IS&T International Symposium on

Electronic Imaging

SCIENCE AND TECHNOLOGY

PROCEEDINGS

26 January 2020 — 30 January 2020 • Burlingame, CA, USA

Stereoscopic Displays and Applications XXXI

Editors: **Andrew J. Woods,** Curtin University (Australia),
Gregg E. Favalora, Draper (United States),
Nicolas S. Holliman, Newcastle University (United Kingdom), and
Takashi Kawai, Waseda University (Japan)

Stereoscopic Displays and Applications XXXI

Conference overview

The World's Premier Conference for 3D Innovation

The Stereoscopic Displays and Applications Conference (SD&A) focuses on developments covering the entire stereoscopic 3D imaging pipeline from capture, processing, and display to perception. The conference brings together practitioners and researchers from industry and academia to facilitate an exchange of current information on stereoscopic imaging topics. The highly popular conference demonstration session provides authors with a perfect additional opportunity to showcase their work. Large-screen stereoscopic projection is available, and presenters are encouraged to make full use of these facilities during their presentations. Publishing your work at SD&A offers excellent exposure—across all publication outlets, SD&A has the highest proportion of papers in the top 100 cited papers in the stereoscopic imaging field (Google Scholar, May 2013).

Awards

Best use of stereoscopy in a presentation
Best film (animation)
Best film (live action)

Event

3D Theatre Session

Conference Chairs: Gregg E. Favalora, Draper (United States); Nicolas S. Holliman, Newcastle University (United Kingdom); Takashi Kawai, Waseda University (Japan); and Andrew J. Woods, Curtin University (Australia)

Program Committee: Neil A. Dodgson, Victoria University of Wellington (New Zealand); Davide Gadia, University degli Studi di Milano (Italy); Hideki Kakeya, University of Tsukuba (Japan); Stephan R. Keith, SRK Graphics Research (United States); Björn Sommer, Royal College of Art, London (United Kingdom); John D. Stern, Intuitive Surgical, Inc. (Retired) (United States); and Chris Ward, Lightspeed Design, Inc. (United States)

Founding Chair: John O. Merritt, The Merritt Group (United States)

Conference Sponsors:

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3D THEATRE PARTNERS

Paper authors listed as of 1 January 2020;
refer to manuscript for final authors.
Titles that are not listed with the proceedings
files were presentation-only.

STEREOSCOPIC DISPLAYS AND APPLICATIONS XXXI

Monday, January 27, 2020

Human Factors in Stereoscopic Displays   `JOINT SESSION`

Session Chairs: Nicolas Holliman, University of Newcastle (United Kingdom) and Jeffrey Mulligan, NASA Ames Research Center (United States)

8:4 5 – 10:10 am
Grand Peninsula D

This session is jointly sponsored by: Human Vision and Electronic Imaging 2020, and Stereoscopic Displays and Applications XXXI.

8:45
Conference Welcome

8:50   HVEI-009
Stereoscopic 3D optic flow distortions caused by mismatches between image acquisition and display parameters (JIST-first), *Alex Hwang and Eli Peli, Harvard Medical School (United States)*

9:10   HVEI-010
The impact of radial distortions in VR headsets on perceived surface slant (JIST-first), *Jonathan Tong, Robert Allison, and Laurie Wilcox, York University (Canada)*

9:30   SD&A-011
Visual fatigue assessment based on multi-task learning (JIST-first), *Danli Wang, Chinese Academy of Sciences (China)*

9:50   SD&A-012
Depth sensitivity investigation on multi-view glasses-free 3D display, *Di Zhang[1], Xinzhu Sang[2], and Peng Wang[2]; [1]Communication University of China and [2]Beijing University of Posts and Telecommunications (China)*

10:10 – 10:50 am Coffee Break

SD&A 2020: Welcome & Introduction

Session Chair: Andrew Woods, Curtin University (Australia)

10:50 – 11:10 am
Grand Peninsula D

Autostereoscopy I

Session Chair: Bjorn Sommer, Royal College of Art (United Kingdom)

11:10 am – 12:30 pm
Grand Peninsula D

11:10   SD&A-053
Morpholo: A hologram generator algorithm, *Enrique Canessa, ICTP (Italy)*

11:30
Remastering 360˚ 3D videos into 16:9 3D format, *Andrew Woods, Curtin University (Australia)*

11:50   SD&A-055
Application of high resolution autostereoscopic display for medical purposes, *Kokoro Higuchi, Ayuki Hayashishita, and Hideki Kakeya, University of Tsukuba (Japan)*

12:10   SD&A-403
Monolithic surface-emitting electroholographic optical modulator, *Gregg Favalora, Michael Moebius, Joy Perkinson, Elizabeth Brundage, William Teynor, Steven Byrnes, James Hsiao, William Sawyer, Dennis Callahan, Ian Frank, and John LeBlanc, The Charles Stark Draper Laboratory, Inc. (United States)*

12:30 – 2:00 pm Lunch

PLENARY: Frontiers in Computational Imaging

Session Chairs: Radka Tezaur, Intel Corporation (United States), and Jonathan Phillips, Google Inc. (United States)

2:00 – 3:10 pm
Grand Peninsula Ballroom D

Imaging the Unseen: Taking the First Picture of a Black Hole, *Katie Bouman, assistant professor, Computing and Mathematical Sciences Department, California Institute of Technology (United States)*

For abstract and speaker biography, see page 7

3:10 – 3:30 pm Coffee Break

KEYNOTE: Immersive 3D Display Systems

Session Chair: Takashi Kawai, Waseda University (Japan)

3:30 – 4:30 pm
Grand Peninsula D

                                                          SD&A-065
High frame rate 3D-challenges, issues, and techniques for success, *Larry Paul, executive director, Technology and Custom Solutions Enterprise and Entertainment, Christie Digital Systems (United States)*

Biographies and/or abstracts for all keynotes are found on pages 9–14

5:00 – 6:00 pm All-Conference Welcome Reception

SD&A Conference 3D Theatre

Producers: Dan Lawrence, Lightspeed Design Group (United States); John Stern, retired (United States); Chris Ward, Lightspeed Design, Inc. (United States); and Andrew Woods, Curtin University (Australia)

6:00 – 7:30 pm
Grand Peninsula D

This ever-popular session of each year's Stereoscopic Displays and Applications Conference showcases the wide variety of 3D content that is being produced and exhibited around the world. All 3D footage screened in the 3D Theatre Session is shown in high-quality polarized 3D on a large screen. The final program will be announced at the conference and 3D glasses will be provided.

SD&A Annual Conference Dinner

7:50 – 10:00 pm
Offsite Restaurant

The annual informal dinner for SD&A attendees. An opportunity to meet with colleagues and discuss the latest advances. There is no host for the dinner. Information on venue and cost will be provided during the first day of the conference.

Tuesday, January 28, 2020

7:30 – 8:45 am Women in Electronic Imaging Breakfast; pre-registration required

Autostereoscopy II

Session Chair: Gregg Favalora, Draper Laboratory (United States)

8:50 – 10:10 am
Grand Peninsula D

8:50   SD&A-098
Dynamic zero-parallax-setting techniques for multi-view autostereoscopic display, *Yuzhong Jiao, Mark Mok, Kayton Cheung, Man Chi Chan, and Tak Wai Shen, United Microelectronics Centre (Hong Kong)*

9:10   SD&A-099
Projection type 3D display using spinning screen, *Hiroki Hayakawa and Tomohiro Yendo, Nagaoka University of Technology (Japan)*

9:30   SD&A-100
Full-parallax 3D display using time-multiplexing projection technology, *Takuya Omura, Hayato Watanabe, Naoto Okaichi, Hisayuki Sasaki, and Masahiro Kawakita, NHK (Japan Broadcasting Corporation) (Japan)*

9:50   SD&A-101
Light field display using wavelength division multiplexing, *Masaki Yamauchi and Tomohiro Yendo, Nagaoka University of Technology (Japan)*

10:00 am – 7:30 pm Industry Exhibition - Tuesday

10:10 – 10:50 am Coffee Break

Stereoscopic Image Processing

Session Chair: Nicolas Holliman, University of Newcastle (United Kingdom)

10:50 am – 12:30 pm
Grand Peninsula D

10:50   SD&A-138
Objective and subjective evaluation of a multi-stereo 3D reconstruction system, *Christian Kapeller[1,2], Braulio Sespede[2], Matej Nezveda[3], Matthias Labschütz[4], Simon Flöry[4], Florian Seitner[3], and Margrit Gelautz[2]; [1]Austrian Institute of Technology, [2]Vienna University of Technology, [3]emotion3D GmbH, and [4]Rechenraum e.U. (Austria)*

11:10   WITHDRAWN SD&A-139
Flow map guided correction to stereoscopic panorama, *Haoyu Wang, Daniel Sandin, and Dan Schonfeld, University of Illinois at Chicago (United States)*

11:30   SD&A-140
Spatial distance-based interpolation algorithm for computer generated 2D+Z images, *Yuzhong Jiao, Kayton Cheung, and Mark Mok, United Microelectronics Centre (Hong Kong)*

11:50   SD&A-141
Processing legacy underwater stereophotography for new applications, *Patrick Baker[1], Trevor Winton[2], Daniel Adams[3], and Andrew Woods[3]; [1]Western Australian Museum, [2]Flinders University of South Australia, and [3]Curtin University (Australia)*

12:10
Update from the 3-D SPACE Museum – A 2nd case study, *Eric Kurland, 3-D SPACE (United States)*

12:30 – 2:00 pm Lunch

PLENARY: Automotive Imaging

Session Chairs: Radka Tezaur, Intel Corporation (United States), and Jonathan Phillips, Google Inc. (United States)

2:00 – 3:10 pm
Grand Peninsula Ballroom D

Imaging in the Autonomous Vehicle Revolution, *Gary Hicok, senior vice president, hardware development, NVIDIA Corporation (United States)*

For abstract and speaker biography, see page 7

3:10 – 3:30 pm Coffee Break

3D Developments

Session Chair: John Stern, retired (United States)

3:30 – 4:10 pm
Grand Peninsula D

3:30   SD&A-154
CubicSpace: A reliable model for proportional, comfortable and universal capture and display of stereoscopic content, *Nicholas Routhier, Mindtrick Innovations Inc. (Canada)*

3:50   SD&A-155
A camera array system based on DSLR cameras for autostereoscopic prints, *Tzung-Han Lin, Yu-Lun Liu, Chi-Cheng Lee, and Hsuan-Kai Huang, National Taiwan University of Science and Technology (Taiwan)*

KEYNOTE: Multiple Viewer Stereoscopic Displays

Session Chair: Gregg Favalora, The Charles Stark Draper Laboratory, Inc. (United States)

4:10 – 5:10 pm
Grand Peninsula D

                                                                       SD&A-400
Challenges and solutions for multiple viewer stereoscopic displays, *Kurt Hoffmeister, Mechdyne Corp. (United States)*

Biographies and/or abstracts for all keynotes are found on pages 9–14

5:30 – 7:30 pm Symposium Demonstration Session

Wednesday, January 29, 2020

KEYNOTE: Imaging Systems and Processing | Joint Session

Session Chairs: Kevin Matherson, Microsoft Corporation (United States) and Dietmar Wueller, Image Engineering GmbH & Co. KG (Germany)

8:50 – 9:30 am
Regency A

This session is jointly sponsored by: The Engineering Reality of Virtual Reality 2020, Imaging Sensors and Systems 2020, and Stereoscopic

ISS-189

Mixed reality guided neuronavigation for non-invasive brain stimulation treatment, *Christoph Leuze, research scientist in the Incubator for Medical Mixed and Extended Reality, Stanford University (United States)*

Biographies and/or abstracts for all keynotes are found on pages 9–14

SD&A 3D Theatre – Spotlight

Session Chair: John Stern, retired (United States)

9:40 – 10:10 am
Grand Peninsula D

This session is an opportunity to take an extended look at highlights from the Monday evening 3D Theatre session.

10:00 am – 3:30 pm Industry Exhibition - Wednesday

10:10 – 10:50 am Coffee Break

Stereoscopic Perception and VR

Session Chair: Takashi Kawai, Waseda University (Japan)

10:50 am – 12:10 pm
Grand Peninsula D

10:50   SD&A-243
Evaluating the stereoscopic display of visual entropy glyphs in complex environments, *Nicolas Holliman, University of Newcastle (United Kingdom)*

11:10   SD&A-244
Evaluating user experience of 180 and 360 degree images, *Yoshihiro Banchi, Keisuke Yoshikawa, and Takashi Kawai, Waseda University (Japan)*

11:30   SD&A-245
Visual quality in VR head mounted device: Lessons learned making professional headsets, *Bernard Mendiburu, Varjo (Finland)*

11:50   SD&A-246
The single image stereoscopic auto-pseudogram – Classification and theory, *Ilicia Benoit, National 3-D Day (United States)*

12:30 – 2:00 pm Lunch

PLENARY: VR/AR Future Technology

Session Chairs: Radka Tezaur, Intel Corporation (United States), and Jonathan Phillips, Google Inc. (United States)

2:00 – 3:10 pm
Grand Peninsula Ballroom D

Quality Screen Time: Leveraging Computational Displays for Spatial Computing, *Douglas Lanman, director, Display Systems Research, Facebook Reality Labs (United States)*

For abstract and speaker biography, see page 7

3:10 – 3:30 pm Coffee Break

Visualization Facilities | Joint Session

Session Chairs: Margaret Dolinsky, Indiana University (United States) and Andrew Woods, Curtin University (Australia)

3:30 – 4:10 pm
Grand Peninsula D

This session is jointly sponsored by: The Engineering Reality of Virtual Reality 2020, and Stereoscopic Displays and Applications XXXI.

3:30   SD&A-265
Immersive design engineering, *Bjorn Sommer, Chang Lee, and Savina Toirrisi, Royal College of Art (United Kingdom)*

3:50   SD&A-266
Using a random dot stereogram as a test image for 3D demonstrations, *Andrew Woods, Wesley Lamont, and Joshua Hollick, Curtin University (Australia)*

KEYNOTE: Visualization Facilities | Joint Session

Session Chairs: Margaret Dolinsky, Indiana University (United States) and Andrew Woods, Curtin University (Australia)

4:10 – 5:10 pm
Grand Peninsula D

This session is jointly sponsored by: The Engineering Reality of Virtual Reality 2020, and Stereoscopic Displays and Applications XXXI.

ERVR-295

Social holographics: Addressing the forgotten human factor, *Derek Van Tonder, business development manager, and Andy McCutcheon, global sales manager for Aerospace & Defence, Euclideon Holographics (Australia)*
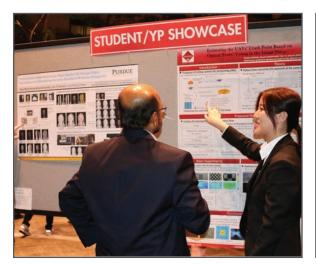
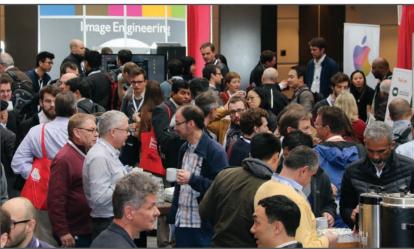*Biographies and/or abstracts for all keynotes are found on pages 9–14*

5:30 – 7:00 pm EI 2020 Symposium Interactive Posters Session

5:30 – 7:00 pm Meet the Future: A Showcase of Student and Young Professionals Research