Stereoscopic Displays and Applications XII

by Steve Berezin

The vanguard of stereoscopic display experts gathered for the 12th Stereoscopic Displays and Applications conference January 23-25 in San Jose, CA. Presided over by Andrew Woods of Australia, these meetings are technical sessions devoted to the development of 3-D displays and are part of the Electronic Imaging section of Photonics West, sponsored by the Society for Imaging Science and Technology (IS&T) and the International Society for Optical Engineering (SPIE).

The opening day of Stereoscopic Displays and Applications started with several interesting videos and papers. One presentation involved high-speed digital stereo imaging at up to 1 million frames per second. The paper, given by D.R. Snyder of the Air Force Research Lab showed in nice 3-D the cutting of a playing card with a moving bullet in frame by frame anaglyphic detail. Some golf shots and breaking glass in stereographic super slow motion were also impressive. Lenny Lipton gave a great overview of 3-D projection and Vivian Walworth of the Rowland Institute spoke about polarization optics.

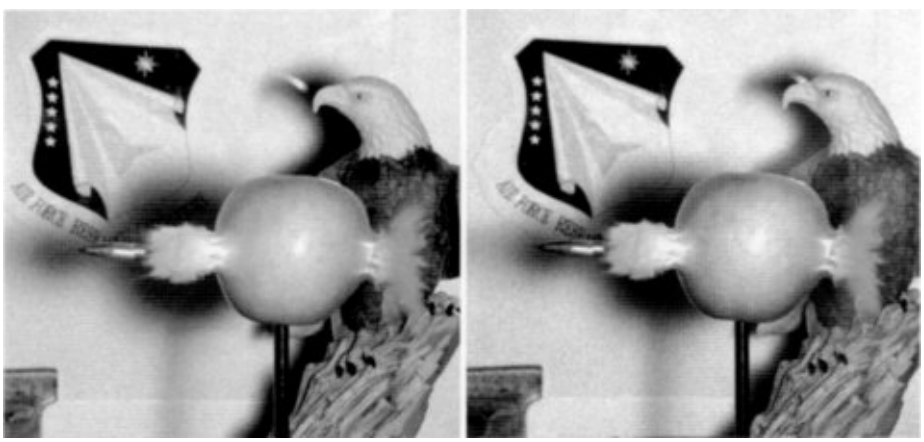
Another interesting paper was "Stereo Mosaicing from a Single Moving Video Camera" This presentation involved stitching together frames taken from a video camera to make a 360 degree stereo panorama and was demonstrated in real time while the presenter was giving his paper. He simply waved a digital camera attached to his laptop computer in front of the audience and before our eyes produced an anaglyphic image of the audience on the projection screen in glorious 3-D.

In one experiment, 3-D imagery in a heads-up display for airplane pilots was used to de-clutter the control panel. It was popular with pilots except for the fact that the green phosphors of the display failed to extinguish soon enough to prevent ghosting with the included shutter glasses. Another involved a complex array of layering used to create a "Multi-media Ambiance Communication". Images far from the viewer were presented in a panoramic non-stereoscopic method, middle distance images were layered and close-up images were rendered in 3-D from computer models. Human subjects were scanned from a whole body scanner and then made to fit a preformed model.

Other presentations included optimizing of polarization materials, field refresh rate issues, use of stereo imaging in treatment of 'lazy eye' and the development of a software toolbox (Winx3D) to help programmers provide stereoscopic support in their programs.

Later, 3-D videos were shown using the stereoscopic rear projection screen in the theater. They included: *Kapo the Clown* a 3-D ride film from EjeZeta in Spain, a new 3-D video title from Ray Hannison (Ray3D) called *Not Your Average Ski Movie*, a fire safety 3-D video titled *Blazer in the Third Dimension* from Media Odyssey in Australia and some 2-D to 3-D video conversions from Dynamic Digital Depth. Of a special note was a Korean 3-D Video called *The Pearl Sea*. This was a short drama about a pearl diver who leaves

One of the stereos exhibited by D.R. Snyder and Associates of the Air Force Terminal Effects Laser Camera Center, Eglin AFB. The 7.62 mm bullet, traveling about 3000 feet per second, has just passed through the apple while the eagle watches. The cameras used were prototype SMD 4M4's developed by Silicon Mountain Design. The sensor resolution was 4 Million Pixels and Vivitar 250mm zoom lenses were used to frame the shot. Base separation was about 30 cm. The scene was illuminated by a twenty billionth of a second pulse of light from a high-powered, pulsed ruby laser. A holographic diffuser element was used to smooth the laser speckle from the beam.



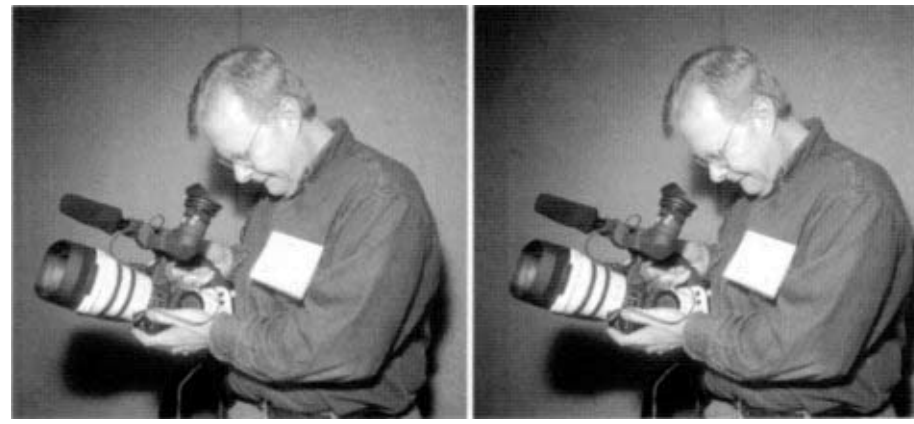
home to become a diver for a large public aquarium. This allows for many nice underwater shots interspersed with scenic terrestrial shots.

The second day of the conference was mainly concerned with autostereoscopic displays (3-D without glasses). Most of the early papers concentrated on improvement of head tracking capabilities in existing autostereoscopic applications. The team at NYU (New York University), the Korean Institute of Science and Technology, and the Electronic Visualization Lab at the University of Illinois in Chicago all went over refinements in this area. Sharp Labs in the UK went over improvements in their 2D/3D switchable parallax barrier that has the advantage of disappearing when not in use.

Several Korean University research teams went about the challenge using different approaches. Kyung-Wan University uses a reflective vibrating scanner array to isolate images and then play them back on a system using 8 separate hard drives. Seoul National University recorded and played back an integrated picture by first shooting through a lenticular system and then playing it back through a similar system.

Some of the more novel concepts detailed were volumetric display concepts. Actuality-Systems is working on a system which attempts to create interactive three-dimensional imagery by projecting a series of 2-D images on a rotating screen. The device, which looks like a spinning disc in a glass globe, will rotate as images are projected on it at 4000 frames per second. They felt it would be good for applications that do not require photo-realism. Unfortunately, the device was not ready in time to be shown at the conference.

John Rupkalvis gave an enjoyable presentation entitled "Human Vision Considerations in Stereoscopic Displays". Some of the concepts he touched on involved proper room lighting for stereoscopic presentations, flat vs. stadium seating (IMAX tends to be shot from a higher angle to account for the stadium seating audience position), and editing styles. MTV type quick edits are not recommended for stereo video because it takes people more time to process a stereo image than a flat image.



Joseph Bogacz of Canon USA demonstrates Canon's new $8499.00 Stereo lens, attached to their prosumer digital camcorder model XL1.Equipped with a high-speed shutter, the lens enables the camcorder's CCD to capture the left and right parallax images alternately as a field image at 1/60-second intervals so that 30 images are taken through the left and right lenses per second for a combined capture-rate of 60 field images per second.

John Roberts, NIST (National Institute of Standards and Technology), detailed other issues important in stereo display usability. He recommended that there be guidelines for cross platform stereo applications and that perhaps even stereo theaters should adapt a certification system to insure consistent quality.

Later, a panel discussion on Standards in Stereoscopic Imaging was given. Michael Weissman of Karl Storz Imaging (stereo endoscopy) chaired, and Andrew Woods (Conference Chair and Photo 3D Member) and Dave Swift (VREX) gave presentations. Discussed were standards such as the VESA (Video Electronic Standard Association) standard for shutter glass connectors and standards for the video signal for those glasses.

The last day of this part of the conference started with a session on the problems of compressing stereoscopic images for Internet use. The morning presentations dealt with multi-view and 2-image stereo.

The conference's keynote presentation took place on Wednesday afternoon. Jeff Kleiser, of Kleiser-Walczak Construction Company (KWCC), spoke of the work they have done in several stereoscopic productions. KWCC produced the stereoscopic computer graphics for the Phillip Glass/Robert Wilson production *Monsters of Grace*. He showed a several minute documentary on the making of the Opera. It was produced with a 3-D background because the original plans for the set design involved a giant foot in the background.

The Canon 3-D attachment incorporates two lenses within the hooded housing along with automatic focus and coupled automatic convergence. The lens unit will focus to 3 feet.

Rather than truck around a giant foot for the productions, they felt it would be more expeditious to produce a stereo image of the foot. Later they decided that the backgrounds for the rest of the opera could also be done in 3-D. They used 70mm film because of the resolution it provided. Due to the slow movement of the backgrounds and Wilson's feeling that extensive texturing was not needed for the effect he wanted to produce, photo-realistic images were not attempted. Later he showed slides of the images in the opera. Most were "behind the stereo window" because of the needs of the set designer. Several images were brought in front of the window but these were rare.

Later he showed the work that went into the production of Uni-

An Employee of Digital Optical Technologies demonstrates their 3-D microscope system.

Jesse Eichenlaub views the DTI (Dimensions Technologies Inc.) display.

versal's "The Adventures of Spiderman" ride. This ride mixed 3-D projection with sensory effects (spraying water, wind...) and props. It is a moving (mobile) ride that attempts to put the rider in the midst of a cartoon. (See *SW* Vol. 27 No. 1 for more information about this production).

He also discussed the extensive testing that was done in deciding where in 3-D space (how far through the stereo window) some objects could go without causing discomfort. They did this by "pulling people off the street" because over time most of the people who worked on the graphics would increase their accommodation of stereo images and hence tolerate more separation than most people. For those not lucky enough to have already visited the ride in Florida, some actual 3-D video footage from the ride was shown on the conference's large 3-D rear projection screen. Kleiser also discussed a new 3-D production they are currently working on for Busch Gardens titled *Corkscrew Hill*. He also demonstrated some of their non-3-D work, including some special effects for the feature length movie *X-Men* and a children's book adapted into a short cartoon.

Demonstration Session

After the Keynote presentation, the much anticipated demonstration session took place. This included autostereoscopic, active, and passive 3-D displays, 3-D cameras and other technologies. Unfortunately, none of the people who presented at the Autostereoscopic presentation the day before had demonstrations available. So goes the "proof is in the pudding" expression. Some of them mentioned having displays available at Comdex but nothing presented was shown here.

Passive 3-D Displays

John Rupkalvis of StereoScope International showed a simple but elegant viewer for a two video camera 3-D system that employed a half-silvered mirror, 2 TV monitors and linear polarizers. This allowed the viewer to use conventional polarized glasses to view the resultant 3-D video image in a mirrored viewing box in real time.

StereoJet had their display of StereoJet prints available for viewing. Significantly, the price for these has recently been reduced and they are now realistically in the range of most stereographers ($50 for an 8 x 10" print).

Dynamic Digital Depth had examples of their streaming video content (aimed at internet users) in anaglyphic format. See: www.stereojet.com.

Active 3-D Displays

I-O Display Systems displayed their various shutter glasses, camcorder attachment and new 3-D CD-ROM titles. These included some Mark Blum titles and Sports Illustrated Swimsuit in interlaced 3-D.

Shown for one of the first times in the U.S. was the dedicated 3-D lens attachment made by Canon for its XL-1 video camera. It's an interchangeable compact zoom lens for the XL-1 digital video camcorder that enables the recording of three-dimensional images. The 3-D zoom lens (Equivalent to 54mm-162mm in a 35mm still camera) incorporates a focusing unit that uses triangulation to measure the distance to the subject and a motor to adjust the mirrors inside the left and right lenses accordingly, enabling the angle of convergence to be set automatically. (Manual over-ride is included for both convergence and focus.) They believe the lens will retail for about $6500 (The camera is $4,000 with a 2-D lens, $3,000 with no lens). It should be available this year. See: http://www.canondv.com/xl1/3d_lens/concept.html.

VREX was present and gave its first public showing of its DLP based stereoscopic video projector. The projector displayed a 120Hz field-sequential 3-D image and was viewed with wireless LC shutter glasses. Source material for the projector came from a field-sequential 3-D DVD. Rumor is that a new version of Depth Charge will be available and later a new DepthCharge Developer Studio. See: www.vrex.com

Autostereo

Several autostereoscopic displays from Dimension Technologies Inc. of Rochester, NY were on show. These displays are similar to the lenticular systems that have been widely displayed but are based on a slightly different technology called parallax illumination. One of the displays was demonstrated using a computer slide show. It had an LED that would go off when you were in the correct position to see 3-D. The other display was attached to a stereomicroscope

Microscope Attachments

Two companies were present showing their microscope accessories for viewing three-dimensionally through a microscope. Edge 3D Imaging of Philadelphia had its Microscope Accessories for Direct-View 3-D Imaging. They used a special light source to allow for stereo viewing using oblique and dual oblique imaging.

Digital Optical Technologies presented their microscope that provided for optical conversion of mono-path high magnification microscopy to dual-path stereoscopic video microscopy. They have partnered with Isee3d, Leica and DTI to integrate the technologies involved. One of their microscopes was demonstrated using a CRT display and shutter glasses and the other microscope was displayed using a DTI autostereoscopic display.

Miscellaneous

The University of Jerusalem demonstrated a system for capturing stereoscopic panoramas using a

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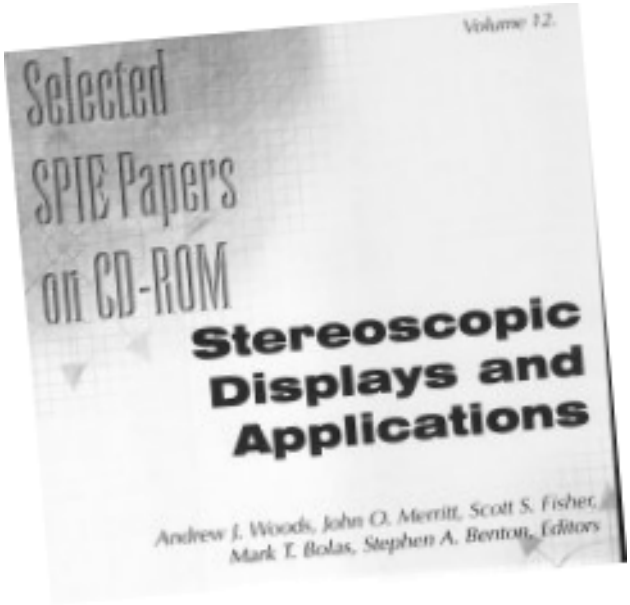

Stereo Papers on CD-ROM

review by Steve Berezin

Like many people with an interest in stereo 3-D, I imagined most information regarding 3-D displays would be available on the Internet. I was pleasantly surprised at the wealth of information found on the 2 CD-ROM set, *Stereoscopic Displays and Applications*, very little of it collected anyplace else. The text was fully searchable so I could enter terms such as "shutter glasses" and get many listings throughout the included papers. Images were plentiful although the image scans were not always of the highest quality.

Contributors include such 3-D notables as Edwin Land (founder of Polaroid), Lenny Lipton (founder of Stereographics), and Christopher Tyler—the inventor of the autostereogram (single-image random dot stereogram, or SIRDS).

This compilation brings together, for the first time, the proceedings of 21 SPIE and SPIE/IS&T conferences on the topic of stereoscopic displays and their applications—documenting a very rich history of research and development over a 24-year period (1977-2000).

Selected SPIE Papers on CD-ROM, Stereoscopic Displays and Applications, Vol. 12

Editors: Andrew J. Woods, John O. Merritt, Scott S. Fisher, Mark T. Bolas, Stephen A. Benton. See www.stereoscopic.org .

CD 1 comprises the papers of the 11 Proceedings of the Stereoscopic Displays and Applications conference, which has been held every year since its inception in 1990, making it the longest-running and most widely attended technical conference worldwide on the subject. This series also includes The Engineering Reality of Virtual Reality, a topically related conference that has copublished with SD&A since 1994.

CD 2 contains a selection of papers from related SPIE conferences that took place over the period 1977-1989. This wealth of information, presented in a fully searchable PDF format, should facilitate many new and exciting developments in stereoscopic imaging.

The conference proceedings volumes summarize an active period in stereoscopic imaging system development. The most popular topic during this period has undoubtedly been autostereoscopic displays, but this is just one of many topics, which include human factors issues in stereoscopic display systems; design, development, analysis, and evaluation of stereoscopic displays, cameras, and recording technologies; digital stereoscopic imaging including image compression, stereoscopic image synthesis, and methods for computer-based stereoscopic imaging; applications of these technologies to scientific visualization, teleoperation, telerobotics, telepresence, augmented reality, medical imaging, telesurgery, industrial inspection, communications, entertainment, broadcast/cable television, training, CAD/CAM, molecular modeling, and advertising.

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single camera (as per their paper presentation). Communications Research Centre Canada demonstrated a stereoscopic MPEG transmission system with a stereoscopic video camera and a 120Hz alternate field 3-D display.

Another first at the show was the NSA table where complimentary back issues of *Stereo World* were available. The table was well noticed and many attendees of the meeting took home copies of the magazine. The area was also a good meeting place for participants of the Internet 3-D discussion group Photo 3D. Present were Lawrence Kaufman, David Lee, Lawrence Haines, Andrew Woods, Michael Georgeoff, John Toeppan, and John Rupkalvis.

A new feature of the meeting was a collection of selected papers previously given on Stereoscopic Displays and Applications on CD-ROM. This two-volume set has a wealth of information on all the conferences between 1977-2000.

Overall, the show was a very good overview of what is happening today in stereoscopic displays. It was great to get caught up on the cutting edge of 3-D displays and meet the pioneers and driving forces behind the 3-D industry today. For more information on the meeting please see the conference website at www.stereoscopic.org.

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Photo 3Ders Lawrence Kaufman, Andrew Woods, Michael Georgeoff and David Lee show off their smiles and cameras.