 1/21 or 1/22 can be acceptable. Sometimes, depending on the features in the photograph, this figure may not actually highlight the problem. For example, auto aligning Pair B gives a figure of 1/64 which looks acceptable but the photo clearly shows problems. This seems to happen in photos with large areas of plain colour, for example the road and the sky in Pair B. In any event, a figure above 1/25 should always be regarded as a warning but pairs with values below this should also be checked for parallax problems using the grid feature.

Figure 5.

Strategy 2: Bring the photo forward and remove the foreground by cropping.
If bringing the photo forward creates window violations, try cropping the foreground to remove the problem. For example, the photo shown in Figure 4 has been brought forward to remove the parallax problem and if we then remove everything in front of the white post the result will be a photo which also has everything behind the window. This is shown in Figure 6(a) below.

It is important to note that removing the background will not improve the photo. Even though parallax problems are only noticeable in the background of the photo, they are actually caused by too large a separation and so it is the foreground which is most affected. Usually we try to push the image back behind the window and this forces the infinity points apart and creates the parallax problem. Cropping away the background usually makes the problem worse because a higher proportion of the resulting image is affected. Figure 6(b) has been produced by cropping the background from Pair B in front of the horizon; some has also been cropped off the sides to keep the shape of the image similar.
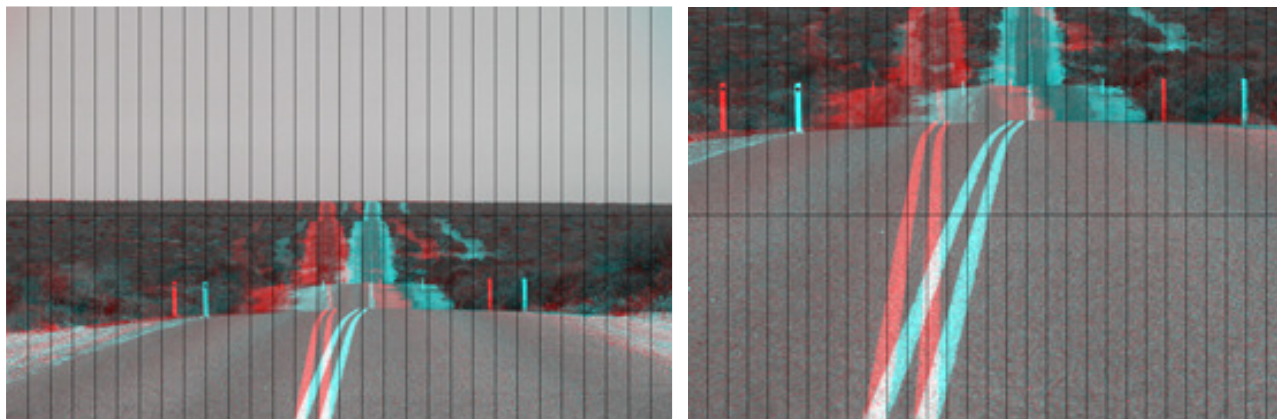

Figure 6 (a) Pair B with foreground removed   (b) Pair B with background removed

As can be seen from Figure 6, cropping the foreground has resulted in infinity points around 2 grid widths apart but in Figure 6(b) the points are almost 5 grid widths apart even though they were only 3 grid widths apart before cropping.

Strategy 3: Discard the pair.
This is often difficult for photographers, especially those who are relatively inexperienced but sometimes we just have to accept that this particular pair will not be suitable for projection. If you can't avoid window violations and parallax problems, it is usually better to discard the pair. There is often a temptation to show it anyway because it has a story behind it, or because it looked good on a small computer screen but your projected show will be judged by the poor images you show rather than the good ones, especially those which cause headaches for the audience.

Window Violations.
In the real world, when we look out through a window our right eye can see more past the left hand edge of the window than our left eye. This is because our right eye is further away from that edge.
This is illustrated in Figure 7.
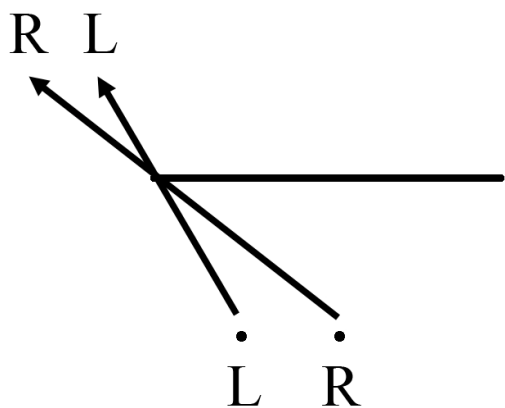
We have evolved with this reality and seeing more with our right eye in this situation does not cause a conflict in our brain.

In the world of stereo photography however, it is possible to present a pair in which the left eye image shows more on this edge than the right eye image. When this happens the brain will experience conflict and discomfort and this is what is referred to as a window violation. The level of discomfort is nowhere near as severe as that experienced with parallax problems but the effect can be off-putting.

Figure 7

Like parallax problems, window violations can also be difficult to identify by eye on a small computer screen but again there are features in SPM which can be used to identify and fix them.

One way to ensure there are no window violations is to make sure everything is behind the window. However, objects can be in front of the window provided they do not intersect with the edge of the window. The image in Figure 8 for example has a hand through the window but no conflict is caused because it does intersect the edge of the window.
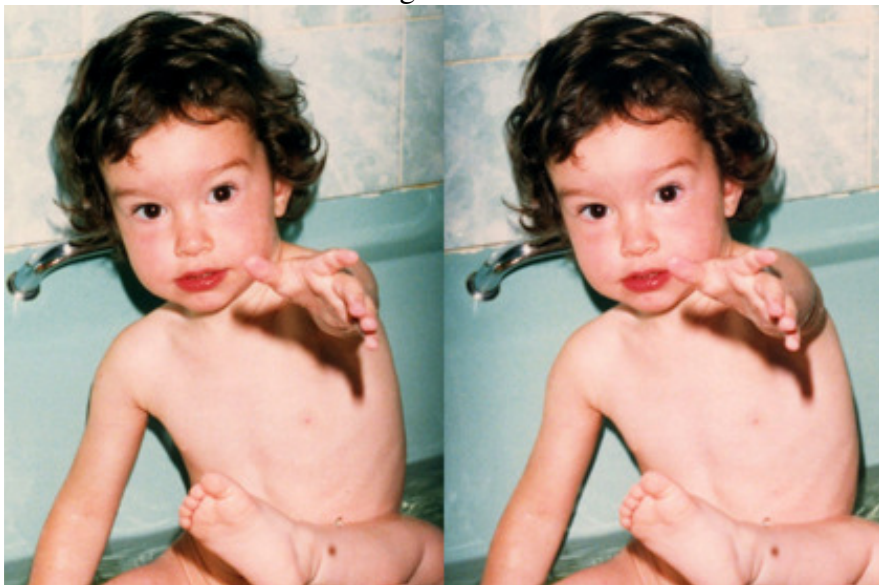

Figure 8

However, it is important to know what is in front of the window. Anaglyphs can also be used to assess this because in the plane of the window, the red and blue images will overlap and will not be visible. For objects behind this point the red image will be on the left of the blue one while those in ront of the window have the red image to the right. This can be seen in Figure 4 above. However, most photos have much more detail than this one and it is often quite difficult to recognise features in the two halves of the picture. An example is shown in Figure 9.
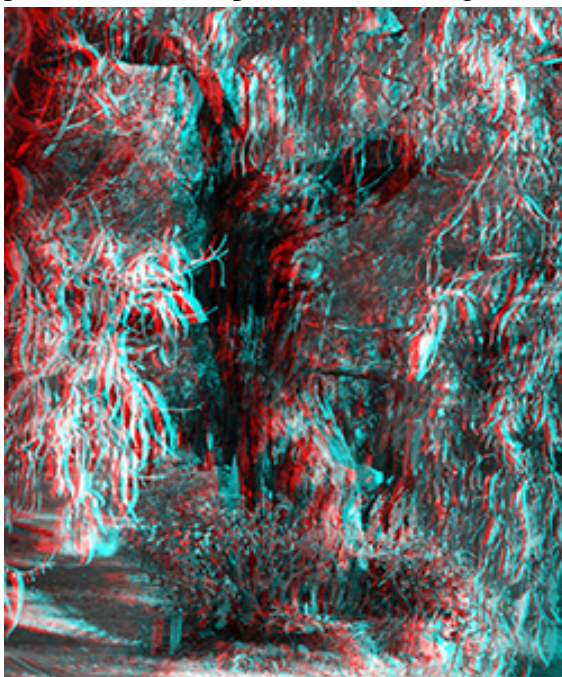

A much more useful SPM feature to use is the flashing single image view which can be accessed by pressing Ctrl-F11. This is difficult to illustrate on paper but it is the most effective way to identify window violations.

What this function does is to put just one of the halves on the screen but to quickly swap between the left and right half. In this mode, the part of the image which is in the plane of the window will remain still while the rest appears to oscillate around this point.

The left hand arrow key (to bring the image forward) and the right hand arrow key (to push it backwards) work in this mode and you can use these to position the image appropriately.

Using these tools it is possible to identify and fix both parallax issues and windows violations and it is important to realise that these cannot be addressed in isolation as the resolution of one often causes problems with the other.

Figure 9

Malcolm McCormick, Victorian 3D Society, February 2010