

Real Time Graphics

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THE NEWSLETTER OF VIRTUAL ENVIRONMENT TECHNOLOGIES AND MARKETS

Xulu Entertainment: LBE With Internet Connectivity

by Louis M. Brill

The luxury starship cruiser Adriana offers its guests a galactic tour of nearby solar systems and neighboring planets with visits to landside destinations. Its passengers can enjoy many of the Adriana's luxury attractions onboard the starship such as fine dining, deckside recreations and tours into nearby outer space from its easy-to-use shuttle personal craft.

Visiting other solar systems will soon be a lot easier than you think. Sponsorship of these various experiences is by Xulu (pronounced *zulu*) Entertainment, a San Francisco-based multimedia company that offers its guests access to its various entertainments via Internet subscription or by personal visits through company managed urban showcase centers.

Xulu guests, whether at home or in a Xulu center, can use force-feedback joysticks, specially equipped game chairs, called I-Chairs, and motion simulators

to add to their enjoyment. While many entertainment companies are exploring Internet game scenarios, Xulu is the first

Continued on page 3

This Issue

- ▲ **Analysis: Xulu Entertainment** 1
- ▲ **Survey: Head-Mounted Displays** 1
- ▲ **Publisher's Desk:**
 - IMAGE Conference
 - Reminiscent of Days Gone By 4
- ▲ **Head-Mounted Display Basics** 6
- ▲ **FAA Purchases FlightViz™** 10
- ▲ **New Infrared Transmitter** 11
- ▲ **Urban Modeling Shown** 11
- ▲ **Telenor Spins Off Octaga SA** 11
- ▲ **Life on the Edge:**
 - Understanding Architecture 12
- ▲ **News Briefs** 14
- ▲ **People & Organizations** 17
- ▲ **Industry Briefs** 18
- ▲ **Calendar of Events** 19



"Condor," one of Xulu Entertainment's simulator attractions.

Our Annual Survey of Head-Mounted Displays

Korean manufacturer Daeyang E&C finally filled the void left by Sony's exit from the medium-resolution market last year. Daeyang's 800 x 600 HMD, the DH-4400VP cycvisor, came on the market in March with a selling price of US\$1200. The units bear a strong resemblance to the discontinued Sony LDI-100 series, but the

resemblance is only skin deep. The display assembly is a completely new design based on a reflective, not a transmissive display. The reflective display requires a beamsplitter assembly to bring the illumination source to the front of the display. Traditional LCD's pass light through the panel. The results appear the same to the user.

Continued on page 2

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Correction



In the last issue it was reported that the Kaiser Electro-Optics HMD is CRT-based. The Sim Eye XL100A is actually AMLCD-based.

Survey of HMDs

Continued from page 1

Advanced word of a planned official price cut for mid August has recently dropped the street price for the cy-visor to under US\$1000. The official Daeyang price cut is at least partly due to the introduction of a new 800 x 600 HMD by i-O Displays. The new i-O Displays device is slated for production in September, although not even a photograph is now available. The new unit will support stereo operation, important for researchers, but none of the consumer video formats (PAL, NTSC, S-VHS) built into the cy-visor. Interestingly, i-O Displays will take over major responsibility for promoting and distributing the cy-visor in the U.S., while concurrently promoting and distributing their own product.

How can i-O Displays selling cy-visors be competing with i-O Displays selling its own product in order to drive prices down? It doesn't make complete sense, but it helps to know that there is a third potential competitor, inViso.

The inViso HMD has the record for the most promoted metaphysically challenged (i.e., non-existent) product in its class. The company has gotten dozens of articles published in the past year touting their eShades™ 800 x 600 ultra compact HMD aimed to sell for \$500 to \$600. For more than a year, production

of the product has remained only two quarters away, which is where it is right now, slated for the fourth quarter. Prototypes using glass, rather than plastic, optics have been seen and according to press reports are available for something over \$2500. The 32 degree field-of-view, and 2 m collimation are nearly identical to the cy-visor. [www.inviso.com]



inViso low-cost SVGA display in prototype.

The cy-visor slipped its schedule repeatedly prior to introduction, without any ultimate apparent harm from the market viewpoint. So if the eShades makes it to the market in the fourth quarter, or whenever, all will be forgiven. The company did not respond to our inquiries.

Virtual Research and Cybermind UK are both making ruggedized versions of the cy-visor, the later for US\$3,995.

In the U.K., SEOS continues with an R&D contract to develop an HMD with a field-of-view of 120 degrees. SEOS is not ready to talk specifics, but may be ready next year.

iReality.com Inc. is in the process of being sold to an educational company and will not be selling HMDs in the future.

Delft Sensor Systems has changed its name to OIP Sensor Systems.

The Liquid Image HMDs are now listed under the company name Tek Gear, with the same address as Liquid Image.

Vista Controls has dropped out of the HMD business.

Ericsson Saab did not respond to our inquiry this year, but may still be in the business.

See HMD Basics on page 6, followed by the survey entries that start on page 7 ▲

Xulu Entertainment

Continued from page 1

entertainment company to offer a multimedia game experience for its customers to be played at home, on local computers and game consoles, or at its on-site entertainment showcase. Visiting its themed destination attraction would be like entering a stage set of a Star Wars-like movie. On-site guests would encounter motion simulation, high fidelity game interfaces, and large format interactive video projection displays, all presenting physical 'larger-than-life' versions of the web site experience.

The vision of this futuristic landscape is provided by a lush graphic rendering created by alumni staff who worked on *Star Wars* and *The Fifth Element* movies. Xulu guests enter this fictional universe via a series of adventures both on the star ship and on several of the planets the Adriana orbits around.

Setting the stage for all of this has taken five years, says Jim Solomon, CEO and co-founder of the company. The Xulu content is completely original as he notes, "Rather than license some one else's intellectual property such as Star Wars or Disney, we decided to develop our own brand as a stand-alone product. The development time is longer, but the payoff is higher. To do this, we developed a fictional history of our universe, complete with a back story about traveling to other planets which drives the complete guest experience."



"Hover Hockey" is one of the Xulu attractions under development.

"Our rollout will be in the second half of 2002 and will simultaneously introduce both our on-line presence and a highly diversified entertainment center complete with themed attractions and dining. The initial offering will have four to five major player adventures based on sightseeing, exploration, sports, and social encounters. The company will not only offer its various on-line game experiences, but will also sell certain home peripherals to enhance game play. This includes everything from properly configured computers to a special game playing chair (I-Chair).

Xulu Entertainment CGI adventures take place in many settings - with some ship-based, some outside the starship, and some planet side. These adventures are accessed via the motion simulator, a large-format video screen or via some specialized computer graphic gaming tables. The ride simulator alone promises a multitude of sports experiences including "Condor" (a combination of hang gliding and basketball), "Dominion" (dune buggy competition), "Hover Hockey" (bumper car + hockey), and various space adventures. Each game lasts approximately seven minutes for two very busy Xulu guests, one acts as pilot, the other as co-pilot.

With the many home and showcase site products that Xulu offers in its virtual extra-galactic tourist adventures, *Real Time Graphics* has chosen to focus on its physical side. Specifically we will deal with its motion ride simulator and the management of its computer architecture that will present these virtual worlds for guest exploration.

Xulu ride simulators are true interactive user-controlled motion base simulators that move in just about real time as one navigates

various landscape-derived computer graphic environments. "The motion base for our simulator is a 6 DOF electric motion base, which we feel is much smoother and quieter, when compared to low-end hydraulic bases," says Solomon. "Our motion base of choice comes from a British company known as Motion Base PLC. This system is a commercially available base that is aimed at the high-end flight sim market. We custom design and build our own 2-seater vehicle cabins which we place on these motion bases."



Xulu auto racing experience.

"Visual display of the CGI world is through multiple rear projectors. We currently use Sharp video projectors (XG-NV 2U) to display Xulu virtual world images. Because the simulator includes two passengers, collimated optics is not used, thus allowing both passengers to experience a surround vision effect. The cabin display window is three screens (i.e. three video projectors beamed into mirrors and onwards to the display screens) seamed together, creating one complete 'landscape' region that visitors can navigate through."

The core engine for all these virtual worlds as explained by Solomon, "is a physics simulator which calculates the correct physics of real time interactions as you'd experience them in the real world. It's the only way to build a robust virtual environment that feels real. This solves Newton's Laws in real time and in three dimensions using a very high-powered, multi-processor, multi-threaded server. This computing system incorpo-

Continued on page 5



The IMAGE Conference began two decades ago as a forum for specialists in visual simulation. In the early days, the club was kept exclusive by the very high price of visual simulation, around a million dollars a channel. A relatively few large companies were the mainstays of the industry, and of the IMAGE Conference. Technical topics were obscure, but the blazing Arizona sun outside the air conditioned meeting rooms helped to maintain focus in the sessions.

Much has come and gone in twenty years. Entertainment, Virtual Reality, and VR in Medicine came and went as major conference topics. This year we were back to a few aerospace companies as core sponsors, aerospace-oriented attendees, and some appropriately obscure discussion topics. The golden sun must have been partly responsible for a first day standing-room-only session on sensor simulation, although at IMAGE there is a faction that actually finds this an exciting topic.

In "old style" simulation, the question was how to make simulators more realistic, with cost a secondary issue. SIMNET ushered in the "new style" era when the focus shifted to cost as the primary concern and performance the secondary concern, in the belief that there was more training value in having a great number of less-than-perfect simulators. As measured by IMAGE, we are firmly back in the old style pursuit of perfection.

No, we are not back to million dollar per channel simulators. Networked simulation is here to stay. What has happened is that technology has lowered the cost of simulation to the point where the military can afford to pursue perfection

IMAGE Conference Reminiscent of Days Gone By by Roy Latham

and still keep costs within bounds. An image generator channel in a networked simulator now costs about thirty or forty thousand dollars, with more than half in software and database costs. That is plenty relative to, say, a game PC setup, but it is not so much as to make cost the central issue. Performance issues and features are center stage.

After a decade of relative cost consciousness, the thrust of IMAGE has returned to solving unsolved problems.

The phrase "pursuit of perfection" may seem to imply "needless pursuit of perfection." How much realism is enough? This has for decades been a fundamental question of the simulator business. The scenario is: (1) simulators are rarely, if ever, so good as to be indistinguishable from the real world, (2) for any particular set of training tasks, clearly not every aspect of the real world is needed in the simulator, (3) the simulator user knows that if the simulation appears perfect, it will be adequately realistic, and (4) the simulator user will be unsure if the simulator is adequate if it less than perfect. So sometimes the pursuit of perfection is mere gold plating, and other times it is curing fundamental defects. There are well established methods of task analysis which are designed to resolve such issues, and it can only be said that they are rarely called into play and even less often subsequently believed.

At the PC Simulation Special Interest Group, the discussion included the components used to build PC-based systems and lists of features currently missing from PC-based simulators. The discussion reinforced our thinking that there are two varieties of PC-simulation. The first is the military variety of PC simulation in which the focus is not so much on getting PC-simulators to do all the things conventional simulators have done, but rather on getting PC-simulation to do things that have never been done by any simulator. PC-based systems from E&S, Primary Image, Quantum3D, and others do just about everything done in conventional image generators, albeit at prices in line with military budgets. So the only problems remaining are ones that have never been solved by any means.

The second variety of PC simulation is the cost-conscious one. The notion is that if costs could be further lowered new applications for simulators, both military and commercial, would become practical. This second variety of simulation is of special interest to long-time believers in simulation as a tool to aid society in many ways. While it exists as a concept, it surely does not exist as a market, and it does not exist as a Government-funded research topic. A STRICOM SBIR initiative on PC simulation which seemed to hint of interest in the low-cost variety ended up solidly as a pursuit of perfection effort. This is logical in that SBIR requirements are driven by program offices, and there aren't any program offices charged with low-cost simulation as a primary responsibility.

Are there really no examples of the low-cost variety of PC-simulation? We spoke of some of the topics that had

come and gone over the years. A topic that has come and stayed is driving simulation. Part of driving simulation is an interest in true low-cost simulation. There is a money-is-no-object side to driving simulation, like the National Advanced Driving Simulator (NADS), but that is the exception. Both for research and for training, driving simulation depends upon the development of true low-cost systems.

Driving simulation has long been a bit separate from aerospace simulation. The driving simulator sessions at IMAGE showed some unfamiliarity with the standard body of knowledge built in the aerospace simulation world. Still, the enthusiasm for building good simulators cheaply was unmatched. Perhaps driving simulation will be the breakthrough application to the broad commercial applications we hope to be the future of simulation.

Xulu Entertainment

Continued from page 3

rates servers with up to 32 processors each (using an SMP or Shared Memory Processor architecture) and supports our habitable virtual worlds for both the Internet and for our on-site showcase centers. These servers, together with the guest pods, form a client-server architecture that allows us to generate the precise simulation of physical forces, surround visuals, a sense of touch (haptic



This Xulu attraction offers a tour of a futuristic city.

The exquisite desert locales of the IMAGE Conference is the object of a long term love/hate relationship among more than a few attendees. On the one hand, it really is too hot. On the other hand, the desert has its unquestioned charms and in these days of air conditioning, the heat keeps only a few people away. This year storms threatened early in the week. Monday was 103 and humid, the humidity making it one of the most truly unpleasant heat experiences of a lifetime. By Friday temperatures had warmed to 108, but the humidity had dissipated so it was merely a warm day in Arizona.

This year IMAGE was at the Marriott Mountain Shadows resort in Scottsdale (north of Phoenix). I've heard that some people think the Mountain Shadows to be a bit old fashioned, but it has much charm and is

well kept. They are quite loyal to the "desert colors" motif. They have planted the grounds with bougainvillea, a plant famous for its masses of brilliant colors, especially reds and purples. At the Mountain Shadows, however, they use exclusively a sandy-colored bougainvillea, which they use exclusively to avoid damaging true Southwestern sensibilities.

Next year, IMAGE will return to the Marriott Scottsdale Inn, a truly extraordinary property on a world class scale. They say that this is where the Marriott family vacations and where such diverse celebrities as G. Gordon Liddy and Sandra Day O'Connor may be caught brunching, though not necessarily in proximity. We didn't see any celebrities, but we did check the brunch, solely for the benefit of our readers, to ensure that standards are being maintained. They are. ▲

feedback), and sound (music effects and voice) that is essential for our guests in allowing them to become immersed in an alternate reality."

Another critical element of the ride sim's physics engine for the Internet is its ability to present each ride experience in near-real-time, which it does by using a latency-tolerance algorithm allowing the simulation software to respond to communications between the server and its remote clients, predicting where the operator's vehicle might have gone. If the prediction proves wrong, the software gracefully corrects the course on the next positional update.

While LBEs have been around for a while, most died within a few years of opening. How Xulu will fare remains to be seen. It does, however have business model advan-

tages to enhance its success. First off, it is neither strictly an LBE operation nor an Internet game experience as much as it is both of these. It incorporates both experiences as cross-over attractions for each other. This may provide enough critical mass to build a combined loyal audience to sustain both the clicks of cyberspace and its bricks attraction in real space. The Internet component is planned to be the major source of revenue and profit growth, while the physical showcases have the role of driving audience growth and loyalty. Another wild card factor is the 2002 opening of *Star Wars Episode II*, followed by *Star Wars On-Line* which may rekindle enough interest in space operas to drive film fans into Xulu's Adriana for the ride of their life. Stay tuned for the final boarding call. ▲

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Head-Mounted Display Survey

Head-Mounted Display Basics

Price, resolution, and weight are important HMD attributes, but not the only important attributes. Field-of-view is a major consideration, and there are also stereo capability, color depth, the refresh rate, and the collimation distance to consider. Let us explain.

The pixel format is one factor in display resolution. Computer graphics people, like us, have a mental picture of a frame buffer as an array of $N \times M$ pixels, with each pixel having red, blue, and green color components. We then think of the display as a similar rectangular array of displayed pixels, with each pixel colored according to the frame buffer. This mental picture is a reasonably accurate way to think of color CRT displays and certain other types of displays. Then the picture format of $N \times M$ pixels is a good description of the display capability. Popular display formats include 640 x 480 (VGA), 800 x 600 (SVGA), 1024 x 768 (XGA), and 1280 x 1024.

The conceptual model of neat rows and columns of pixels works for shadow mask CRTs, for displays made using three superimposed images of the primary colors, and for field sequential color (FSC) displays. Superimposed displays include Kaiser's HMD that use three panels of light emitting diodes, optically combined. Field sequential displays separate red, green, and blue fields in rapid sequence, at typically 120 to 180 fields per second. FSC displays most commonly use a monochrome CRT with liquid crystal shutter technology to sequence color filters (as done by n-Vision, Kaiser, and others).

Color liquid crystal displays (LCDs) use small squares, which we call dots, with a red, blue, or green color filter in front of each dot. One way to make an LCD display is to use three primary-colored dots to make a pixel. This is in

keeping with our idea of a pixel format. Thus a *true* VGA LCD display has 640 x 480 pixels and 640 x 480 x 3 = 921,600 dots. (Some new LCD displays use a field sequential color technique.)

However, the display specifications in our product survey include LCD devices in which the claimed number of pixels is equal to the claimed number of dots. This occurs most often in low-cost displays designed for watching television or playing video games. Television format video provides separate luminance (brightness) and chrominance (color) data. One could imagine, for example, showing a monochrome image by applying the luminance signal to the LCD dots, ignoring the color filters in front of the dots. This would seem to produce interesting color fringing effects, but it would serve to confuse the definitions of a dot and a pixel. We do not know what display vendors do to achieve a claim of equal numbers of *dots* and *pixels*, but it is probably a compromise inferior to a true color display in which there are three dots per pixel.

One vendor, i-O Displays, has used active doubling to increase the resolution of some of its display products. Active doubling uses an electro-optical technique to move the image by half a pixel between fields. The technique seems to work fine.

The resolution of a display is a combination of display format, field-of-view, and optics. Early HMDs tried spreading a relatively few pixels over a wide field-of-view in the belief that field-of-view would be more important than resolution. Over the years, customer acceptance has reversed the trend; better not to spread the pixels too thin. The ideal for many applications, of course, is to have both wide FOV and many pixels. That combination is still expensive, and in fact just getting a wide field-of-view tends to be expensive.

For our survey, we have not attempted to measure optical quality, contrast, color depth, or a number of human fac-

tor elements. The limitation is imposed by our resources, not by the importance of these parameters. Our survey simply states the manufacturer's claims for certain parameters.

Color depth is the ability of the HMD to cover a large range of colors. CRTs have traditionally offered better color depth than LCDs, but new technology is closing the gap.

Collimation distance is the distance to which the user's eyes focus. Even though the display is close to the user's eye, every HMD uses optics to adjust the focus distance to a point more distant. This focus distance varies from about three feet to about 15 feet. If the HMD will be used for an application in which work is done at one characteristic distance, it would make sense to try to match that distance in the HMD.

Most HMDs have separate displays and optics for the left and right eyes, but that does not mean that the electronics will support stereo operation. Only a relative few support stereo, and when stereo is supported there is no standardization of the stereo signal format. Displays may require the stereo to be generated with the left and right eye images or on alternate scan lines, on alternate frames, in concurrent synchronized images, or in concurrent unsynchronized frames.

You cannot safely assume that a particular display will fit any particular user. Some HMDs, even some of the expensive ones, will not fit large head sizes. Others will not fit people with glasses or will not fit the combination of glasses with a large head size. Head shape comes into play as well, and there are displays that will not fit wide heads.

For traditional LCD displays, depixelization is important. Depixelization is an optical technique that spreads the light from each dot over its boundaries. Without depixelization, the display looks like it is being viewed through a screen door. ▲

Head-Mounted Display Survey

CAE Fiber-Optic HMD

120°(H) x 55°(V) FOV; programmable line rate CRT; 25° overlap; CRT projector through fiber optics; stereo: yes; weight: 4.8 lb.; price: contact vendor.

Kari Adrover, CAE, P.O. Box 1800, St. Laurant, Québec, Canada H4L 4X4, Tel: 514-341-2000, Fax: 514-340-5339, e-mail: adrover@cae.com <http://www.cae.com>



CAE USA Gemin-Eye 3

98°(H) x 49°(V) FOV; 1280 x 1024 pixels; 26° overlap; monochrome CRT with field sequential color, standard UXGA video inputs; 1.31M dots; stereo: yes; 7 lb.; us\$150,000.

Dennis Joseph, CAE USA, 4908 Tampa West Boulevard, Tampa, FL 33684, Tel: 813-887-1591, Fax: 813-887-1530. e-mail: dennis.joseph@cae.com <http://www.cae.com>



CAE USA Gemin-Eye 2

104°(H) x 52°(V) FOV; 1024 x 768 pixels; 34° overlap; monochrome CRT with field sequential color; 768,432 dots; stereo: yes; 5.5 lb.; us\$125,000.

Dennis Joseph, CAE USA, 4908 Tampa West Boulevard, Tampa, FL 33684, Tel: 813-887-1591, Fax: 813-887-1530. e-mail: dennis.joseph@cae.com <http://www.cae.com>



CYBERMIND Visette-Pro

60°(H) x 46.8°(V) FOV; 640 x 480 pixels; overlap: 100%; AMLCDs; 307,200 dots per LCD; stereo: yes; weight: 840 g.; us\$3750. [PAL available]

Matt Drakard, Cybermind UK Ltd., The Ridgemere Centre, Barkby Road, Syston, Leicestershire LE7 2AJ, United Kingdom, Tel: +44-116-260-4310, Fax: +44-116-260-4320, e-mail: mattd@cybermind.co.uk <http://www.cybermind.co.uk>



CYBERMIND bi-Res 800

28°(H) x 21°(V) FOV; 832 x 624 pixels; overlap: 100%; 2 x 0.7 in. LCDs; 1.55M dots per LCD; stereo: no; weight: 825 g.; us\$4995.(see-through capability)

Matt Drakard, Cybermind UK Ltd., The Ridgemere Centre, Barkby Road, Syston, Leicestershire LE7 2AJ, United Kingdom, Tel: +44-116-260-4310, Fax: +44-116-260-4320, e-mail: mattd@cybermind.co.uk <http://www.cybermind.co.uk>



CYBERMIND bi-Res 900

25°(H) x 19°(V) FOV; 800 x 600 pixels; overlap: 100%; 0.49 in. LCD; 1.44M dots; stereo: no; weight: 635 g.; us\$3145.

Matt Drakard, Cybermind UK Ltd., The Ridgemere Centre, Barkby Road, Syston, Leicestershire LE7 2AJ, United Kingdom, Tel: +44-116-260-4310, Fax: +44-116-260-4320, e-mail: mattd@cybermind.co.uk <http://www.cybermind.co.uk>



Daeyang cy-visor DH-4400VP

59.8°(H) x 43°(V) FOV; 800 x 600 pixels; overlap: 100%; 0.49 in. LCOS; 480,000 dots; stereo: no; weight: 160 g. (display unit); us\$950.

Roy Latham, CGSD Corporation, 2483 Old Middlefield Way #140, Mountain View, CA 94043, Tel: 650-903-4920, Fax: 650-967-5252 e-mail: sales@cgds.com <http://www.cgds.com/DaeyangHMD>



Fakespace Labs FS²/BOOM-HF

30-140°(H) x 90°(V) FOV; 180Hz RGB FSC; 100% overlap; CRT; 1280 x 1024 pixels; stereo: yes; weight: n/a (counterbalanced); us\$95,000.

Eric Lorimer, Fakespace Labs, Inc., 241 Polaris Ave., Mountain View, CA 94043, Tel: 650-688-1940, Fax: 650-688-1949. e-mail: info@fakespace.com <http://www.fakespacelabs.com>



Fakespace Labs PUSH1280

30-140°(H) x 90°(V) FOV; 180Hz RGB FSC; 100% overlap; CRT; 1280 x 1024 pixels; stereo: yes; weight: 50 lb.; us\$24,995.

Eric Lorimer, Fakespace Labs, Inc., 241 Polaris Ave., Mountain View, CA 94043, Tel: 650-688-1940, Fax: 650-688-1949. e-mail: info@fakespace.com <http://www.fakespacelabs.com>



Fakespace Labs PUSH640

37° or 28°(H) x 21° or 9°(V) FOV; 640 x 532 pixels, 60Hz VGA; 100% overlap; TFT-LCD; 340,000 dots; stereo: yes; weight: 25 lb.; us\$9,995.

Eric Lorimer, Fakespace Labs, Inc., 241 Polaris Ave., Mountain View, CA 94043, Tel: 650-688-1940, Fax: 650-688-1949. e-mail: info@fakespace.com <http://www.fakespacelabs.com>



Head-Mounted Display Survey

Interactive Imaging VFX3D

31°(H) x 19°(V) FOV; 263 x 480 pixels; 100% overlap; AMLCD; 360,000 dots; stereo: yes; weight: 32 oz.; US\$1795 includes 3DOF tracker and interface



Steve Glaser, Interactive Imaging Systems, Inc., 2166 Brighton-Henrietta TL Road, Rochester, NY 14623, Tel: 716-273-8293, Fax: 716-240-8003. e-mail: stephen_glaser@iisvr.com <http://www.iisvr.com>

i-O Display Systems i-glasses LC, LCB

24°(H) x 18°(V) FOV; 266 x 225 pixels; 100% overlap; 180k color AMLCD; 180,000 dots; stereo: special order; weight: 8 oz.; US\$399. [supports composite and S-video] [LCB, supports RCA and S-video, \$499.]



Dave Graham, i-O Display Systems, LLC, 1338 N. Market Boulevard, Sacramento, CA 95834, Tel: 916-928-9639, Fax: 916-928-9539. e-mail: daveg@i-glasses.com <http://www.i-glasses.com>

i-O Display Systems i-glasses LCB X2

24°(H) x 18°(V) FOV; 450 x 266 pixels; 100% overlap; 180k color AMLCD + active doubling; 360,000 dots; stereo: special order; weight: 8 oz.; US\$599. [supports composite and S-video]



Dave Graham, i-O Display Systems, LLC, 1338 N. Market Boulevard, Sacramento, CA 95834, Tel: 916-928-9639, Fax: 916-928-9539. e-mail: daveg@i-glasses.com <http://www.i-glasses.com>

i-O Display Systems Protec

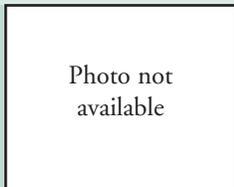
37°(H) x 21°(V) FOV; 640 x 480 pixels; 100% overlap; 512k color AMLCD + active doubling; 1.024M dots; stereo: yes; weight: 12.5 oz.; US\$4,000.



Dave Graham, i-O Display Systems, LLC, 1338 N. Market Boulevard, Sacramento, CA 95834, Tel: 916-928-9639, Fax: 916-928-9539. e-mail: daveg@i-glasses.com <http://www.i-glasses.com>

i-O Display Systems i-glasses SVGA

20.8°(H) x 15.6°(V) FOV; 800 x 600 pixels; 100% overlap, 7"10" convergence; Reflective LCD by Zight; 1.44M dots; stereo: option; weight: 6.5 oz.; US\$999.



Dave Graham, i-O Display Systems, LLC, 1338 N. Market Boulevard, Sacramento, CA 95834, Tel: 916-928-9639, Fax: 916-928-9539. e-mail: daveg@i-glasses.com <http://www.i-glasses.com>

Kaiser Electro-Optics ProView™ XL35 & XL50

29°(H) x 21°(V) FOV [40°(H) x 30°(V) for the XL50]; 1024 x 768 pixels; 100% overlap; full color AMLCD; 2.36M dots/channel; stereo: yes; weight: 35 oz.; US\$19,500.



Rose Waldie, Kaiser Electro-Optics, Inc., 2752 Loker Ave. West, Carlsbad, CA 92008, Tel: 760-438-9255, Ext: 243, Fax: 760-438-6875. e-mail: rwaldie@keo.com <http://www.keo.com>

Kaiser Electro-Optics ProView™ XL40/50STm

36°(H) x 27°(V) [48°(H) on 50ST] FOV; 1024 x 768 pixels; 100% overlap [24° for 50ST]; AMLCD monochrome; 786,432 dots/channel; stereo: yes; weight: 28 oz. w/headband mount; price: US\$50,000.



Rose Waldie, Kaiser Electro-Optics, Inc., 2752 Loker Ave. West, Carlsbad, CA 92008, Tel: 760-438-9255, Ext: 243, Fax: 760-438-6875. e-mail: rwaldie@keo.com <http://www.keo.com>

Kaiser Electro-Optics Sim Eye™ XL100A

100°(H) x 50°(V) FOV w/30% overlap [65°(H) x 50°(V) FOV w/100% overlap]; 1024 x 768 pixels; 100% or 30% overlap; full color AMLCD; 3.8 arcmin/color group; stereo: yes; weight: 5 lb. w/helmet; price: US\$87,500.



Rose Waldie, Kaiser Electro-Optics, Inc., 2752 Loker Ave. West, Carlsbad, CA 92008, Tel: 760-438-9255, Ext: 243, Fax: 760-438-6875. e-mail: rwaldie@keo.com <http://www.keo.com>

Kaiser Electro-Optics ProView™ SL35 Monocular

34°(H) x 27°(V) FOV; (800 x 3) x 600 pixels; full color AMLCD; 2.6 arcmin/color group @ SVGA; stereo: yes; weight: 350 g.; price: US\$16,500.



Rose Waldie, Kaiser Electro-Optics, Inc., 2752 Loker Ave. West, Carlsbad, CA 92008, Tel: 760-438-9255, Ext: 243, Fax: 760-438-6875. e-mail: rwaldie@keo.com <http://www.keo.com>

n-Vision Datavisor® 80

80° monocular [120° max. (H)] x 60° (V) FOV; 640 x 480 to 1280 x 1024 pixels; 50% overlap; 1 in. CRT; stereo: yes; weight: 64 oz.; US\$90,000. (USA List)



Marc Foglia, n-Vision, Inc., 7915 Jones Branch Drive, Ste. 1201, McLean, VA 22102, Tel: 703-506-8808, Fax: 703-903-0455. e-mail: info@nvis.com <http://www.nvis.com>

Head-Mounted Display Survey

n-Vision Datavisor® VGA, HiRes*

52° monocular [78° max. (H)] x 39° (V) FOV; 640 x 480 pixels (VGA), HiRes can be 640 x 480 to 1280 x 1024 pixels; 50%/100% overlap; 1 in. CRT; stereo: yes; weight: 56 oz.; US\$45,000 (HiRes), US\$20,000 (VGA) (USA List)* See-through option shown]



Marc Foglia, n-Vision, Inc., 7915 Jones Branch Drive, Ste. 1201, McLean, VA 22102, Tel: 703-506-8808, Fax: 703-903-0455. e-mail: info@nvis.com <http://www.nvis.com>

n-Vision Virtual Binoculars VGA, HiRes

42°(H) x 31.5°(V) [60°(H) x 45°(V) LCD]FOV; 640 x 480 to 1280 x 1024 pixels (HiRes), [640 x 480 pixels VGA, LCD]; 100% overlap; 1 in. CRT (HiRes, VGA), [1.3 in. AMLCD; 921,600 dots [LCD]; stereo: yes; weight: 36 oz. [32 oz. LCD]; US\$25,000 (HiRes), \$13,500 (VGA), \$10,000 (LCD). (USA List)



Marc Foglia, n-Vision, Inc., 7915 Jones Branch Drive, Ste. 1201., McLean, VA 22102, Tel: 703-506-8808, Fax: 703-903-0455. e-mail: info@nvis.com <http://www.nvis.com>

n-Vision Datavisor NVG

40°(H) x 30°(V) FOV; multisync 1280 x 1024 to 1700 x 1350 pixels; 100% overlap; 1 in. monochrome CRT; stereo: yes; weight: 2 lb. (w/o helmet); US\$25,000. (USA List)



Marc Foglia, n-Vision, Inc., 7915 Jones Branch Drive, Ste. 1201., McLean, VA 22102, Tel: 703-506-8808, Fax: 703-903-0455. e-mail: info@nvis.com <http://www.nvis.com>

OIP Sensor Systems HOPROS Video 20°

16°(H) x 12°(V) FOV; PAL CCIR & NTSC/RS-170; overlap: n/a; B&W CRT; 350 x 300 pixels; stereo: no; weight: 440 g.; price: contact vendor.



Francoise De Groote, OIP Sensor Systems, Westerring 21, B-9700 Oudenaarde, Belgium, Tel: +32-55-333-811, Fax: +32-55-316-895. e-mail: fdg@oip.be <http://www.oip.be>

OIP Sensor Systems HOPROS Multisync 26°

21°(H) x 16°(V) FOV; PAL CCIR & NTSC/RS-170, VGA ... XVGA; overlap: n/a; high brightness B&W CRT; 750 x 560 pixels; stereo: no; weight: 550 g.; price: contact vendor.



Francoise De Groote, OIP Sensor Systems, Westerring 21, B-9700 Oudenaarde, Belgium, Tel: +32-55-333-811, Fax: +32-55-316-895. e-mail: fdg@oip.be <http://www.oip.be>

Olympus Eye-Trek FMD-20P

30°(H) x 22.7°(V) FOV; 267 x 225 pixels; AMLCD (Delta); 180K dots; stereo: no; weight: 85 g.; US\$399. Requires Sony PlayStation 2



Joseph Leo, Olympus America Inc., 2 Corporate Center Drive, Melville, NY 11747-3157, Tel: 631-844-5000, Ext. 5608, Fax: 631-844-5339 e-mail: Joseph.Leo@olympus.com <http://www.eye-trek-olympus.com>

Olympus Eye-Trek FMD-250W

37.5°(H) x 21.7°(V) FOV; 356 x 225 pixels; AMLCD (Delta); 180K dots; stereo: no; weight: 95 g.; US\$799.



Joseph Leo, Olympus America Inc., 2 Corporate Center Drive, Melville, NY 11747-3157, Tel: 631-844-5000, Ext. 5608, Fax: 631-844-5339 e-mail: Joseph.Leo@olympus.com <http://www.eye-trek-olympus.com>

Olympus Eye-Trek FMD-200

30°(H) x 22.7°(V) FOV; 267 x 225 pixels; AMLCD (Delta); 180K dots; stereo: no; weight: 85 g.; US\$499.



Joseph Leo, Olympus America Inc., 2 Corporate Center Drive, Melville, NY 11747-3157, Tel: 631-844-5000, Ext. 5608, Fax: 631-844-5339 e-mail: Joseph.Leo@olympus.com <http://www.eye-trek-olympus.com>

Olympus Eye-Trek FMD-700

30°(H) x 22.7°(V) FOV; equivalent to 533 x 450 pixels (Optical Super Resolution); AMLCD (Delta); equivalent to 720K dots; stereo: no; weight: 105 g.; US\$1199.



Joseph Leo, Olympus America Inc., 2 Corporate Center Drive, Melville, NY 11747-3157, Tel: 631-844-5000, Ext. 5608, Fax: 631-844-5339 e-mail: Joseph.Leo@olympus.com <http://www.eye-trek-olympus.com>

OpTechs Talos

22.2°(H) x 16.6°(V) FOV; 800 x 600 pixels; 100% overlap; CMD; 480,000 dots; stereo: yes; weight: 6 oz.; US\$1,850



Jeffery McCabe, OpTechs, Inc., 1442 E. Lincoln Avenue, Suite 392, Orange, CA 92865, Tel: 714-637-5215, Fax: - e-mail: mccabeja@optechs.net, <http://www.optechs.net>

Head-Mounted Display Survey

Tek Gear **PCTV-K180**

30°(H) x 23°(V) FOV; 800 x 225 pixels; 100% overlap; display AMLCD with OSR; [180K x 4(OSR) = 720,000 dots; stereo: yes - eye SCREAM encoded; weight: 3.7 oz.; US\$2,450.



Deborah Williams, Tek Gear, 1-90 Market Avenue, Winnipeg, MB, R3B 0P3, Canada, Tel: 204-988-3001, Fax: 204-988-3050.
e-mail: deborahw@tekgear.ca <http://www.tekgear.ca>

Tek Gear **PTV-K240**

37.5°(H) x 21.7°(V) FOV; 1068.5 x 225 [16:9 - 4:3] pixels; 100% overlap; display AMLCD; 240,000 dots; stereo: yes - field sequential; weight: 3.4 oz.; US\$1,500.



Deborah Williams, Tek Gear, 1-90 Market Avenue, Winnipeg, MB, R3B 0P3, Canada, Tel: 204-988-3001, Fax: 204-988-3050.
e-mail: deborahw@tekgear.ca <http://www.tekgear.ca>

Tek Gear **PTV-K240DP**

37.5°(H) x 21.7°(V) FOV; 1068.5 x 225 [16:9 - 4:3] pixels; 100% overlap; display AMLCD; 240,000 dual channel dots; stereo: yes; weight: 3.4 oz.; US\$2,000.



Deborah Williams, Tek Gear, 1-90 Market Avenue, Winnipeg, MB, R3B 0P3, Canada, Tel: 204-988-3001, Fax: 204-988-3050.
e-mail: deborahw@tekgear.ca <http://www.tekgear.ca>

Tek Gear **M1**

16°(H) FOV; 320 x 240 pixels; overlap n/a [monocular]; AMLCD; 76,800 dots; stereo: no; weight: <4.0 oz.; US\$500.



Deborah Williams, Tek Gear, 1-90 Market Avenue, Winnipeg, MB, R3B 0P3, Canada, Tel: 204-988-3001, Fax: 204-988-3050.
e-mail: deborahw@tekgear.ca <http://www.tekgear.ca>

Tek Gear **M2**

22°(H) x 16.6°(V) FOV; 800 x 600 pixels; overlap n/a [monocular]; display reflective DNLCoS; 480K (monochrome dots) x 3 (RGB) dots; stereo: no; weight: <210 g.; US\$3,500.



Deborah Williams, Tek Gear, 1-90 Market Avenue, Winnipeg, MB, R3B 0P3, Canada, Tel: 204-988-3001, Fax: 204-988-3050.
e-mail: deborahw@tekgear.ca <http://www.tekgear.ca>

FAA Purchases FlightViz™ Data Visualization Software System

The Federal Aviation Administration (FAA) has purchased FlightViz data visualization software for its Aviation System Standards (AVN) program.

AVN develops, flight inspects, and publishes all instrument approach procedures for the FAA. They will be using FlightViz data visualization software in two ways. The first will be to enhance their approach procedures development process. They expect that the ability to visualize data from their own aircraft, as well as data gathered from outside sources, will improve the way they implement criteria and develop and amend approach procedures. FlightViz will enable them to better recognize potential problems and determine the changes that would most effectively solve those problems.

AVN will work closely with the Flight Standards program, which develops and refines the criteria for approach procedures, and they expect FlightViz to enhance that process as well. The different possible variations in criteria that Flight Standards considers for an approach can be animated to create "what if" scenarios. This will allow AVN staff to check and validate procedures under development before resources are used to flight check and publish the procedures.

Secondly, AVN wants to use FlightViz to enhance their internal Flight Operations Quality Assurance (FOQA) program. Using FlightViz, AVN will develop ways to analyze flight data from their own fleet of approximately 33 aircraft, looking for trends that should be addressed before they become safety problems.

According to Jon Phelps, AVN's director of safety and quality assurance, FlightViz visualizations will be used for more than analyzing data; they will be used to educate. "It's difficult to illustrate ideas with data," he said. "It's always easier to describe situations or problems if you can visualize them." He feels that FlightViz will prove to be an effective tool to communicate with their flight crews, management, the FAA as a whole, and their external customers.

Located at the Mike Monroney Aeronautical Center in Oklahoma City, Oklahoma, AVN has total responsibility for managing and administering instrument approach procedures development; the Federal Aviation Administration's flight inspection program, aircraft operations, and aircraft maintenance; and the United States Air Force's flight inspection missions. [See <http://www.mmac.jccbi.gov/avn>]

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New Infrared Transmitter Expands Area of Stereoscopic Effect

Fakespace Systems, Inc. and StereoGraphics Corporation have announced the availability of an infrared (IR) transmitter for use in immersive environments. The new Extended Range Emitter™, jointly developed by the two companies, provides a strong signal, covering an expanded area, for stereo viewing in large-scale visualization systems such as the WorkWall™, CAVE®, and RAVE™.

Infrared transmitters emit infrared pulses that alternate the electronic shutters on active stereoscopic glasses to synchronize them with alternating left eye/right eye projected images. The new Extended Range Emitter provides an emission range of up to 100-ft. compared to the current 30-ft. maximum range of commercially available emitters, and an improved cone or angle of emis-

sion. It is also powerful enough to project its beam through a hard or soft display screen, which simplifies installation and keeps the emitter hidden from view.

Designed for use with Fakespace Systems displays, the emitter increases the power of the infrared beam used to control stereoscopic eyewear and decreases the number of emitters necessary for immersive viewing in large areas. It also reduces the potential for signal loss, which can occur if placement of emitters is restricted. For example, in order to maintain a reliable stereo signal within a walk-in, immersive room, up to 14 standard emitters were previously required. With the new Extended Range Emitter, just three devices are needed to provide coverage throughout a ten-ft. by ten-ft. environment. The number of emitters required to provide coverage to large audience venues such as auditoriums is also reduced.

Fakespace initially developed the concept of a more powerful emitter, which could be realized by increasing the size of the infrared emitting diode array, and increasing the supplied power. StereoGraphics further developed the design, and is manufacturing the Extended Range Emitter, which is now available. It will be sold in conjunction with Fakespace Systems products until the end of the year, when it will be available as part of the StereoGraphics family of products.

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Urban Modeling and Visualization Tools Demonstrated

Harris Corporation and the Defence Research Establishment Valcartier (DREV) recently collaborated to showcase new 3-D visualization tools to the agencies in charge of security during the Summit of the Americas in Quebec City, Canada.

The tools, which include realistic scene visualizations of Quebec City for situational awareness, was demonstrated to the security forces in charge of protecting the 34 international leaders and other diplomats attending the Summit.

The 3-D urban modeling software developed by Harris was the main focus of the demonstration. Harris supplied the Canadian DREV with a 3-D model of Quebec City and the surrounding area, InReality™ visualization software, and the Silicon Graphics computer equipment used to display the virtual city.

Harris RealSite™ and InReality urban modeling and visualization software provides tools that facilitate planning and other tasks critical to the safe-

guarding of resources in an urban environment. RealSite uses imagery from multiple sources and sensors to create and analyze high-resolution, geospatially-accurate 3-D models covering large areas. InReality visualization software provides scene navigation and analysis capabilities.

Contact:

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<http://www.harris.com>

Telenor Research Spins Off Octaga AS

Octaga AS has recently been founded by eight researchers as a spin-off company from Telenor Research and Development in Norway. The company can offer tailored multi-user 3-D applications for the professional market, and is based on several years of research and technology development carried out in Telenor R&D. This includes the tool DOVRE for dis-

tribution and streaming of 3-D and multimedia content, including MPEG-4/VRML. DOVRE is being used to develop applications in areas such as distributed medical training, offshore incident management training, collaborative engineering environments, or distributed simulations. The client/server technology is primarily targeting the PC market, but can also be used in mobile,

broadband, and SGI/Unix environments. Octaga is jointly owned by Telenor (www.telenor.com) and the founders, and is located in Oslo.

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LIFE on the EDGE



Commentary by Ben Delaney

Mies in Berlin, at MOMA

Understanding Architecture

Here's the problem: Museum exhibitions of architecture have seldom been able to give a sense of scale, or space, appropriate to the subject. After all, few museums can afford the space or money to build a full-size, or even a large-scale replica of an architect's work. Even if it were possible, how do you choose one piece to represent an entire career?

When the Museum of Modern Art (MOMA) in New York, in conjunction with the Whitney Museum, decided to do a major retrospective of the work of the seminal architect of the 20th century, Ludwig Mies van der Rohe, this issue of how to represent the work was a big one. MOMA was the recipient of Mies' papers upon his death, and so has a fine collection of documentation, including drawings, letters, notes and plans. But architecture is, after all, the art of using space for living. What could be as dead as a collection of yellowing drawings of architectural details?

I recently visited the exhibit, and saw that MOMA had found a solution. Along with a theatrical-scale presentation of a video that capsulized his early life and work, and highly detailed modern models of several of his designs, they commissioned 3-D walk-throughs of four of Mies' houses. While not interactive, these presentations, when seen in the context of plans, drawings, and physical models, provide the extra insight that helps one understand key elements of Mies' thinking – that the interaction of a building with its envi-

ronment, and the interior space, and movement through it – are key aspects of architecture.

These walk-throughs were so important to my appreciation of Mies' early work that I contacted the company that created them to discuss the issues, challenges, and creative decisions involved.

PROUN (rhymes with *crown*) Space Studio (PSS) is the business of John Bennett and Gustavo Bonevardi. Both with MA's in Architecture, they founded the studio a few years ago to collaborate on architectural and computer modeling and animation projects. Their attractively funky and airy studio on New York's far west side is stuffed with computers and video equipment. That was where we talked about the Mies work for MOMA.

Bonevardi explained that they tried to show Mies' early work in a very site-specific format. Mies was very interested in how his buildings fit into their surroundings. This is evident in even the earliest work – homes in the Berlin suburb of Potsdam. But representing the buildings was difficult. The outsides are not exciting, and the architectural models show only the exterior. The MOMA exhibit may be the first time that architectural models and virtual walk-throughs have been shown together. The relatively large-scale architectural models, about a meter or more on a side, show the houses on their lots, giving a pretty good sense of the property and landscaping. PSS provided video programs that take the viewer in the front door and through the house. At various points in the walk-throughs, a contemporary photo of the interior is superimposed on the model, showing how the place looked when people lived there.

The walk-throughs are deceptively simple in appearance. For example, the Riehl House presentation starts with a photo of the house as seen from the front gate. That photo then dissolves into a CG image of the house, fence, gate and yard from the exact same angle. As the camera moves forward, the gate swings open, and the viewer is carried up

the walkway toward the front door. The garden and surrounding area are full-color photos, but the house is rendered in a monochrome, plastic-looking finish.

Combining old pictures of the interior and exterior with the 3-D models adds credibility, and gives the viewer a sense of the space filled with people and their belongings. But most importantly, the walk-throughs provide a far deeper understanding of the architectural design. Not only that, they're fun to watch several times, as they loop in a bit over a minute. Because PSS had 360° panoramic photos taken at each site, which they use as backgrounds for the models, one can look out of the windows of the virtual homes and see what their residents would have seen. It's more than informative, it's fun. As Bonevardi explained, "they're little documentaries – a story is told. It has to be entertaining."

There were other reasons for keeping the models simple. Time and budget constraints were a big factor, of course. But more importantly, not much is known about how the interiors looked, or would have looked. Of the 4 buildings shown, only Riehl house still stands – two others were never built and Wolf House was destroyed in the Second World War. So there was no way to use the actual houses as source material. What is known about materials and furnishings is found in Mies' letters, notes and sketches, which are, well, sketchy.

Mies was experimenting with space, the demarcations between interior and exterior, and the use of glass and other reflective surfaces, especially as his work matured in the late 1920's. The virtual models effectively show that. While "the walk-throughs' lack of color and texture is intended to emphasize space and sequence of spaces", as Bennett told me, PSS took great care with lighting, reflection mapping, and transparency. As the camera moves through the virtual spaces, one sees shifting reflections and refractions as one looks at and through windows at changing angles. The effect is beautiful and

quite believable, almost like walking through a house with all the furniture removed, and everything spray-painted semi-gloss white.

How they did it

PSS worked with five students from Parsons School of Design, who built the models in Discreet's 3D Studio Max. Lightscape was used for rendering the models, which PSS then assembled into the presentations. It took from February till June of this year to finish the four walkthroughs and some other models used in another presentation.

Mies had long history with MOMA. In fact, the unbuilt Resor House, intended for a lot near Jackson Hole, Wyoming, was designed for two trustees. Thanks to the Mies archive at MOMA, PSS was able to work with original drawings and letters. One unusual source of material was found: CAD files of the Riehl House – which had been remodeled in 1988. For Wolf House, now gone, they found some of Mies' original drawings from the 20's. Working from copies, they built models in AutoCAD.

MOMA chose the display systems for the walk-throughs: small floor-standing kiosks with a CPU inside and an LCD screen mounted at an angle on top. Oddly, though, the computers were not rendering the walk-throughs live, though they could have. Instead, they were playing DVDs burned with a video file. These systems were the only problem with the walk-throughs. Because the LCD screens have relatively narrow fields of view, gallery visitors had to crowd right in front of the kiosks to see the images well. A CRT display would have provided a wider field of view, and at a lower cost.

PSS produced another piece in the show that also made very good use of virtual models. In a ten-minute overview of Mies years in Berlin, they used full-featured models to show his famous Barcelona Pavilion at the 1929 Exposition, the Glass Room he designed and built for a German glass company's trade exposition exhibit, and several

other projects. I was impressed by how well they managed the reflections and textures. The Barcelona Pavilion, which was well-documented contemporaneously, was a good test of the model's accuracy in representing the textures of the stone, wood, glass and water Mies used as he explored space and light.

Talking about the challenges of the Barcelona Pavilion, Bennett told me, "Mies' use of shiny materials and emphasis on reflections and transparency made the project difficult." PSS used Lightscape to create transparency in sheer fabrics and glass, and to create realistic reflections. The lighting in the Barcelona Pavilion is so complicated, that it alone took one week to render on a pair of 1GHz PCs.

I asked how the kiosks had been chosen to display the walk-throughs, and if PSS had considered a more interactive presentation. Bennett answered. "We considered using headsets for the presentation, and tried it out with the Barcelona pavilion." But HMDs proved too expensive, not reliable enough, hard to get people in and out of, and raised hygiene issues. "In general, they were not good enough for this application", he added. PSS also considered a large-screen stereo display with shutter glasses, but it was too expensive for the project budget.

Why not an interactive system, I asked. Said Bennett, "we're not big fans of interactivity. We wanted to make a movie." The movie format, he said, gives them the ability to control the story being told, which is difficult with an interactive system. Also, with tens of

thousands of visitors expected over the duration of the show, there was no time for training guests to use the system. "I've seen it [interactive VR] in a museum. People are looking at the floor. They can't figure it out," Bennett said. The learning curve is too steep.

Simulation in Museums

I guess it's obvious that I really like the work PSS did on the Mies exhibit. By keeping their goals modest and their technology fairly simple, they were able to focus on the key points – Mies' use of space and light – and avoid being distracted by the minutia of fabrics, colors, textures and all the other minor details that add clutter (and expense), but not necessarily information or realism. As Bonevardi and Bennett emphasized, the key issue was to show how Mies challenged conventional thinking on the use of space and the interaction of indoor and outdoor areas.

This is an example of using 3-D technology in just the right way. The project was fast and on budget. It compliments the conventional media used in the rest of the display. It does not call attention to itself (Now!!! Experience Mies in Virtual Reality!! – Not!), but contributes substantially to one's understanding of the material. No wonder museums are starting to take to VizSim in a big way.

Museums are using VizSim far more than they have in previous years. In my company's annual report, the Market for Visual Simulation/Virtual Reality Systems, we have followed the uptake of VizSim in both architecture and muse-

Continued on page 14

'01 Rank	'00 Rank	Sector	Application	'01 % Using	'00 % Using	'99 % Using
1	1	R	VizSim/VR research	4.31%	4.76%	4.80%
2	2	M	Virtual prototype	3.97%	4.03%	6.32%
3	3	T	Postgraduate education (college)	3.62%	3.66%	4.68%
4	6	B	Museum/Exhibition	3.55%	3.29%	
5	4	M	Design evaluation	3.13%	3.60%	3.63%
6	N/A	R	Data visualization for research	2.99%		
7	5	B	Architecture	2.92%	3.54%	3.98%
8	11	B	Trade show exhibit	2.78%	2.93%	3.51%
9	21	M	Auto and truck	2.57%	2.07%	2.11%
10	8	C	Software development/testing	2.57%	3.11%	3.63%

Top 10 applications of VizSim/VR, Sector codes: R=Research, M=Manufacturing, T=Training & Education, B=Business Services, C=Computers & Communications. ©2001 CyberEdge Information Services, Inc.

Understanding Architecture

Continued from page 13

ums for the past three years. Here's what we found.

We see that the number of companies using VizSim technology in museum settings has increased by 8%, to 338 world wide, while moving up two places to become the fourth most cited application. Obviously, Museum curators are losing their fear of the technology as it shows itself robust, comprehensible, and

inexpensive enough to add to gallery shows. Just as important, they now can call on more than 300 companies in the world that can help museums prepare and deploy VizSim systems.

I expect to see many more examples of VizSim being used as an adjunct to conventional exhibitions for museums. There's money to be made here. Have you talked to your local curator lately?

Finally, a plug. *The Market for Visual Simulation/Virtual Reality Systems, Fourth Edition*, has just been completed.

It is the product of years of continuing research into the details of the VizSim marketplace, and provides detailed information on market size, composition, and location. International in scope, 150 pages long, and relied on by the leading companies in the business, the report is available now at the same price as last year's edition. Visit our web site, <http://www.cyberedge.com>, for more information, or contact me directly: ben@cyberedge.com. ▲

News Briefs

Atlantis to Develop DCIEM Helicopter Deck Landing Simulator

Atlantis Systems Corp. announced the signing of a technology licensing agreement between its Atlantis Systems International subsidiary in Brampton, Ontario, and the Canadian Department of National Defence. The agreement allows Atlantis to further develop and use helicopter deck landing simulator technology developed originally by the Defence and Civil Institute of Environmental Medicine (DCIEM), a unit of Defence R&D Canada in Toronto, Ontario.

Traditionally, pilots have been trained on helicopter deck landing maneuvers at sea. However, significant human, financial, and physical resources are required and as the margin for error is small, the Canadian military is strongly motivated to supplement training with an inexpensive, land-based alternative. There are obvious significant advantages in training pilots in a virtual environment where mistakes do not endanger lives or equipment.

The DCIEM technology uses simulated visual, auditory, and motion cues to replicate the experience of a deck landing at sea, a highly specialized skill requiring hours of practice. Virtual reality headgear and electronic motion

drives simulate the pitch and roll of a ship at sea and the heave, surge, and sway of a helicopter in flight.

Under the terms of the licensing agreement, Atlantis will develop and sell products based on the DCIEM technology for commercial use, with royalties on the sale of the products to be paid to the Department of National Defence.

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e-mail: info@AtlantisSI.com
<http://www.AtlantisSI.com>

E&S Signs Reseller Agreement with CATI

Evans & Sutherland Computer Corporation announced that the company has signed an agreement to become a value-added reseller (VAR) of Carmel Applied Technologies, Inc. (CATI) X-IG™ Run-Time Scene Generator software.

Under the terms of the VAR agreement, E&S will offer X-IG bundled with its simFUSION™ PC-based image generator. The bundled package provides visual simulation for a variety of applications, including helicopter training, fixed wing, ground based, and marine applications.

The X-IG run-time software is a cross-platform image generation system that provides high-quality rendered scenes, physics-based sensors, high-reso-

lution satellite inserts, flight symbology, and increased scene update rates. It utilizes OpenGL for integration with graphics hardware and OpenFlight® as the source for database modeling.

Contact:

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Evans & Sutherland Computer Corporation
Tel: 801-588-1453, Fax: -4538
e-mail: jmitchel@es.com
<http://www.es.com>

3rdTech's NanoManipulator Wins Award

3rdTech's NanoManipulator DP-100 Visualization and Control System has been selected by *R&D Magazine* as an *R&D 100 Award winner for 2001*. The magazine's winners are products chosen "on the basis of their importance, uniqueness, and usefulness."

The NanoManipulator DP-100 combines interactive 3-D computer graphics with the capabilities of a scanning probe microscope (SPM) to produce a research and development product for the growing nanotechnology market.

The NanoManipulator DP-100 consists of a SensAble Technologies PHANTOM™ Desktop force-feedback device, a PC with 3-D graphics, and NanoManipulator DP-100 software - and is integrated with an SPM from ThermoMicroscopes. Users of the system can interactively view "nanoscale"

News Briefs



Award winning NanoManipulator.

objects such as carbon nanotubes and individual viruses in 3-D, feel the surface of the structures, and interactively manipulate them. The ability to do real time exploration and manipulation of atomic-sized structures makes the system useful for research and development in a variety of areas, including nano-electro mechanical systems (NEMS), material science, physics, biochemistry, and genomics.

The NanoManipulator DP-100 is now shipping. List price is approximately \$85,000 and includes on-site installation and training. Full descriptions of the award-winning products will appear in the September 2001 issue of *R&D Magazine* (See www.rdmag.com for more information). Additional information about the NanoManipulator DP-100 Visualization and Control System is available from 3rdTech.

The NanoManipulator DP-100 is based on technology first developed by the Departments of Computer Science, Physics, and Astronomy of the University of North Carolina at Chapel Hill. This initial technology received funding from the NIH National Center for Research Resources through the Biomedical Technology Resource at UNC-Chapel Hill.

Contact:

Doug Schiff
3rdTech
Tel: 919-929-1903, Fax: -2098
e-mail: dbs@3rdtech.com
<http://www.3rdtech.com/NanoManipulator.htm>

Link Simulation & Training To Build Landing Craft Air Cushion Trainee Station

Link Simulation and Training division has been awarded a US\$13 million contract from Textron Marine & Land Systems (TM&LS) to build the trainee station for a Landing Craft Air Cushion (LCAC) Full Mission Trainer (FMT). The FMT, which will simulate a hovercraft vehicle that can carry up to 75 tons of military transport equipment and personnel, will be used to train Japanese Maritime Self Defense Force LCAC crews.

The trainee station, to be completed in mid-2003, will be designed to train LCAC craft master, engineer, group commander, and partial navigator crew positions. It will include simulated versions of consoles, instrumentation, and controls that are found on the actual hovercraft. In operating the hovercraft simulator, the crew will have to react to the trainer's craft systems malfunctions, in addition to changes in environmental and meteorological conditions.

During simulated training exercises, LCAC crews will be able to launch the hovercraft from, and return to, the well deck of its mother ship. In addition, the crew will conduct simulated missions over dynamic sea state conditions ranging from calm to rough seas and will practice operations over diverse terrain conditions.

TM&LS will act as the prime contractor and technical director for the trainee station, which will be manufactured by Link. The TM&LS contract was awarded by Yamada International Corporation based in Tokyo, Japan. Yamada was awarded the contract from Mitsubishi Precision Corporation of Japan, which will develop the visual and

motion systems and integrate the complete FMT.

The total system is being procured by the Japanese Defense Agency. The simulator will be used to train Japanese Maritime Self Defense Force LCAC crews to provide humanitarian assistance to citizens located in remote coastal areas in times of natural disaster, such as was needed during the Kobe earthquake of 1995.

Contact:

Rick Oyler
Link Simulation & Training
Tel: 817-619-3536, Fax: -3555
e-mail: raoyler@link.com
<http://www.L-3Com.com>

Fakespace Systems Wins Contract With US Army to Develop Visualization Technologies

Fakespace Systems announced that it has contracted with the U.S. Army Tank-Automotive & Armaments Command's (TACOM) National Automotive Center (NAC) to collaborate on the development of immersive displays and advanced devices for interacting with computer-generated visual simulations. The joint development project is part of the federal government's Dual Use Science & Technology (DUST) program, which is designed to share the benefits of technology between the defense and the private sector.

TACOM has done other work with Fakespace Systems, including current projects that use the CAVE® (CAVE Automatic Virtual Environment) and WorkWall™ display systems to improve design and shorten delivery cycles for military and civilian vehicles and weapon systems. Used as part of the group's Advanced Collaborative Environments (ACE) program, immersive visualization helps TACOM increase vehicle performance, safety, and

Continued on page 16

News Briefs

News Briefs

Continued from page 15

durability, and reduces the costs of design, manufacturing, operation, and maintenance.

Parametric Technology Corporation (PTC), developer of software engineering tools for product development, is the primary contractor on the DUST program. As a subcontractor, Fakespace Systems will collaborate with PTC and other members of the DUST team, which include General Dynamics Land Systems, Lockheed Martin Advanced Technology Labs, and IITRI/AB Technologies.

Contact:

Jeff Brum
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519-749-3144, Fax: -3151
e-mail: jbrum@fakespacesystems.com
<http://www.fakespacesystems.com>

JAL Orders E&S Visual Systems for New Simulators

Evans & Sutherland Computer Corporation announced that the company has received a multimillion-dollar order to supply visual systems for Japan Airlines' (JAL) new B767 and B777 simulators.

The order includes two three-channel ESIG®-3800GT image generator/ESCP™-2000 systems using E&S's 200-degree field-of-view projection system technology. The E&S systems, which will be installed on flight simulators manufactured by CAE Electronics, are scheduled to go into service during the first half of 2003.

This order represents Evans & Sutherland's first sale of ESIG-3800GT and ESCP-2000 to a Japanese customer and will be the fourth and fifth systems to be supplied configured with a three-channel, 200-degree field-of-view display system.

Contact:

Joan Mitchell
Evans & Sutherland Computer Corporation
Tel: 801-588-1453, Fax: -4538
e-mail: jmitchel@es.com
<http://www.es.com>

Lockheed Martin Delivers Truck Driver Simulation System to Singapore Military

Lockheed Martin Information Systems delivered a truck driver training simulator system to the Singapore Ministry of Defense. The 16-vehicle, high-fidelity Driver Training Simulation System (DTSS) uses a computer-generated virtual environment with full-motion effects to evaluate driver performance in a computer-generated visual environment that interacts with an actual truck cabin. The system gives trainees a basic introduction to truck driving with several types of vehicle configurations simulated. Trainees also learn necessary driving techniques for correcting malfunctions and for responding to emergency situations that cannot be safely practiced in the real vehicle.

The DTSS consists of four clusters networked together for convoy operation. Each cluster includes four driver stations, a brief-debrief facility and an instructor-operator station. Networking allows up to 16 simulators to participate in convoy operations training.

Trainees learn fundamental driving techniques and use automated intelligent traffic models that allow for realistic driver-traffic interaction. The system automatically assesses and tracks trainee performance. The DTSS also enables its users to develop defensive, highway, cross-country, adverse-condition, convoy, tactical, and advanced driving skills. Those skills include accident-prevention techniques, effective maneuvering on varied road surfaces, driving at night and in rain, snow, and ice. Performance is assessed and tracked automatically, which permits the training to be tailored

to meet individual needs. Students receive feedback through recorded playbacks of their performances in a brief-debrief facility.

"The training curriculum also includes a library database that can store up to 500 training exercises," said Rick Brownfield, DTSS Program Manager. "The scenarios are unique in that they present the trainee with a realistic traffic environment in geo-specific databases of various areas of Singapore, and in all weather and daylight conditions."

Contact:

Stuart Doyle
Lockheed Martin Information Systems
Tel: 407-306-7303, Fax: -1147
e-mail: stuart.w.doyle@lmco.com
<http://lmis.ort.lmco.com/pa/index.html>

Digital Element Introduces World Builder v3.0

Digital Element announced that it is making the Standard version of its landscape creation and animation software, World Builder 3.0, available for \$399, a 60% discount from the Professional edition. New features include a recently introduced plugin and support for characters created using Curious Labs' Poser™, a character animation package for hobbyists.

World Builder is used by film and television animators, video game designers, Web developers, architects, and landscape designers to create realistic, animated 3-D landscapes and scenery.

The newly introduced Standard version is nearly identical to the Professional edition, except that the Professional version contains a plugin for Discreet 3DS Max, and supports network rendering.

However, both the previously released Professional version and the new Standard version of World Builder 3.0 include several new features:

- Intuitive user interface
- OpenGL support
- "The Variator" automatic variation wizard for sky, plants, and scripts

News Briefs

- Undo-redo feature
- Revised Area Editor
- Poser support
- Improved rendering
- Support for translucency and antialiasing
- Improved shadowing and “point light shadows”
- New shades and filters
- Plant and Grass Editor
- New file format support and unit conversion support

Contact:

Don McClure
Digital Element, Inc.
Tel: 415-407-5577, Fax: 510-451-8010
e-mail: don@digi-element.com
http://www.digi-element.com

Fakespace Systems Reports Immersive Display System Wins

Fakespace Systems, Inc. announced four contracts to provide immersive displays to organizations involved in energy resource exploration. Fakespace Systems is providing visualization systems to Phillips Petroleum, Petrobras, Norwegian University of Science and Technology, and the University of Oklahoma. These include a range of displays that are used by geologists, geophysicists, and engineers to promote collaboration and understanding of complex data, ranging from fully-immersive room environments to depth-enhanced displays that fit in an average size conference room.

Since January 2001, Phillips Petroleum has taken delivery of five conCAVE™ displays for use at its facilities in Bellaire, Texas; Stavanger and Tananger, Norway; and Anchorage, Alaska. The conCAVE, which enables multidisciplinary teams to work with spatially correct, “standing in the tunnel” visualizations, was originally developed by Phillips and is licensed to Fakespace Systems. The company was also contracted by Phillips to develop a

volumetric mapping and interaction software API specifically for the conCAVE environment. The API, called Avignon, has been made available to selected oil/gas software developers for integration into their applications later this year.

The University of Oklahoma, which has strong research and educational programs in the earth sciences, has also purchased a conCAVE display and CubicMouse™ interaction device for its School of Geology and Geophysics. The conCAVE will be used for 3-D seismic interpretation, 3-D geologic and petrophysical modeling, and other applications in the earth sciences.

Petrobras, headquartered in Rio de Janeiro, Brazil, took delivery of an ImmersaDesk® R2 stereoscopic display driven by a Silicon Graphics® Onyx2® for use in the development of exploration technology that reduces risk and optimizes exploitation. This transportable system offers a four-foot by five-foot rear-projected screen that can be adjusted from horizontal to nearly vertical.

Norwegian University of Science and Technology (NTNU) is a center for technological education and research located in Trondheim, Norway. One area of focus for research at the university is data visualization and numerical analysis for the localization and recovery of petroleum resources. The university has a digital laboratory with geodata and production data from the Gullfaks field in the North Sea, which is used for both teaching and research. Projects often include commercial partners such as Norsk Hydro, Statoil, Shell, TotalFinaElf, BP, and Enterprise.

To better utilize the software and data stored at the digital laboratory the university contracted with Fakespace Systems to design and install a RAVE™ (Reconfigurable Advanced Visualization Environment). The RAVE is a modular system that supports multiple viewing modes including immersive room environments, flat wall displays, angled the-

aters, and other configurations. In early June, Fakespace Systems completed the installation of three RAVE modules at NTNU, each with an eight-foot by eight-foot rear-projected viewing surface.

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e-mail: jbrum@fakespacesystems.com
http://www.fakespacesystems.com

BVR Systems to Upgrade AMOS Simulator for Israeli Air Force

BVR Systems (1998) Ltd. announced that it has been awarded a contract valued at approximately NIS 2.5 million (approximately US\$600,000) to upgrade the AMOS flight simulator for the Israeli Air Force (IAF).

BVRS' AMOS system has been in use as a pilot selection system in the IAF Flight Academy since 1992 and will be upgraded. The system includes a “Tzokit” aircraft flight simulator, flight simulation analysis together with a PC-based statistical package. The software and hardware upgrade will include an upgrade of the existing cockpit, two new cockpits, an instructor operator station, mission debriefing, and “what if” capabilities.

Contact:

BVR Systems (1998) Ltd.
Rosh-Ha'ayin, Israel
Tel: +972-3-900-8000, Fax: -8030
e-mail: marketing@bvr.co.il
http://www.bvrsystems.com

People & Organizations

□ SEOS Displays has announced the appointment of **Graham Fairbairn** to the company's newly created position of Financial Director. Graham joined SEOS five years ago as Financial Controller and was later made Company Secretary.

Industry Briefs

Aerospace

□ **Evans & Sutherland Computer Corporation** (Salt Lake City, UT) announced that **Delta Air Lines** has placed an order with E&S to supply the visual systems for three full flight simulators.

The order calls for Evans & Sutherland to deliver ESIG®-3350GT image generators and twelve raster/caligraphic monitor replacement projectors. The visual systems will be used to replace the existing image generators and monitor displays on Delta's B757 No.1, B757 No.2, and B767 No.1 full flight simulators. Delivery of the first system will begin in October 2001.

Separately, E&S announced that it has signed a contract for Encore service and support with **Senasa**, the **Spanish Society for Civil Aeronautical Training**.

Under the terms of the agreement, E&S will provide Encore support for the ESIG®-3350/ESCP™-2000 visual system on the A340 simulator, jointly owned and operated by the Senasa/Indra consortium, at the Senasa training facility in Madrid, Spain. The initial contract duration is three years. [Tel: 801-588-1453, Fax: -4538, e-mail: jmitchel@es.com, <http://www.es.com>]

Industry

□ **Ascension Technology Corporation** (Burlington, VT) announced that it has recently received ISO 9001 registration. Ascension selected **Intertek Testing Services**, a testing, inspection, and certification company, to provide audit and compliance reviews. Intertek was able to ensure that Ascension's products conform to national and international requirements. Ascension is working with medical OEMs in countries around the world. The ISO 9001 registration is helpful to the

OEMs in establishing and understanding standards. [Tel: 802-893-6657, Fax: -6659, e-mail: ascension@ascension-tech.com, <http://www.ascension-tech.com>]

□ **NVIDIA® Corporation** (Santa Clara, CA) announced that it has earned the highest ranking for semiconductor companies for the second straight year in **BusinessWeek's** "Information Technology Annual Report - The Info Tech 100" cover story dated June 18, 2001. NVIDIA also earned the fourth spot overall in the annual wrap-up of the world's top technology companies. [Tel: 408-486-2512, Fax: -615-2800, e-mail: dperez@nvidia.com, <http://www.nvidia.com>]

PC Graphics

□ **Evans & Sutherland Computer Corporation's** (Salt Lake City, UT) Ensemble™ PC-based image visual system has been accepted for the **Bradley Advanced Training System (BATS)**.

The Ensemble systems were ordered for the **U.S. Army Tank-Automotive and Armaments Command** in Warren, Michigan, through a subcontract with **United Defense LP** of Santa Clara, California. E&S is under contract for thirteen Ensemble systems to support BATS maneuver and gunnery training systems.

The BATS Ensemble systems run databases that were developed for the E&S ESIG® image generators currently in operation on the **U.S. Army's Close Combat Tactical Trainer (CCTT) Program** and emulates the ESIG host computer interface.

Separately, Evans & Sutherland reported unaudited financial results for the second quarter ended June 29, 2001.

Total sales for the quarter were \$48.1 million compared to \$25.6 million for the second quarter of 2000. Net loss for the quarter was \$5.1 million, or (\$.50) per share, compared to a net loss of \$52.3 million, or (\$5.58) per share, in the prior year.

For the six months ended June 29, 2001, sales totaled \$87.7 million compared to \$71.5 million for the same six

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months of 2000. Net loss for the six-month period was \$11.3 million, or (\$1.13) per share, compared to \$55.5 million, or (\$5.93) per share for the first six months of 2000. [Tel: 801-588-1508, e-mail: bthomas@es.com, <http://www.es.com>]

Quantum3D, Inc. (San Jose, CA) and MultiGen Paradigm, Inc. have announced that optimized support for Aalchemy™ PC-IGs equipped with the Quantum3D nVSENSOR™ hardware sensor post processor will be incorporated in the upcoming Q3 01 release of Vega™ 3.7.1, including SensorVision™ and SensorWorks™ modules. Aalchemy with nVSENSOR™, when combined with the new release of Vega, SensorVision, and SensorWorks, will provide visual simulation and training (VST) customers with an opti-

mized version of the scene management software that is available with integrated support for high-fidelity, physics-based, hardware-accelerated, sensor simulation.

In other news, Quantum3D™, Inc. and SYNnex™ Information Technologies, Inc. recently announced the shipment of the 1,000th Aalchemy™ PC-based image generator (PC-IG) from the SYNnex' facility in Fremont, CA.

The 1,000th Aalchemy unit is part of over one thousand systems being integrated and delivered for a military program on which Lockheed Martin serves as prime contractor. Lockheed Martin represents the single largest Aalchemy customer, and will have taken delivery of over one thousand Aalchemy channels by the end of July,

2001. [Tel: 408-361-9933, Fax: -9982, e-mail: otis@quantum3d.com, <http://www.quantum3d.com>]

Virtual Reality

As reported in the *Kyodo News*, The National Cancer Center Hospital in Tokyo is introducing a virtual reality exposure therapy to ease the pain and nausea of cancer patients, hospital officials said.

Together with Mitsubishi Electric Corp., the hospital in Tokyo's Tsukiji district has developed a special device allowing patients to experience a virtual reality environment while in bed, with tests on a group of patients yielding promising results, the officials said.

The therapy makes patients feel as if they are going for a walk in the woods by watching an image of forests projected onto a screen in front of them.

Calendar of Events

HCI International 2001 in New Orleans, LA, August 5-10

9th International Conference on Human-Computer Interaction will be held at the Fairmont Hotel.

Contact: Gavriel Salvendy, General Chair, Tel: 765-494-5426, e-mail: salvendy@ecn.purdue.edu, <http://hci2001.engr.wisc.edu/>

SIGGRAPH 2001 in Los Angeles, CA, August 12-17

28th annual SIGGRAPH Conference will be held at the Los Angeles Convention Center.

Contact: SIGGRAPH 2001 Conference Management, Smith, Bucklin & Associates, Tel: 312-321-6830, Fax: -6876, e-mail: siggraph2001@siggraph.org, <http://helios.siggraph.org/s2001/index.html>

DS-RT 2001 in Cincinnati, OH, August 13-15

Distributed Simulation and Real Time Applications will be co-located with MASCOTS 2001 at the Kingsgate Marriott Conference Center.

Contact: J. Mark Pullen, George Mason University, Tel: 703-993-1538, Fax: -3692, e-mail: mpullen@gmu.edu, <http://gab517a.csci.unt.edu/~boukerch/DS-RT2001/>

CGIM 2001 in Honolulu, Hawaii, August 13-16

4th IASTED Conference on Computer Graphics and Imaging will be held at the Sheraton Waikiki Beach Resort on the island of Oahu.

Contact: IASTED Secretariat - CGIM 2001, Calgary, Alberta, Canada, Tel: 403-288-1195, Fax: -247-6851, e-mail: calgary@iasted.com, <http://www.iasted.com>

EUROGRAPHICS 2001 in Manchester, U.K., September 4-7

Eurographics 2001 concentrates on visualization, virtual environments, and computer games. It will be held at the Manchester Conference Centre.

Contact: EG2001 Conference Secretariat, Tel: +44-161-200-4068, Fax: -4070, e-mail: eg2001-info@eg.org, <http://www.eg.org/eg2001>

MESM 2001 in Amman, Jordan, September 5-7

The third Middle East Symposium on Simulation and Modeling, sponsored by the European Council of the Society for Computer Simulation International, will be held at Amman University, the first private university to be established in Jordan.

Contact: Philippe Geril, SCS International European Simulation Office, University of Ghent, Belgium, Tel: +32-9-233-77-90, Fax: -223-49-41, e-mail: Philippe.Geril@rug.ac.be, <http://hobbes.rug.ac.be/~scs/conf/mesm2001/index.html>

DSC2001 in Sophia-Antipolis, France, September 5-7

Driving Simulation International Conference 2001 is organized by Renault and the French National Institute for Transport and Safety Research.

Contact: Ms. Agnes Zimniak, Tel: +33-(0)1-34-95-17-86, Fax: -27-30, e-mail: dsc2001@inrets.fr, <http://dsc2001.inrets.fr>

Simulation Interoperability Workshop in Orlando, FL, September 9-14

2001 Fall Simulation Interoperability Workshop will be held at the Holiday Inn International Drive Resort.

Contact: Allison Griffin, SISO Support, Tel: 407-882-1344, Fax: -658-5059, e-mail: agriffin@ist.ucf.edu, <http://siso.sc.ist.ucf.edu/siw/01fall/index.htm>

ISWC 2001 in Zurich, Switzerland, October 8-9

5th International Symposium on Wearable Computers will be held at the Swiss Federal Institute of Technology Zurich.

The conference will include presentations, exhibitions, demos, poster sessions, and fashion shows.

Contact: Prof. G. Tröster, ETH Zurich, Tel: +41-1-632-39-64, Fax: -12-10, e-mail: troester@ife.ee.ethz.ch, <http://www.iswc.ethz.ch>

Pacific Graphics 2001 in Tokyo, Japan, October 16-18

The Ninth Pacific Conference on Computer Graphics and Applications will be held at Surugadai Memorial Hall, Chuo University.

Contact: PG2001 Conference Secretariat, c/o Prof. Hiromasa SUZUKI, The University of Tokyo, Tel: +81(0)-3-5841-6490, Fax: -8552, e-mail: pg2001@cim.pe.u-tokyo.ac.jp, <http://cim.pe.u-tokyo.ac.jp/pg2001/main.html>

Continued on page 20

August through November 2001

August 2001						
SUN	MON	TUES	WED	THURS	FRI	SAT
			1	2	3	4
5	6	7	8	9	10	11
HCI International 2001 in New Orleans, LA						
12	13	14	15	16	17	18
SIGGRAPH 2001 - Los Angeles, CA DS-RT 2001 - Cincinnati, OH CGIM 2001 - Honolulu, HI						
19	20	21	22	23	24	25
26	27	28	29	30	31	

September 2001						
SUN	MON	TUES	WED	THURS	FRI	SAT
						1
2	3	4	5	6	7	8
Eurographics 2001 - Manchester, U.K. MESM 2001 in Amman, Jordan DSC2001 - Sophia-Antipolis, France						
9	10	11	12	13	14	15
Simulation Interoperability Workshop - Orlando, FL						
16	17	18	19	20	21	22
23/30	24	25	26	27	28	29

October 2001						
SUN	MON	TUES	WED	THURS	FRI	SAT
	1	2	3	4	5	6
7	8	9	10	11	12	13
ISWC 2001 - Zurich, Switzerland						
14	15	16	17	18	19	20
Pacific Graphics - Tokyo, Japan						
21	22	23	24	25	26	27
Visualization 2001 - San Diego, CA VSMM2001 - Berkeley, CA						
28	29	30	31			

November 2001						
SUN	MON	TUES	WED	THURS	FRI	SAT
				1	2	3
4	5	6	7	8	9	10
AFRIGRAPH 2001 - Cape Town, S.A.						
11	12	13	14	15	16	17
VRST 2001 - Alberta, Canada						
18	19	20	21	22	23	24
25	26	27	28	29	30	

Continued from page 19

Visualization 2001 in San Diego, CA, October 21-26

IEEE's 12th Visualization conference will be held at the San Diego Paradise Point Resort.

Contact: Mike Bailey, San Diego Supercomputer Center, Tel: 858-534-5142, Fax: -5152, e-mail: mjb@sdsc.edu, <http://vis.computer.org>

VSMM2001 in Berkeley, CA, October 25-27

7th International Conference on Virtual Systems and MultiMedia will be hosted by the Center for Design Visualization at UC Berkeley.

Contact: Center for Design Visualization, University of California Berkeley, Fax: 510-642-3466, e-mail: vsmm-sec@vsmm.org, <http://www.vsmm.org/vsmm2001/contact.cfm>

AFRIGRAPH 2001 Conference in Cape Town, South Africa, November 5-7

The African Graphics Association is promoting computer graphics, Virtual Reality, and interactive techniques, research, and applications in Africa. AFRIGRAPH is an ACM SIGGRAPH affiliated association.

The first International Conference on Computer Graphics, Virtual Reality, and Visualization in Africa will be held at the Bay Hotel Conference facilities in Camps Bay, Cape Town.

Contact: Vali Lalioti, University of Pretoria, Tel: +27-12-420-2547, Fax: -12-362-5188, e-mail: vlalioti@cs.up.ac.za, <http://www.saga.za.org>

VRST 2001 in Banff Centre, Alberta, November 15-17

ACM Virtual Reality Software and Technology has been held in various locations around the world. This is the first VRST held in North America.

VRST 2001 will be held in Banff Centre - in the middle of the Canadian Rockies. Banff Centre provides graduate and professional level education.

Contact: Prof. Mark Green, Department of Computing Science, University of Alberta, Tel: 403-492-4584, Fax: 1071, e-mail: mark@cs.ualberta.ca