

## ORIGINAL ARTICLE



Timothy J. Bennett, CRA, FOPS

*Penn State Milton S. Hershey Medical Center  
Department of Ophthalmology  
P.O. Box 850  
Hershey, PA 17033  
717/531-5516  
717/531-5009 Fax  
tjbennett@psu.edu*

# Stereo Anaglyph Preparation for PowerPoint

## INTRODUCTION

Stereoscopic imaging is a valuable diagnostic tool with a long history in ophthalmology. Stereo images enhance diagnostic information by providing a visual sense of depth and realism beyond ordinary two-dimensional photographs. The use of this technique in ophthalmology dates back as far as 1909, but it wasn't until the 1960's that stereo fundus photography became widely employed after Lee Allen described a practical technique for sequential stereo fundus photography.<sup>1</sup> A few years later, the seven standard field stereo protocol was adopted for use in the Diabetic Retinopathy Study.<sup>2</sup> To this day, stereo imaging remains the standard for many clinical trials investigating treatment of retinal diseases. Stereo imaging techniques have also been employed for slit-lamp biomicrography and, to a lesser extent, external photography.

Despite the widespread use and inherent educational value of this technique, stereo photography has been underutilized as a teaching tool in ophthalmology. Since the

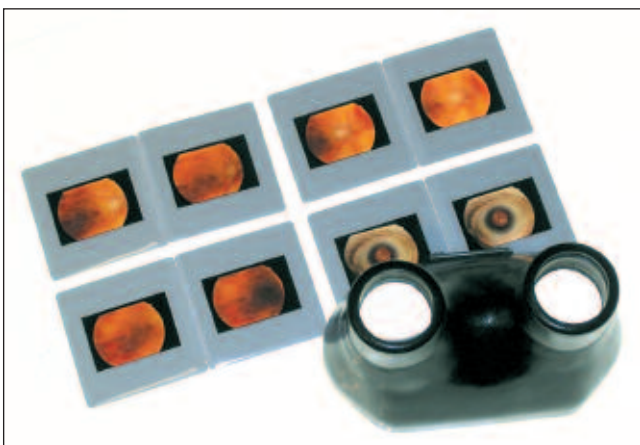
early days of stereo photography, investigators have searched for practical methods to display large stereoscopic images to groups of viewers.<sup>3</sup> Diagnostic stereo fundus photographs and fluorescein angiograms have traditionally been imaged on 35mm film. Using film-based stereo images as a teaching tool usually requires that individual viewers take turns examining 2x2 slides or 35mm contact sheets on a light box with an optical stereo viewer (Figure 1).

Presenting 35mm stereo pairs to large audiences is possible using the cross-polarized projection technique, but this practice has largely been abandoned as impractical for routine use. This method requires a highly skilled projectionist and meticulous alignment of slides.<sup>4</sup> Stereo projectors and specialized slide mounts are no longer manufactured and standard 35 mm slide projectors are quickly becoming obsolete. In just a few short years we have witnessed a dramatic change in the way that lectures are presented in ophthalmology. The days of delivering ophthalmic lectures with side-by-side 35mm slide projectors have all but disappeared. Most major educational meetings no longer support 35mm projection and now require all speakers to present electronically using LCD projectors and computer presentation software such as Microsoft PowerPoint™.

## ANAGLYPH STEREO

The shift to digital projection has facilitated a revival of the chromatic anaglyph stereo presentation technique for large audiences. Often dismissed as little more than a novelty, it is an effective method of creating and displaying stereo images. The underlying principle of stereo display requires separate left and right images to be presented, simultaneously but independently, to each eye. The brain fuses the two images, constructing a visual sense of depth.

Instead of employing optics or polarization to create a stereo effect, the anaglyph method uses complementary colors to encode and deliver stereo information. In principle, any pair of true complementary colors can be combined to

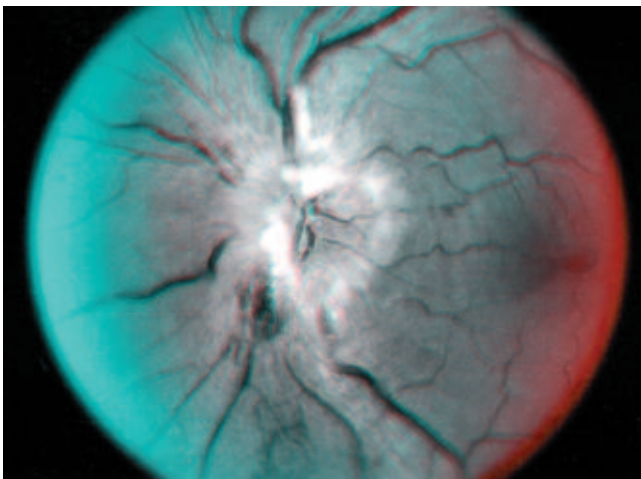


**Figure 1:** Stereo pairs have traditionally been viewed on a light box with an optical stereo viewer, limiting observation to a single user at a time.

*Editor's Note: A pair of cyan/red anaglyph cardboard glasses are inserted into this Journal for viewing the following anaglyph images and were donated by Twin Chimney Publishing.*



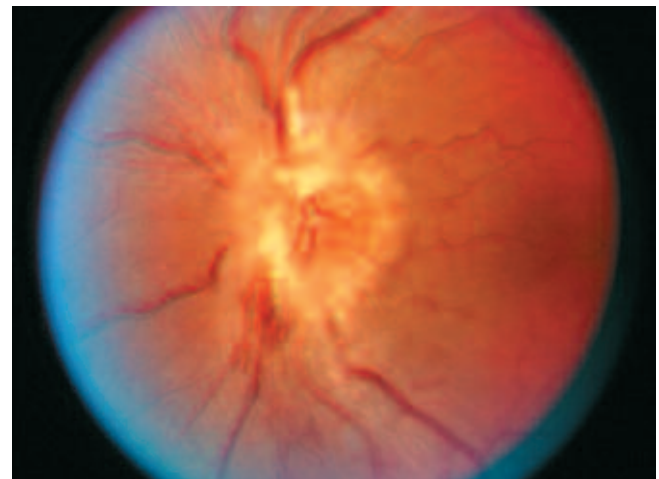
**Figure 2:** The anaglyph method uses complementary colors to encode and deliver stereo information. The left image of a stereo pair provides the red component and the right image provides the blue and green (cyan) components. When the components are superimposed, a full spectrum anaglyph stereo image results (center). Anaglyph images can be viewed with glasses that use corresponding red and cyan colored filters.



**Figure 3a:** The anaglyph method of stereo presentation works well with grayscale images.

form a full spectrum of white light. Left and right images are rendered in complementary colors and superimposed to form an anaglyph that can be viewed in stereo with selection eyewear that utilize filters in corresponding complementary colors (Figure 2). These filters transmit the target color while blocking its complement so that each eye sees only the intended half of the pair. The brain mixes the colors and perceives a composite grayscale or color stereo image. Red and cyan are the most commonly used colors, but any pair of complementary colors can be used.

Ironically, the anaglyph method was the original form of stereo projection, dating back to 1858 when Joseph D'Almeida used red and green filters on the lenses of separate projectors to present magic lantern slide shows to audiences wearing red and green spectacles.<sup>5</sup> This method can also be adapted to printed material. Its reputation as a gimmick or novelty stems in part, from its use in comic books and low-budget Hollywood horror films. In contrast, noted scientific institutions such as the National Aeronautics and Space Administration, the U. S. Geological Survey and

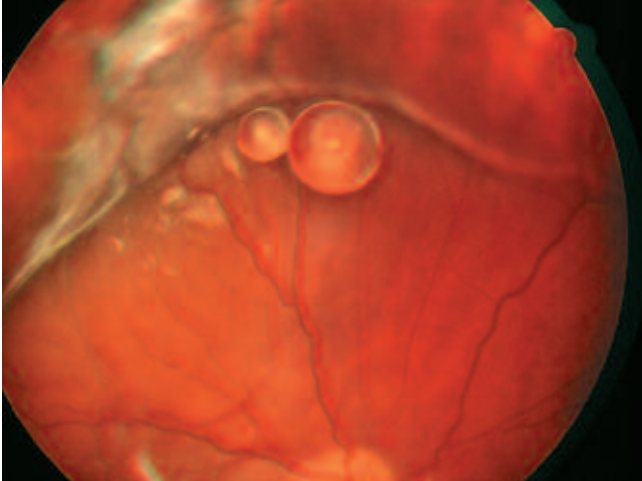


**Figure 3b:** Color images often appear less saturated and lower in contrast when viewed through anaglyph glasses. Ophthalmic use of anaglyph stereo has typically been limited to black-and-white images for this reason.

National Geographic have also used anaglyph stereo to present stereo images to mass audiences. In 1998, National Geographic distributed 9.5 million copies of a magazine containing grayscale and color anaglyphs from NASA's Mars Pathfinder probe and underwater images from the wreck of the Titanic.<sup>6,7</sup> Grayscale anaglyphs have also been published in the ophthalmic literature.<sup>8,9,10</sup>

The recent resurgence in use of anaglyph stereo is due in part to the economical and technical simplicity of this technique. A stereo pair can be digitally color encoded as a single image that can be presented with a single projector and inexpensive eyewear. Unlike polarized stereo projection, anaglyph projection does not suffer from cross-talk between left and right images when viewers shift or tilt their heads.

Anaglyph stereo does however, have some limitations. This method works very well with black-and-white photographs, but color images may lose saturation and contrast when converted to anaglyph (Figure 3).



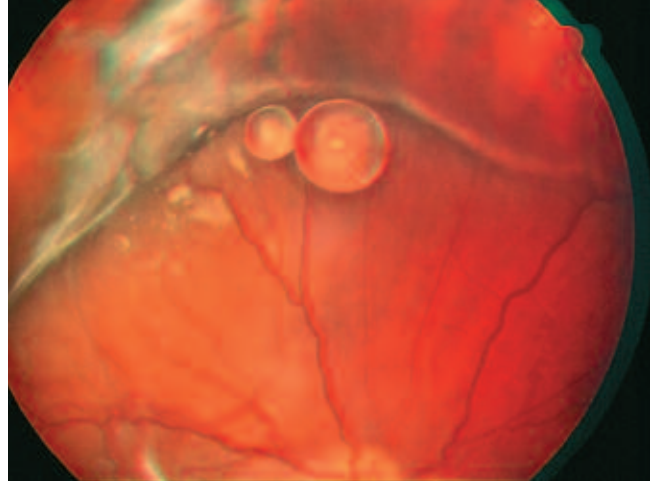
**Figure 4a:** Even illumination of the fundus is often sacrificed in order to obtain adequate stereo separation through a small pupil. Exposure asymmetry between halves of the stereo pair can result in an uneven appearance when viewed as a pair.

Anaglyph projection has a reputation for causing headaches and eyestrain, although much of this effect can be attributed to poor registration of images. Improper registration may result in an exaggerated stereo separation that is difficult for many viewers to fuse. A red-green flickering effect commonly referred to as retinal rivalry, or color bombardment, can sometimes occur when a color anaglyph contains large areas of bright red, green or blue.<sup>3</sup> Viewing difficulties can also be the result of poorly matched color filters.<sup>11</sup>

### BINOCULAR SYMMETRY

Binocular symmetry is an important element of constructing effective stereo pairs. This means that both images should be the same size and magnification as well as similar in color balance, contrast and exposure.<sup>12</sup> This especially holds true when creating anaglyphs. In stereo fundus photography, it is sometimes advantageous or necessary to diverge from the rule of binocular symmetry. We often sacrifice even illumination of the retina to get maximum stereo separation through pupils that are not maximally dilated.<sup>13,14</sup> Exposure asymmetry between halves of a stereo pair doesn't seem to matter when using an optical stereo viewer to view fundus photographs. In the anaglyph method however, uneven exposure can adversely effect the final product. This can be mitigated by digitally adjusting the contrast and brightness of each half of the image pair for consistency before making an anaglyph (Figure 4).

Even when both images are consistent in overall appearance, binocular asymmetry can occur if the subject displays a high percentage of one of the anaglyph encoding colors. Red-cyan, the most commonly used color combination, doesn't work particularly well with color fundus photographs due to the high percentage of red hues in the typical fundus. The cyan filter of the viewing eyewear blocks most of the red tones, reducing the light that reaches the



**Figure 4b:** The contrast and brightness of the individual left and right images can be adjusted for consistency before combining in anaglyph form to improve the overall appearance of the stereo image.

right eye. Conversely, the red viewing filter transmits a high percentage of red, making the image appear bright on the left side. The asymmetry caused by this brightness imbalance can adversely effect color saturation and reduce the stereo effect. Fortunately, the gradient of red and yellow hues found in most color fundus images prevents the flickering effect associated with retinal rivalry in subjects that contain areas of solid, bright red.

Blue and yellow would likewise be a poor choice of complementary colors because of the amount of yellow present in most fundus photographs. Common sense

**Table 1. Step-by-step Instructions for creating red/cyan anaglyphs in Adobe® Photoshop® and Photoshop® Elements**

#### In Adobe® Photoshop®:

Open left and right images.  
 Select the Channels view from the Window menu.  
 Copy the red channel of the left image.  
   > Click on red channel.  
   > Select and copy the red channel  
 Select the right image file window.  
 Select red channel.  
 Paste red channel from left image.  
 Select RGB Channel.  
 Use Move tool to align layers while viewing with anaglyph glasses.  
 Save as new image.

#### In Photoshop® Elements:

Open left and right images.  
 Convert left image to red.  
   > Levels - select green channel and set output level to 0.  
   > Levels - select blue channel and set output level to 0.  
 Convert right image to cyan.  
   > Levels - select red channel and set output level to 0.  
 Select and Copy right image.  
 Paste into left image.  
 Set layer mode from "Normal" to "Screen".  
 Use Move tool to align layers while viewing with anaglyph glasses.  
 Flatten Image under the Layers menu.  
 Save as new image.



suggests that magenta and green might be the best complementary color combination for fundus images. The magenta filter would partially transmit some of the red tones while the green filter would transmit an approximately equal amount of yellow. My brief experience with this combination indicated a slight improvement in the appearance of color fundus anaglyphs encoded in magenta and green and viewed through appropriate filters (Wratten 32 & 58). Unfortunately, this color combination is not available in mass-produced, inexpensive anaglyph eyewear.

### CREATING ANAGLYPHS

Digital imaging software facilitates accurate and effective registration of anaglyph stereo pairs. There are various methods of creating anaglyphs in image editing programs such as Adobe® Photoshop®, Photoshop® Elements, and Paint Shop™ Pro® (Table 1). The specific technique may vary depending on what version of these programs you are working with, but the concept is usually the same: copy the red component of the left image and paste it in place of the red component of the right image. The resulting red-cyan combination is the most common

**Table 2. Stereo software**

Visit [www.stereoscopy.com](http://www.stereoscopy.com) for descriptions and download links to a variety of dedicated stereo programs that will enable you to quickly make color and grayscale anaglyphs. Many programs also support interlaced and page-flipped stereo processing for LCD shutter glasses.

**3D Stereo Image Factory™** – Comprehensive stereo software program that supports a wide range of image file formats. Windows only. \$99.00. <http://members.aol.com/threedr>

**Anaglyph Maker** - Intuitive, easy to use program. Limited to BMP or JPEG formats. Windows only. Freeware. [http://www.stereoeye.jp/software/index\\_e.html](http://www.stereoeye.jp/software/index_e.html)

**StereoPhoto Maker** - Excellent program with some automated functions and image editing controls. Use keyboard arrow keys for quick and easy alignment of anaglyphs. JPEG, BMP or TIFF formats. Windows only. Freeware. <http://www3.zero.ad.jp/esuto>

**Anaglyph Creator** - A small program that can be used to create anaglyphs from digitized stereo images. Created by Paul Montague, CRA, FOPS. Windows only. Freeware. <http://webeye.ophth.uiowa.edu/Anaglyph/>

**Z-Anaglyph** - Very basic program with French and English command menus. Windows only. Freeware. [http://z-graphix.com/anaglyph/zanag\\_en.htm](http://z-graphix.com/anaglyph/zanag_en.htm)

**Anabuilder** - Anaglyph program also includes stereomorphing feature to convert 2-D images to stereo. Windows only. 21 MB download. Freeware. <http://anabuilder.free.fr/indexEN.html>

**StereoPress** - Very basic program for Macintosh. Freeware. [http://www2.pair.com/~shuono/tools/stereo\\_tool\\_e.shtml](http://www2.pair.com/~shuono/tools/stereo_tool_e.shtml)

**Anaglyph Maker** - New program for Macintosh OS X. Freeware. <http://www.lamarchefamily.net/nakedsoft/>

**Sources for Anaglyph glasses:**

[www.3dglasses.net](http://www.3dglasses.net)  
[www.berezin.com/3d/](http://www.berezin.com/3d/)  
[www.3dglassesonline.com](http://www.3dglassesonline.com)  
[www.TwinChimney.com](http://www.TwinChimney.com)

choice for anaglyph display, but other pairs of complementary colors will also work. Images need to be in RGB color mode when using these methods.

It is important to differentiate between blue and cyan (equal parts green and blue) when rendering or viewing anaglyphs. Many sources refer to both of these colors as “blue” which can lead to some confusion in matching anaglyphs with the correct eyewear. Historically, many grayscale anaglyphs have used red/blue or red/green as the color encoding choice. This is acceptable with grayscale images but not in full-color anaglyphs as these color combinations are not true complementary pairs and do not provide a full spectrum of color.

Software programs designed specifically for constructing anaglyphs from stereo pairs can be used as an alternative to the Photoshop® method (Table 2). These programs simplify the process by automating the individual steps for anaglyph creation. Some programs also support other stereo viewing formats including interlaced stereo for use with LCD shutter glasses. The better stereo programs offer basic image editing tools and facilitate easy registration of pairs. Controls include vertical and horizontal shift and in some cases incremental rotation. They automatically crop overlapped borders and permit resizing. Rendering options typically include red/green, red/blue, or red/cyan combinations for grayscale anaglyphs. Color anaglyphs are rendered in red/cyan, although some programs incorrectly refer to this combination as red/blue.

Any desired image editing enhancements should be done to the individual images of a stereo pair before converting to anaglyph form. Make sure that both images are the same size and scale. Anaglyph images intended for projection in PowerPoint should be sized appropriately. For full frame display, set the resolution to 1024 x 768 pixels.<sup>15</sup> Images at this size will fill an entire PowerPoint slideshow frame of 7.5 x 10 inches at just over 100 pixels per inch. This resolution is consistent with the output of commonly used XGA resolution projectors. Adjustments to brightness, contrast, color balance, or sharpness should also be done to the images before combining in anaglyph form. A slight increase in contrast and saturation beforehand may help to compensate for the typical loss of saturation in color anaglyphs. Avoid oversaturation, however, since this can lead to the problems associated with retinal rivalry. Shifting the color balance to add a small amount of yellow to color fundus photographs will sometimes improve the final result.

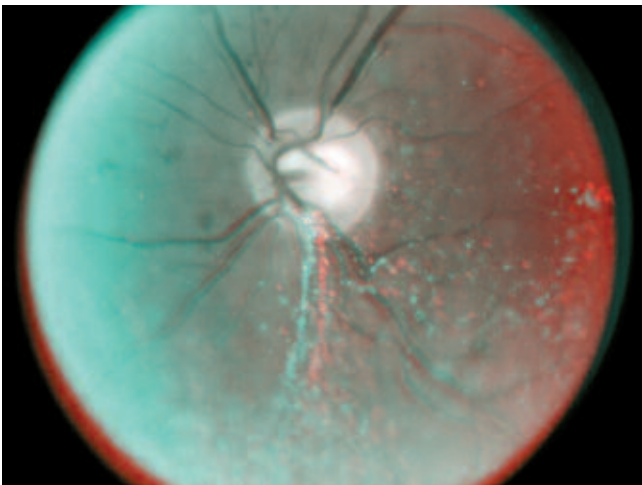
When making a large series of anaglyphs, edit all images for size and resolution, name or number the files in sequential order, and store them in one folder to streamline the process. Batch conversion of multiple stereo pairs is possible in some programs. This technique should only be used if the stereo base is consistent for all stereo pairs, such as images from a simultaneous stereo fundus camera or slit-lamp. Batch conversion of sequential stereo fundus photos or angiograms is not practical since these pairs usually require individual alignment adjustment.



**Figure 5a:** Horizontal displacement of the stereo image is adjusted to align the near point of interest (the fingers holding the lens) resulting in neutral or slightly positive parallax. The stereo effect appears at, or behind, the plane of the stereo window.



**Figure 5b:** Horizontal displacement is adjusted so that image alignment occurs deeper in the scene (the indirect ophthalmoscope). This results in negative parallax that causes the hand and lens to appear as if they are coming out of the printed page.

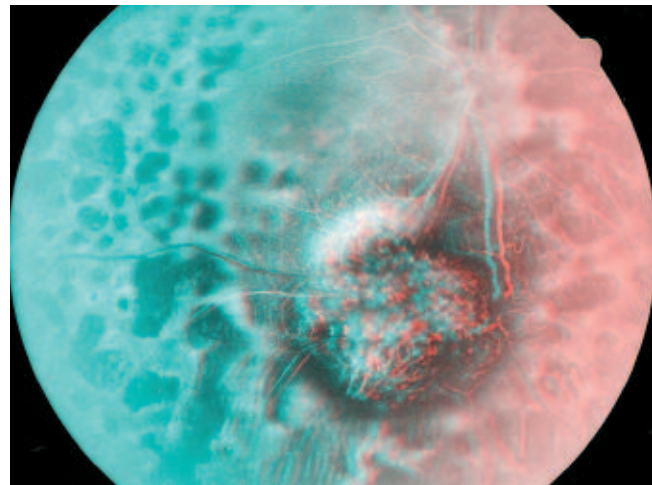


**Figure 6a:** A conflict of depth cues can occur when an area of negative parallax intersects the boundary of the stereo window. The effect is more troublesome along vertical borders. In this example, negative parallax causes the asteroid hyalosis to appear as if it's coming off the page in the area just inferior to the optic disc. If you look toward the bottom or to the right edge of the image it appears to flatten due to contradictory depth cues.

### ALIGNMENT

The success or failure of an anaglyph presentation is highly dependent on image alignment. Misalignment of stereo images can cause eyestrain or make it difficult to perceive a stereo effect. To adjust alignment in a stereo software program (or Photoshop®), open the left and right images and combine them in anaglyph form to view the red/cyan overlay. First, use the alignment tools to shift the red image channel to eliminate any vertical displacement or rotation between layers. This step can usually be done without wearing anaglyph glasses.

Next, adjust the horizontal displacement while



**Figure 6b:** Negative parallax is present in the center of this image, but it does not come in contact with the edges of the stereo window. A conflict of depth cues is avoided and the elevated serous detachment appears to come off the page.

wearing anaglyph glasses to view the results. Horizontal displacement is necessary to achieve a stereo effect, but the amount of separation should be carefully controlled. This is mostly a subjective judgment, but observing the principles of parallax and the "stereo window" can be helpful. The border surrounding a stereo image provides a viewing reference plane commonly known as the stereo window. In the case of fundus photography, the round or elliptical black mask of the fundus camera becomes the stereo window. Parallax describes the horizontal separation in the image pair as well as the depth effect in relation to the stereo window. Parallax can be classified as neutral, positive or negative. Neutral parallax places the nearest object in a scene at the plane of the stereo window. Positive parallax produces an image

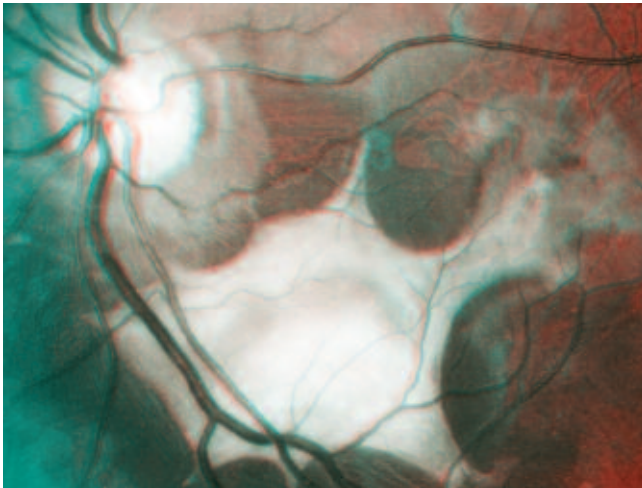




**Figure 7:** Toxemia of pregnancy.



**Figure 8:** Peripapillary choroidal neovascular membrane.



**Figure 9:** Choroidal rupture with neovascular membrane and hemorrhage.

as seen through the stereo window or behind the screen. Negative parallax results in an off-screen effect appearing in viewer space (Figure 5).

Adjust the horizontal shift to place the image in an optimum position for comfortable viewing relative to the stereo window. It is common practice to align the principle subject or nearest object in a scene, placing it close to the plane of the stereo window. An added benefit of aligning the near point of interest is that the anaglyph will appear sharpest at the point of registration. It can be tempting to make all objects appear as if they are coming out of the screen or off the printed page, but overuse of negative parallax can cause viewing difficulties due to a separation of accommodation and convergence planes.<sup>16</sup>

Accommodation and convergence normally coincide at the same point. Optical stereoscopes preserve the coincidence of accommodation and convergence, but a breakdown of this relationship occurs when viewing stereo images on a monitor or projection screen. Our eyes accommodate at the plane of the screen but converge based on screen parallax. Experienced viewers are

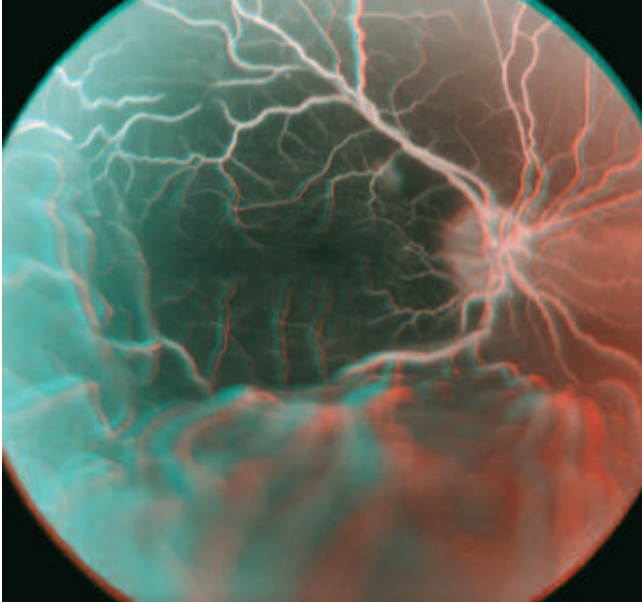
sometimes able to overcome the conflicting visual cues much like the ability to “free-view” 35mm stereo pairs that can be learned with practice.<sup>17</sup> Another conflict of depth cues can arise when the border of the stereo window intersects an object with negative parallax (Figure 6). Limiting negative parallax will ensure that most of the audience will be able to appreciate a stereo effect without difficulty.

Although this process may sound complicated, it only takes a few seconds to align most stereo images. The stereo effect usually appears more pronounced the farther an observer is from the screen, so it may help to occasionally move back from the monitor, or zoom out, to get a better idea of how the depth effect will look when projected. Zoom in to ensure that the image is accurately superimposed at the point of interest. Once properly aligned, anaglyphs can be saved in a file format compatible with PowerPoint and inserted in a presentation in the usual manner. High quality/low compression JPEG files are a good choice that is supported by most stereo programs.

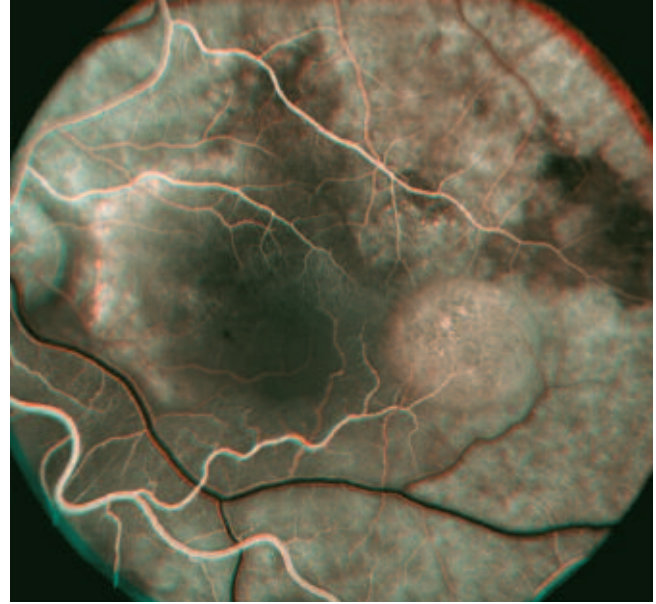
### PROJECTING ANAGLYPHS

Unlike polarized stereo projection, which requires a lenticular screen surface, any standard projection screen can be used for anaglyph projection. For best viewing results, make sure the audience is seated no more than 30 degrees to either side of the center of the screen. Some projection screens provide a maximum viewing angle of 50 degrees from center,<sup>18</sup> but viewing anaglyphs at an extreme angle will cause distortion of the images and a loss of stereo effect.

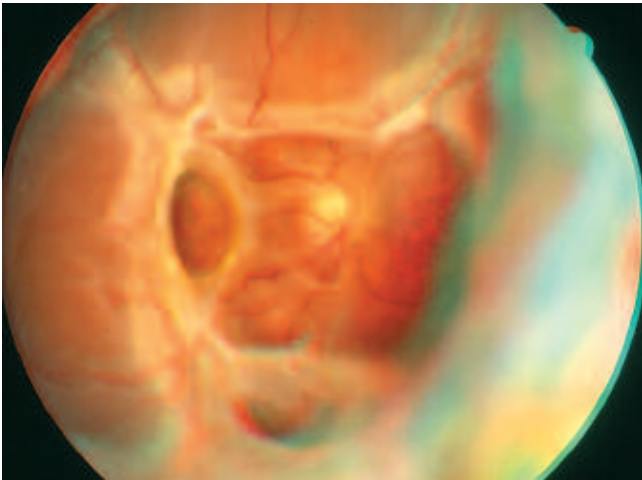
The spectral quality of the filters in anaglyph glasses can vary considerably. Inexpensive cardboard viewers with acetate filters can be purchased in bulk for large audiences. Make sure to use red/cyan glasses rather than red/blue or red/green, especially when presenting full-color anaglyphs. Higher quality glasses with nylon frames and cast acrylic lenses are available for less than \$10 a pair.



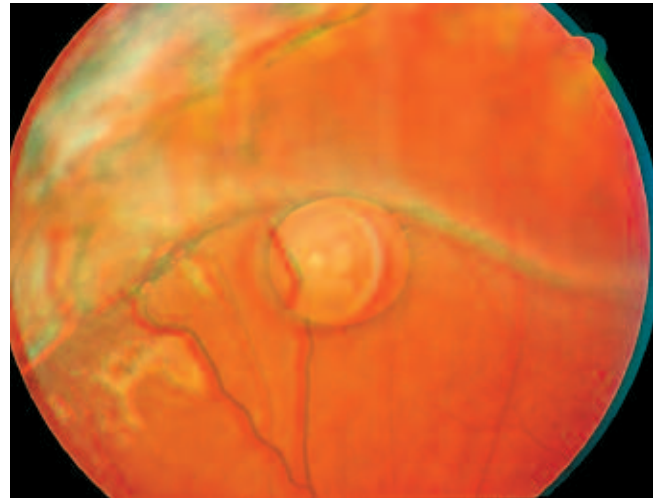
**Figure 10:** Exudative age-related macular degeneration with sub-retinal hemorrhage and retinal detachment.



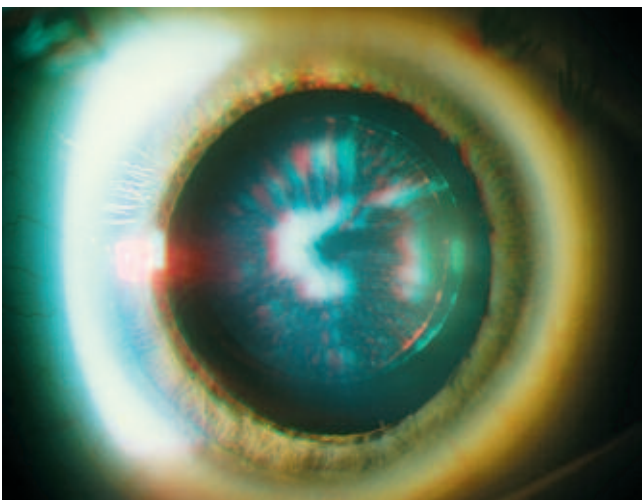
**Figure 11:** Idiopathic central serous chorioretinopathy with pigment epithelial detachment.



**Figure 12:** Fibrovascular proliferation from untreated diabetic retinopathy.



**Figure 13:** Retinal detachment repair with silicone oil bubble.



**Figure 14:** Cataract.



**Figure 15:** Dislocated lens.



Some models (Anachrome, Mirachrome, from Anachrome 3D or Berezin Stereo Products) provide a slight plus diopter correction in the red lens to compensate for the difference in focus between red and cyan. These lenses are also density balanced. The red lens is a little darker and the cyan lens appears a little greener than the acetate filters found in cardboard viewers. The view through these glasses is a little darker than with the cardboard type, but they exhibit increased contrast and better color fidelity. The appearance of color fundus anaglyphs is vastly improved with these lenses.

Any LCD projector can be used for PowerPoint anaglyph presentations, but models with a high light output will help compensate for the loss of brightness from the anaglyph glasses. Ambient room light should be reduced as much as possible. Instruct the audience to wear the anaglyph glasses with the red lens covering the left eye. For mixed presentations that include both stereoscopic and non-stereoscopic images, consider including a small symbol in the corner of the stereo slides to indicate to the audience when to use the anaglyph glasses. Leave each anaglyph onscreen long enough to allow viewers ample opportunity to properly fuse the stereo pair.

### BACK TO THE FUTURE

Recently, a perception exists that the routine use of stereo imaging in ophthalmology is in decline. It has been suggested that the decrease may be due to a scarcity of ophthalmic publications that present stereoscopic images.<sup>9</sup> Other contributing factors may include the rise of digital imaging and the lack of stereo presentation in ophthalmic education. As ophthalmology has moved to a digital imaging environment, the longstanding tradition of viewing stereo slides and negatives on a light box has changed, and many practitioners have not embraced the available methods of viewing digital images in stereo.

In 1964, Lee Allen stated: "I am aware of the difficulty of presenting such pictures to large groups and can only hope that at some time in the future this will be corrected by some ingenious development in stereoprojection."<sup>19</sup> The technology that Allen hoped for is here today. High field-rate digital projectors that utilize passive polarized eyewear and autostereoscopic monitors that eliminate the need for stereo eyewear are now available.<sup>12, 20-22</sup> Typical of many new technologies, these methods of stereoscopic display are very expensive. Until they become more affordable and commonplace, we can simply go "back to the future" and employ the oldest form of stereo projection with the newest generation of commonly available projectors and presentation software.

Over the last few years, a small number of lectures at the Ophthalmic Photographers' Society Annual Education Program have been presented in digital anaglyph form. Hopefully, this is just the start of a trend that will result in a renewed enthusiasm for stereo imaging in ophthalmology.

### REFERENCES

1. Wong D. *Textbook of Ophthalmic Photography*. Birmingham: Inter-Optics Publications, 1982.
2. Quillen DA, Gardner TW, Blankenship, GW. The Diabetic Retinopathy Study. In: Kertes PJ, Conway MD, eds. *Clinical Trials in Ophthalmology: A Summary and Practice Guide*. Baltimore: Lippincott Williams & Wilkins; 1998:1-13.
3. McKay HC. *Three-Dimensional Photography - Principles of Stereoscopy*. 1953; 167. [www.stereoscopic.org/library/index.html](http://www.stereoscopic.org/library/index.html).
4. Waack FG. *Stereo Photography*. 1985 [www.stereoscopy.com/library/index.html](http://www.stereoscopy.com/library/index.html).
5. Leggat R. *A History of Photography, From its beginnings till the 1920s*. [www.rleggat.com/photohistory/history/anaglyph.htm](http://www.rleggat.com/photohistory/history/anaglyph.htm).
6. Newcott WR. *Return to Mars*. National Geographic, August 1998; 2-27.
7. MacInnis JB. *Tragedy in Three Dimensions; Titanic*. National Geographic, August 1998; 120-127.
8. Barry CJ. A simple method to convert a Zeiss fundus camera into a simultaneous stereo camera. *J Ophthalmic Photography* 21(1):20-22, 1999.
9. Stevens RA, Saine PJ, Tyler ME. *Stereo Atlas of Fluorescein and Indocyanine Green Angiography*. Boston: Butterworth-Heinemann, 1999. [www.TwinChimney.com](http://www.TwinChimney.com).
10. Barry CJ, Kanagasigam Y, Morgan W. Optic disc topographic changes post-trabeculectomy visualized by anaglyphs. *Aust NZ J Ophthalmol*. 27;79-93, 1999.
11. Lipton L. *Foundations of the Stereoscopic Cinema – A Study in Depth*. Van Nostrand Reinhold, 1982;259 [www.stereoscopic.org/library/index.html](http://www.stereoscopic.org/library/index.html).
12. Lipton L. The stereoscopic cinema: from film to digital projection. *J SMPTE*. 110; 586-593, 2001.
13. Coppinger JM. *Stereo Fundus Photography*. In: Coppinger JM, Maio M, Miller K. *Ophthalmic Photography*. Thorofare, NJ: Slack 1987; 97.
14. Fundus Photograph Reading Center. *Modified 7-Standard Field Color Fundus Photography Procedure*. <http://eyephoto.ophth.wisc.edu/photography/Protocols/mod7-ver1.3.html>.
15. Tyler ME, Saine PJ, Bennett TB. *Practical Retinal Photography and Digital Imaging Techniques*. Philadelphia, PA: Butterworth-Heinemann, 2003;104. [www.TwinChimney.com](http://www.TwinChimney.com).
16. Lipton L. *Stereo3D Handbook*. StereoGraphics Corporation 1997. [www.stereographics.com/support/body\\_whtpapers.html](http://www.stereographics.com/support/body_whtpapers.html).
17. Saine PJ, Tyler ME. *Ophthalmic Photography: Retinal Photography, Angiography, and Electronic Imaging*. 2nd Ed. Butterworth-Heinemann, 2002; 132. [www.TwinChimney.com](http://www.TwinChimney.com).
18. Selecting the Right Screen. Da-Lite Screen Company. <http://www.da-lite.com/products/selecting.php>.
19. Allen L. Ocular fundus photography. *Am J Ophthalmol* 1964;57:13-28.
20. Dimension Technologies, Inc. *How does the DTI display work?* <http://www.dti3d.com/technology.asp>.
21. Lipton L, Feldman M. *A new autostereoscopic display technology: the SynthaGram*. [http://www.stereographics.com/x\\_downloads/whitepapers/synthagram/SynthaGram\\_LL\\_031904.pdf](http://www.stereographics.com/x_downloads/whitepapers/synthagram/SynthaGram_LL_031904.pdf).
22. Kleinberger P, et al. *A full-time, full resolution dual stereoscopic/autostereoscopic display*. [http://www.3ality.com/spie%20paper%202003%20\(EI%205006A-18\)%20Preprint.pdf](http://www.3ality.com/spie%20paper%202003%20(EI%205006A-18)%20Preprint.pdf).