

Excel anaglyph stereoscopy #2 – how to split the image

by George Lungu

- The previous section showed an improvement in the practical implementation of spreadsheet multiplication, namely based on the associativity of matrix multiplication the three elementary rotation matrices were combined in a composite rotation matrix which was computed and updated in a single place then used all over the worksheet for a possibly large number of coordinate transformations. This improves speed, saves spreadsheet area and development time.
- In this section the effect of anaglyph stereoscopy is explained using sample pictures and diagrams.

A quoted explanation from Wikipedia:

“- Anaglyph images are used to provide a stereoscopic 3D effect, when viewed with glasses where the two lenses are different (usually chromatically opposite) colors, such as red and cyan. Images are made up of two color layers, superimposed, but offset with respect to each other to produce a depth effect. Usually the main subject is in the center, while the foreground and background are shifted laterally in opposite directions. The picture contains two differently filtered colored images, one for each eye. When viewed through the "color coded" "anaglyph glasses", they reveal an integrated stereoscopic image. The visual cortex of the brain fuses this into perception of a three dimensional scene or composition.”



The anaglyph goggles:

“A pair of eyeglasses with two filters of the same colors, once used on the cameras (or now simulated by image processing software manipulations) is worn by the viewer. In the case above, the red lens over the left eye allows only the red part of the anaglyph image through to that eye, while the cyan (blue/green) lens over the right eye allows only the blue and green parts of the image through to that eye. Portions of the image that are red will appear dark through the cyan filter, while portions of colors composed only of green and blue will appear dark through the red filter. Each eye therefore sees only the perspective it is supposed to see.” Wikipedia

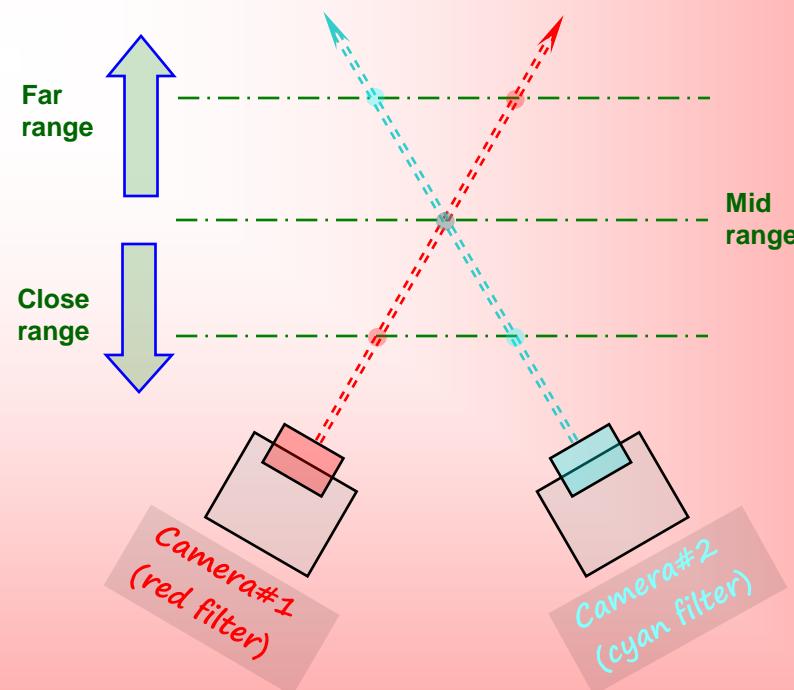


Anaglyph images – empirical observations:

- Looking at various anaglyph images off the internet, I found out that depending on the depth within the photograph (distance from the observer), there is a variable red-cyan misalignment.
- Anaglyph images usually have the object split sideways, on one side there is mostly red and on the other there is mostly the complementary color - cyan (which looks like a light blue). Some pictures have the same sign color offset (red for instance is always to the left and the cyan is always to the right within the whole picture) but others for instance have red to the left and cyan to the right on the bottom area of the picture and red to the right and cyan to the left on the top area of the picture. Somewhere in the middle these pictures contain an area with no color offset where the colors of the objects are correct and their edges are sharp.

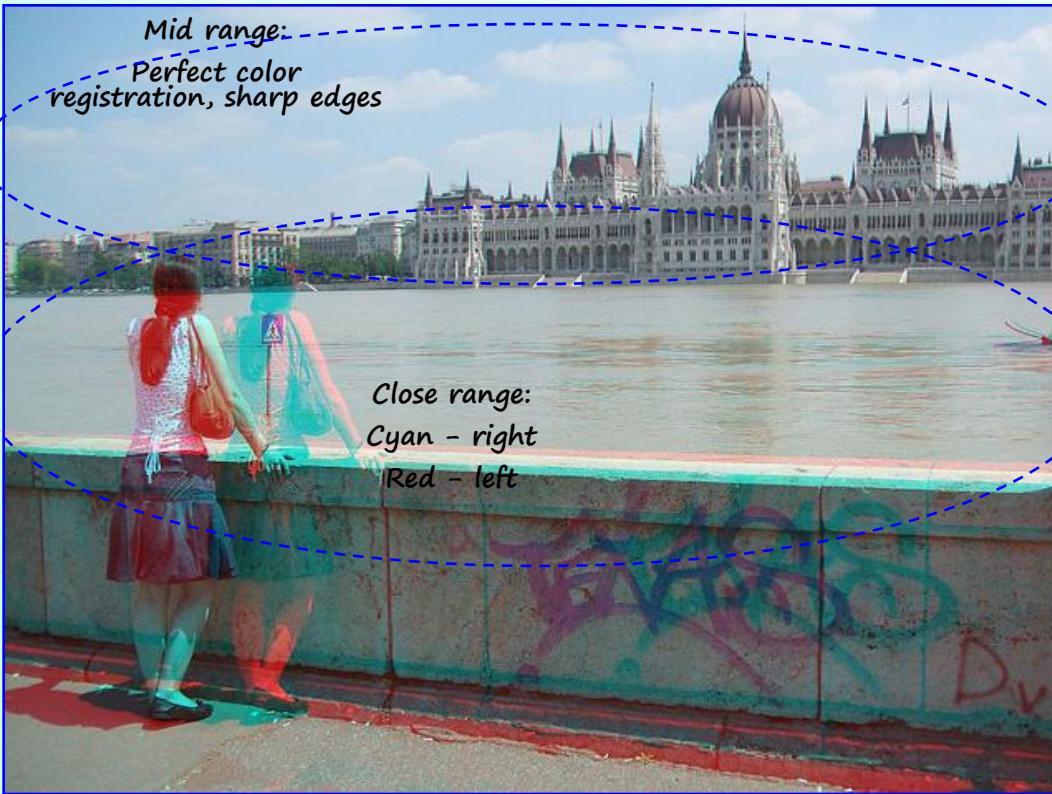
Some explanations:

- The eye gasses send the red part of the image to one eye and the complementary (cyan) to the other eye and that's how we can reconstruct stereoscopic images.
- It makes sense that when an observer focuses on a part of the image (let's say the middle level) the depth levels before and behind that focus levels will split. In real life that is not too visible because the eyes have a small distance between them so the separation is small and the brain will filter out detail information except in the area where the eyes are focused.
- You can still see this "image splitting" in real life while watching an object (your finger) at very close range (few inches in front of your nose) and trying to pay attention to the scene behind the object.
- Stereoscopy tries to emulate nature by placing two cameras each fitted with a different color filter, at a distance between each other laterally and pointing forward at a converging angle.
- In the midrange the images will overlap and there will be an almost perfect color registration (alignment).
- In the close range the cyan image will be offset to the right of the red image and in the far range the cyan image will be offset to the left of the red image.



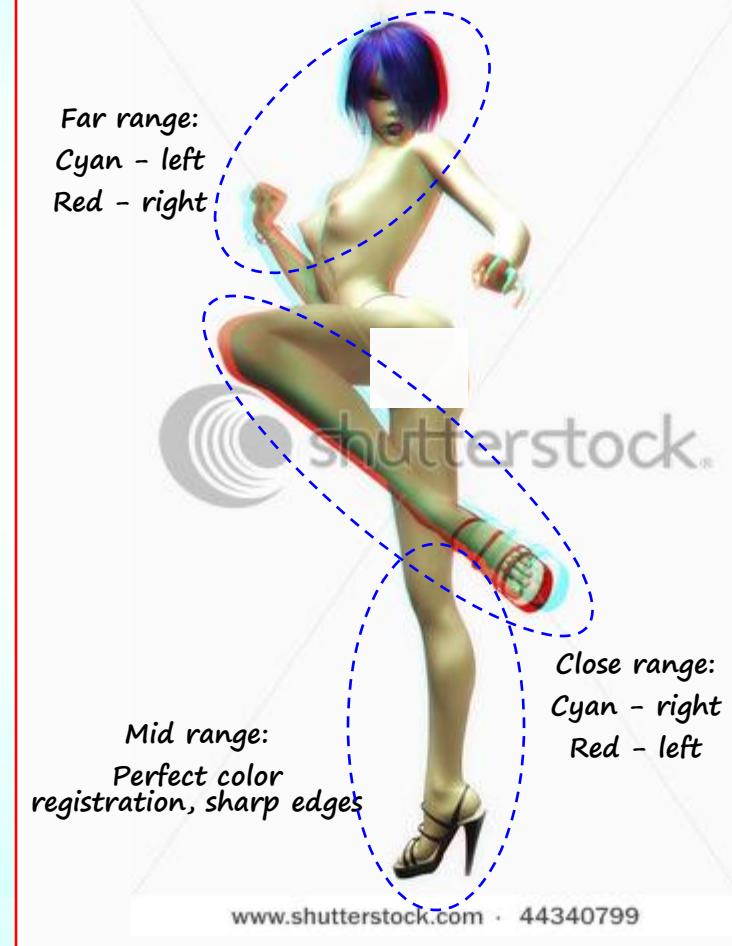
Some anaglyphic photos:

Here are some examples of anaglyph photos. Analyze the amount of color offset and the sign of this offset in various regions of the picture and try determining the various ranges.



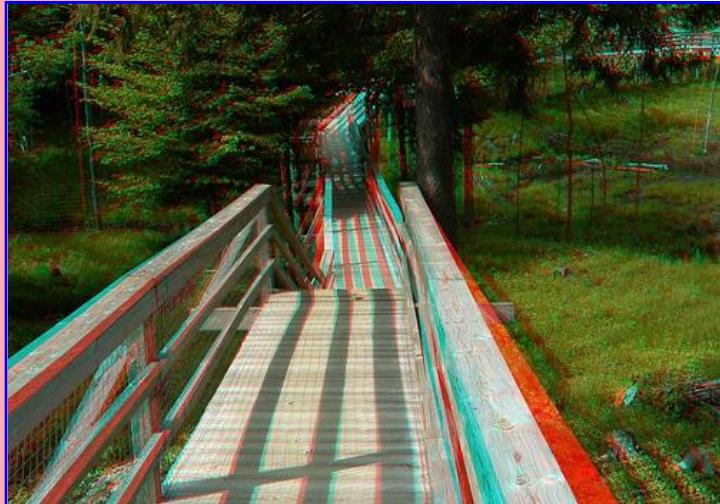
- In this anaglyph photo from Budapest the midrange is chosen at infinity. The midrange is where there is no color offset and the edges are clear when observed without using glasses). There is no far range in this anaglyph.

- The anaglyph below is a good example of a well balanced close range and far range. In most anaglyph out there the far range is dominating.



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Some anaglyphic photos - continuation:



Above there are two examples of well balanced anaglyphs. The top photo has a particularly large distance between the red and cyan cameras.

There is no close range in this anaglyph. Matter of fact even the midrange is so close to the cameras that is barely visible in the lower right corner.

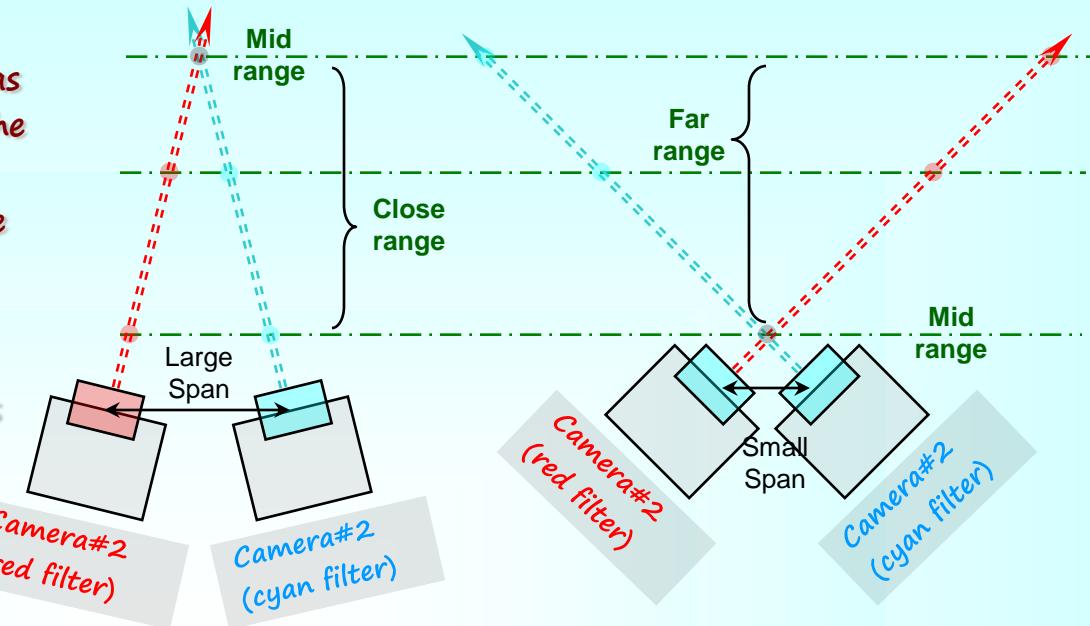
Some anaglyphic cameras:

- Depending on the angle between the cameras the mid range can be brought very close to the cameras or sent very far.

- Of course the smaller the convergence angle between cameras the larger the separation needs to be in order to obtain significant 3D effects.

- For large landscapes, spans of a few meters or even tens of meters are not uncommon.

In this case, special care has to be taken to perfectly align the vertical angle (altitude) of the cameras with respect to each other to keep the image resolution sharp.



Some anaglyphic cameras:



A professional anaglyphic camcorder



An anaglyphic webcam



A high end digital anaglyphic camera