Do-It-Yourself Single-Lens Anaglyph Capture

COMPUTATIONAL PHOTOGRAPHY involves the use of cameras not to directly produce the best looking image on the film or sensor, but to capture the information necessary and use computations to create the desired representation of the scene. For about a decade, our group has been getting more out of *unmodified* commodity digital cameras, often using supercomputers and a GENETIC ALGORITHM (GA). However, this handout is about a simple by-product of our research attempting to develop a precise empirically-grounded understanding of BOKEH, the properties of the OUT-OF-FOCUS (OOF) portions of an image. This method does not require any special computing support....

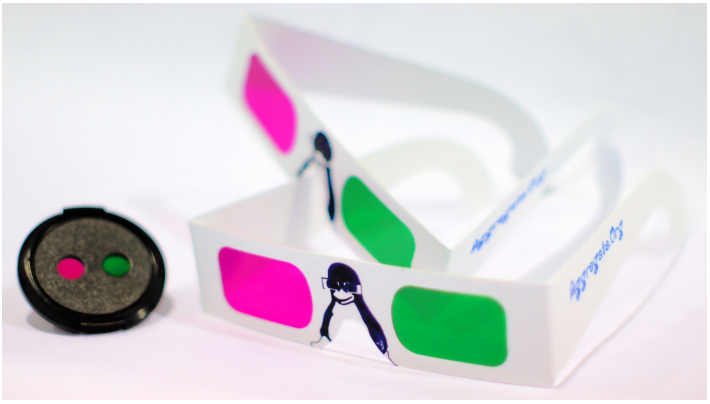
An ANAGLYPH is a color image that creates the illusion of depth when viewed through color filters that separate the left and right views – like the above image. The concept of an anaglyph is usually credited to Wilhelm Rollman for experiments he performed in 1853, but may be much older. The basic technology is essentially unchanged, with most recent interest in the choice of colors and computer algorithms for encoding color stereo image pairs as anaglyphs. In contrast, the work presented here centers on capture of anaglyphs, not viewing nor creation of anaglyphs from other "3D" representations.

When a real lens focuses a point of light on a sensor, the resulting image is not a point, but a pattern known as the POINT SPREAD FUNCTION (PSF). The OOF image of a point is not a blur, but an enlarged PSF hard-clipped by the aperture, essentially replicating its shape. The interesting implication is that each pixel within the PSF image is being exposed by rays coming at slightly different angles from the point source. Thus, if these rays can be distinguished, views constituting a stereo image pair can be recovered. Why not encode left and right side rays at capture by color-shaping the PSF?

J. D. Songer's 1973 patent, #3,712,199, describes such a method for capture of directly-viewable anaglyphs that essentially does this. His approach appears to have been used by the famous, but discontinued and rare, VIVITAR SERIES 1 QDOS 70-210MM F/2.8-F/4.0 3-DIMENSIONAL LENS SYSTEM MACRO 1:2.5X. That lens contains a special segmented red/cyan filter near the lens iris. What do we do differently?

- Color – Bayer filters in most digital cameras work better with a green/magenta color combination rather than red/cyan.
- Aperture shape and position – circular aperture stops ***in front of an unmodified lens***. Below is shown a native PSF, an aperture design, and the resulting color-shaped PSF obtained by simply placing the stop in front of an existing lens. Our computer program, `anaperture`, creates suitable stop designs as SVG images. It may be freely accessed via an HTML form interface at `http://aggregate.org/anaperture` which also provides details about how this all works.

Simply print the stop design, cut it out (or drill holes in a lenscap), and tape colored filters cut from a pair of viewing glasses over the holes. Total cost easily less than $1.



That's it. Enjoy 3D photography with your the stop in front of the lens of your existing still or video camera. Images can be viewed using the same colored glasses, either as prints or a live display.

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