

# ***Stereoscopic Displays and Applications XXII***

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*Editors*

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## Introduction

For a twenty-second year, SD&A was the premier venue for the dissemination of research into stereoscopic displays and their applications. SD&A attracts key players in the field – stereoscopic experts from industry and academia were on our two panels, presenting the two keynote presentations, speakers of the technical presentations, and in the audience. The conference had an excellent technical program covering a wide range of stereoscopic topics. This year we were able to accept a little under half of the submitted papers for oral presentation, with an additional 37 papers accepted as posters.

This proceedings volume contains the technical papers in support of the presentations and posters given at the conference. This introduction gives an overview of the conference - a reminder for those who attended and an insight into what happened for those who were unable to attend.

The SD&A conference was held 24–27 January 2011 as part of the 2011 IS&T/SPIE Electronic Imaging: Science and Technology Symposium, at the Hyatt Regency San Francisco Airport Hotel, next to San Francisco Airport, in Burlingame, California, USA. This year's conference grew dramatically: There were 50% more attendees than last year, making it the best attended since the series began. Several of this year's sessions had over 200 people in the room, listening to presentations on a wide range of stereoscopic topics.

The **first day** had technical sessions on visual comfort and quality, combining depth cues, view synthesis, and multiview systems. There was our first keynote, the two-hour 3D theatre, and our conference banquet.

The **first Keynote Presentation** was given by Dr. Michael Robinson, Chief Scientist at RealD. He gave an excellent summary of the current state of stereoscopic 3D, in both cinema and television.

The two-hour **3D Theatre Session** (chaired by Andrew Woods and Chris Ward) is a regular event that showcases 3D content from around the world. This was the most popular session of the conference, with over 300 attendees. This year, we screened the following pieces (or segments thereof) on the 5.6 meter (18 foot) diagonal stereoscopic projection screen:

### Competition Category

- "Stereoikkuna" by Riku Naskali (Finland)
- "Hong Kong - Potential Unlimited" by Digital Magic (Hong Kong)
- "Ztring Theory" by Karl Bryhn and Jo Eldøen, Chiptoons (Norway)
- "Go Kia" by Dsignlight (United States)
- "The Girl Who Had No Fear" by John Hart (United States)

- “Gloria (The Death of Me)” by Andrew Murchie, Enhanced Dimensions (United Kingdom)
- “My Best Stuff!” by Nat Bartholomew, Spinteck (United States)
- “Plasticity 3D” by Ryan Suits, Atomic Cheesecake Productions (United States)
- “Mercedes-Benz 3D 2010” by Lightspeed Design, Inc. (United States)
- “The Army Learning Concept 2015” by Digital Revolution Studios (United States)
- “Smart Action 3D” by Korean Broadcast Service (South Korea)
- “Stereo Timelapse” by Takashi Sekitani, STEREOeYe (Japan)
- “White Knuckles” by OK Go (United States)
- “Experiments in Stereoscopic Imaging” by Volker Kuchelmeister, UNSW iCinema Centre (Australia)
- “The Solo Adventures 3D” by The Digital Animation and Visual Effects School (United States)
- “Jack Daniels whisky company” by GALI-3D, Arnold Prague (Czech Republic)
- “Highly Strung” by Buzzbomb Media (Australia)
- “Holy Moly” by Passmore Lab (United States)
- “Microworlds” by Passmore Lab (United States)
- “3D Safari: Africa” by Digital Revolution Studios (United States)
- “Coming Home” by Rehela Jagric (Slovenia)
- “Citrullus Lanatus” by Argyris Theos (Greece)
- “3D MOOD Aquarium” by Lightspeed Design, Inc. (United States)
- “Spinteck 3D Shorts” by Nat Bartholomew, Spinteck (United States)
- “Dead Boring 3D” by Dave Edwardz, AFTRS (Australia)
- “Waiting for the End, Linkin Park” by Passmore Lab (United States)
- “Fractal Odyssey” by John Hart and Jerry Oldaker (United States)

### **Demonstration Category**

(N.B.: items in the Demonstration Category were not judged for the Best of Show or Honorable Mention awards.)

- “Go Ahead!” by U-Staff (Japan)
- “Invincible Tiger - The Legend of Han Tao” by Blitz Games Studios (United Kingdom)
- “21st Century 3D Demo Reel” by 21st Century 3D (United States)
- “Keitai Deka - Zenigata Yui” by BS-TBS Inc. (Japan)
- “2009 Stereo Clips” by Enxebre (Spain)
- “Une Nuit Au Cirque 3D” by Olivier Kauffer and Fabien Remblier (France)
- “Gnomeo and Juliet (trailer)” by Walt Disney Studios (United States)
- “Hidden 3D (Opening Title Sequence)” by Dsignlight Studios (United States)
- “Immersive PC Games with NVIDIA 3D Vision” by various games companies
- “Maker Faire” by Stone Circle Productions (United States)
- “3D AFL Grand Final (Australian Rules Football)” by Seven Network (Australia) and 3Ality Digital (United States)
- “StreetDance 3D (trailer)” by Paradise FX (United States)
- “Tekkonkinkreet - 3D digest” by Tekkonkinkreet Program Committee (Japan)
- “Garo Red Requiem 3D” by Keita Amemiya (Japan).

In recognition of the high quality of material shown at the 3D Theatre, we offered three “Best of Show” prizes for pieces entered into the Competition Category. The judges were Dr. Samuel Zhou, Director of Image Technology at IMAX Corporation, Canada, and Bernard Mendiburu, author of *3D Movie Making: Stereoscopic Digital Cinema from Script to Screen*. The winners and honorable mentions in the three categories were:

Best of Show – Live Action:

“White Knuckles 3D” by OK Go (United States)

Honorable Mention – Live Action:

“Stereo Timelapse” by Takashi Sekitani, StereoEyE (Japan)

Best of Show – Computer Graphics:

“Fractal Odyssey” by John Hart and Jerry Oldaker (United States)

Honorable Mention – Computer Graphics:

“Holy Moly” by Passmore Labs (United States)

Best of Show – Visual Effects:

“Dead Boring” by Dave Edwardz, AFTRS (Australia)

Honorable Mention – Visual Effects:

“Experiments in Stereoscopic Imaging” by Volker Kuchelmeister, UNSW iCinema Centre (Australia)

An illustrated listing of the content shown during this year’s 3D Theatre session is available from the conference website:

[www.stereoscopic.org/3dcinema](http://www.stereoscopic.org/3dcinema)

Many thanks to Dan Lawrence at Lightspeed Design who handled the data wrangling for the 3D Theatre session, and Stephan Keith who helped with the content specifications handling.

The evening concluded with our traditional conference dinner at a new venue: El Torito on the bay front near the conference hotel. Approximately 60 conference attendees mingled, talked, and ate in a relaxed atmosphere. We will do it again next year!

The **second day** of the SD&A conference had technical sessions on applications and developments, a joint session with the HVEI conference (Human Vision and Electronic Imaging, Proc. SPIE Vol. 7865) on quality evaluation, the demonstration session, and the poster session. The full papers from both the technical sessions and the poster session are all contained in this volume – except for two of the

papers from the joint session which will appear in Proceedings of SPIE Volume 7865:

- "Examination of 3D visual attention in stereoscopic video content," Huynh-Thu Quan, Luca Schiatti, Technicolor (France) (7865-20), and
- "Quantifying how the combination of blur and disparity affects the perceived depth," Junle Wang, Marcus Barkowsky, Vincent Ricordel, Patrick Le Callet, Univ. de Nantes (France) (7865-21).

The **first discussion forum** considered 3DTV dangers: truth or fiction. Lenny Lipton chaired a panel of experts: Marty Banks (UC Berkeley), Eli Peli (Harvard University), Christopher Riemann (Cincinnati Eye Institute), and Pete Ludé (Sony Electronics). They were skeptical of the extreme warnings that have recently been released by consumer electronics companies. Lenny, in particular, pointed out that, in 20 years of selling active glasses, he had never had a single complaint about eye strain. However, the panel also pointed out that the human visual system never stops adjusting to its environment and that there are many things we do not know. There was a plea for display engineers and human vision scientists to partner in conducting research.

The final event of the day was the ever-popular **Demonstration Session**, which has run every year since 1990. Since 2006, this has been a symposium-wide event, open to demonstrators from all of the Electronic Imaging conferences. It was pleasing to see a wide range of demonstrations and to see a large audience actively engaging with the various displays and vendors. The energy in the demonstration session was astounding and many demonstrators were still going strong after two and a half hours.

This year the following 3D hardware and 3D software products were on show at the demonstration session:

- **JVC** (Rod Sterling) demonstrated a pre-release version of the new GS-TD1 Full-HD stereoscopic camcorder which is scheduled for release in March.
- **NVIDIA** (Dave Cook and Michael McSorley) showed a 3D Vision Surround system consisting of the 3D Vision product running across three screens (Alienware AW2310 120HZ 3D LCD monitors) viewed with 3D Vision active shutter glasses and running the game Mafia 2. Graphics cards used were two GeForce GTX580s.
- **DDD** (Julien Flack and his team) demonstrated their TriDef 3D game and 3D video software driving a large screen 3D TV and two 3D notebook computers all viewed with active shutter glasses - specifically:
  - an HP Envy 17" 3D notebook running EA's Need for Speed Hot Pursuit in 3D,
  - an Acer 5738DG 3D notebook demonstrating TriDef 3D's real-time 2D to 3D conversion process for HD video, and
  - a Samsung 3D TV driven by a standard shuttle PC with an AMD Radeon 6000 GPU connecting via HDMI 1.4 and using TriDef 3D's game drivers to run EA's Medal of Honor in 3D.



- **Ainsworth & Partners** (Richard Ainsworth assisted by Dan Sandin) showed their stereoscopic panoramic photography system: two cameras on a motorized mount, with associated software.
- **HumanEyes** (Assaf Zomet and Shmuel Peleg) demonstrated their multi-view cross-talk reduction mechanism on both an autostereoscopic monitor and on lenticular 3D prints.
- **Centre for Vision Research, York University, Toronto** (Inna Tsirlin & Laurie Wilcox) showed the experimental stimuli for their work on evaluating the effect of cross-talk (as presented in SPIE paper 7863-37).
- Ronald S. Karpf demonstrated a prototype of their continuously adjustable Pulfrich spectacles.
- **Accurex Measurement** showed their StereoScan 3D scanning hardware and software.
- **Volfofi** demonstrated their ActiveEyes glasses that can work with (almost) any active or passive circularly polarized display.
- The **University of Tsukuba** (Hideki Kakeya and his team) had two demonstrations: both variations on integral imaging, using beam splitters and multiple displays to produce three-dimensional multi-view images.
- The **Tokyo University of Agriculture and Technology** (Yasuhiro Takaki and Junya Nakamura) showed a super multi-view display with viewing zones only 2.6mm wide. Each eye had eight abutting viewing zones, so head movement was restricted. Zones this narrow allowed some people to converge and accommodate at the same depth, other than the screen depth.
- **Lightspeed Design** (Chris Ward) demonstrated their DepthQ polarization modulator in operation with their latest DepthQ HD projector.
- **3M Company** (Michael Sykora, Vincent King and Glenn Casner) showed their new two-view autostereoscopic display, which is used in a recently released commercial device.
- **ELDIM** (Pierre Boher) provided literature on their system for performance characterization of autostereoscopic displays.

A prize was awarded for the best demonstration at the session. The judging panel was chaired by Prof. Neil Dodgson. The prize was awarded to HumanEyes, with honorable mentions to York University and the Tokyo University of Agriculture and Technology.

An extensive photo montage and listing of the demonstration session and exhibits from this year's SD&A conference will be available on the conference website:

[www.stereoscopic.org](http://www.stereoscopic.org)

The **third day** of the SD&A conference had technical sessions on autostereoscopic displays, crosstalk, 3D perception and interaction. There was the second keynote and the symposium reception with a 3D gaming demonstration.

The **second Keynote Presentation** was given by Prof. Ramesh Raskar (MIT Media Lab). He inspired the audience with his talk of 4D, 5D, 6D and 8D displays. He gave a broad sweep across a range of ideas coming out of his laboratory, leaving the audience with many new ideas. Further information is available from [raskar.info](http://raskar.info).

The Electronic Imaging Symposium Reception on Wednesday evening was a great way to chat and relax with colleagues. As an added attraction, two 3D gaming demonstration systems were setup during the reception to add a bit of fun to the evening. Each system consisted of a new JVC RS40 LCoS Full-HD 3D projector, each driven by a Playstation 3 console running in 3D mode, projecting onto a large projection screen and viewed using active shutter glasses. The PS3 3D games being shown were "Tron: Evolution" on the first system and "Avatar: The Game" on the second system. Many thanks to Rod Sterling and Steve Inoue from JVC and Stephan Keith for supporting this event with equipment and helping with setup. Many attendees enjoyed playing these systems in 3D.

For the first time, SD&A went into a **fourth day**. There were technical sessions on 3D content, stereoscopic production and playback, and the second of our discussion forums.

The second **discussion forum** considered screen size factors. The panel comprised Bernard Mendiburu (Chair), David Broberg (CableLabs), John Merritt (The Merritt Group), Jukka Häkkinen (Aalto University) and Frédéric Devernay (INRIA).

All sessions at this year's SD&A conference were video recorded thanks to River Valley Technologies. Editing is underway and the content will be available online very soon.

A final **prize** was offered at the conference for the best use of the stereoscopic projection tools during the technical presentations. The winner, chosen by the SD&A conference chairs, was:

- Christopher Riemann (Cincinnati Eye Institute & MedNet Technologies), "Machine vision and vitrectomy: three-dimensional high definition video for surgical visualization in vitreoretinal surgery."

The prizes this year were copies of *Stereoscopic Displays and Applications 1990-2009: A Complete 20-Year Retrospective* and *The Engineering Reality of Virtual Reality 1994-2009* (Selected SPIE/IS&T papers on DVD-ROM), published by SPIE in 2010, and copies of Bernard Mendiburu's book *3D Movie Making: Stereoscopic Digital Cinema from Script to Screen*, published in 2009 by Elsevier. Congratulations to all our prize-winners in the cinema, demonstration, and presentation awards.

Many individuals and companies contributed in various ways to the success of this year's SD&A conference:

- The major sponsors of this year's conference were **IMAX Corporation** (Mississauga, Ontario, Canada) and **DepthQ Stereoscopic** (Bellevue, Washington). Conference sponsorship is a valuable way for companies to support the running of the conference and to gain marketing exposure. IMAX and DepthQ are both key players in the stereoscopic industry, and we thank them for their support.
- We also appreciate the support of this year's stereoscopic projection sponsors: **Christie Digital** (Cypress, California), **Visitech 3D** (Los Angeles, California) and **STRONG / MDI Screen Systems** (Joliette, Quebec, Canada).

The ability to present high-quality large-screen stereoscopic images and video at the conference is vital to the conference's success. This year we had a Christie Digital Mirage WU7K-M projector (1920×1200 resolution, 16:9 aspect ratio, 3 chip DLP, 6300 lumens, provided by Christie Digital) projecting onto a 4.9×2.7 meter screen (provided by STRONG / MDI Screen Systems and setup by Visitech 3D), outputting frame-sequential circularly-polarized 3D (at 120Hz) by way of a DepthQ active polarization modulator (provided by DepthQ Stereoscopic). The system was driven by a DepthQ stereoscopic media server for playback of all of the stereoscopic video content shown during the 3D Theatre. Many thanks for a job done extremely well go to: **Chris Ward** and **Dan Lawrence** from DepthQ Stereoscopic; **Wayne Bickley** from Christie Digital; **Brad Nelson** from Visitech 3D, **François Barrette** from Strong / MDI Screen Systems; and **Adrian Romero** and staff from Spectrum Audio Visual. The AV setup was project managed by **Diana Gonzalez** from IS&T and **Andrew Woods** from Curtin University.

- We thank our media sponsors who helped promote the conference: **Veritas et Visus** and **Dimension 3**.
- We very much appreciate the dedicated support of **Stephan R. Keith** (SRK Graphics Research), who had a multi-tasked role at this conference, helping support the AV needs of all of our presenters.
- We are grateful to all of the providers of 3D content for the 3D Theatre session for allowing their content to be shown to the conference audience.
- Thanks to the demonstration session presenters for bringing equipment to show. A lot of equipment traveled from overseas, making the contribution to the meeting particularly worthy of additional praise.
- The conference committee plays an important role throughout the year, ensuring the correct technical direction of the meeting. Sincere thanks go to our founding chair, **John Merritt**, and our committee, **Gregg Favalora**, **Hideki Kakeya**, **Takashi Kawai**, **Janusz Konrad**, **Vivian Walworth**, **Chris Ward**, **Michael Weissman**, and **Samuel Zhou**.
- Thanks also to the staff at IS&T and SPIE, who were instrumental in helping to organize the meeting.

- Most importantly, we thank the conference authors and attendees, who ultimately made this meeting such a successful event. Thanks especially to those who travel a long way to join us each year.

Conference activities do not stop at the end of the January meeting. The SD&A conference website and Linked-In group provide focuses for conference activities during the time between conferences. We will soon be actively seeking abstracts for the 2012 conference, with a deadline in June 2011 - see the website for details and deadlines. You can join the conference mailing list to receive conference announcements: visit the SD&A conference website for details. The website has an extensive collection of photographs highlighting the activities of past conferences. In addition the website hosts the stereoscopic virtual library, which contains several historically important books that have been digitized, in full, into PDF format, and are available for *free* download. We have an active discussion group on the business networking site LinkedIn:

[www.linkedin.com/groups?gid=1945944](http://www.linkedin.com/groups?gid=1945944)

Visit the conference website to gain an understanding of the past, present, and future of stereoscopic imaging and, most of all, think now about submitting a paper or attending next year's conference. The Stereoscopic Displays and Applications conference website is at:

[www.stereoscopic.org](http://www.stereoscopic.org)

Next year, the 23rd conference will be held for three (or possibly four) days in the period 23–26 January 2012, at the Hyatt Regency San Francisco Airport Hotel, as part of the 2012 IS&T/SPIE Electronic Imaging: Science & Technology Symposium. The hotel is twenty minutes from central San Francisco by public transport. It is very close to the international airport and there will be free shuttle buses running from San Francisco International Airport to the conference venue. Parking is easy for local attendees. The conference will be in the same week as Photonics West (which will be held in central San Francisco) with all SD&A attendees automatically being registered for access for the Photonics West exhibition.

The 2012 SD&A conference will continue a tradition of presenting and demonstrating the latest technologies relevant to stereoscopic displays and applications. Please consider attending, presenting, or demonstrating at the 2012 Stereoscopic Displays and Applications conference. We hope to see you there!

**Andrew J. Woods**  
**Nicolas S. Holliman**  
**Neil A. Dodgson**

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