IS&T International Symposium on
Electronic Imaging
SCIENCE AND TECHNOLOGY

29 January – 2 February 2017 • Burlingame, CA, USA

• SHORT COURSES • EXHIBITS • DEMONSTRATION SESSION • PLENARY TALKS •
• INTERACTIVE PAPER SESSION • SPECIAL EVENTS • TECHNICAL SESSIONS •
Welcome

On behalf of IS&T—the Society for Imaging Science and Technology—we would like to welcome you to the 29th annual International Symposium on Electronic Imaging.

Imaging is pervasive in the human experience—from the way we view the world each day to the photographs we take on our smart phones to its exciting use in technologies related to national security, space exploration, entertainment, medical, and printing applications—and an increasingly vital part of our lives.

This week you have the opportunity to hear the latest research from the world’s leading experts in imaging, image processing, sensors, color, and augmented/virtual reality/3D, to name but a few of the applications and technologies covered by the event. You also have many opportunities to develop both your career and business by networking with leading researchers and entrepreneurs in the field.

The Electronic Imaging Symposium is the premier international meeting in this exciting technological area, one that brings together academic and industry colleagues to discuss topics on the forefront of research and innovation. We look forward to seeing you and welcoming you to this unique event.

—Joyce Farrell and Nitin Sampat, EI2017 Symposium Co-chairs
IS&T Board of Directors July 2016 - June 2017

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UPCOMING IS&T EVENTS

May 15-18, 2017; Riga, Latvia
Archiving 2017

September 11 – 15, 2017; Lillehammer, Norway
25th Color and Imaging Conference (CIC25)

November 5 – 9, 2017; Denver, CO
Printing for Fabrication
33rd International Conference on Digital Printing Technologies (formerly NIP)

November 8 – 9, 2017; Denver, CO
Technologies in Digital Photo Fulfillment

Jan. 28 – Feb. 1, 2018; SFO/Burlingame, California
Electronic Imaging 2018

Learn more at www.imaging.org.
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*Plan Now to Participate*  
*Join us for Electronic Imaging 2018*  
*Burlingame, California, 28 January – 1 February, 2018*
EI Symposium Leadership

**EI 2017 Symposium Committee**

**Symposium Co-Chairs**
Joyce Farrell, Stanford University (United States)
Nitin Sampat, Rochester Institute of Technology (United States)

**Symposium Short Course Co-Chairs**
Jonathan B. Phillips, Google, Inc. (United States)
Mohamed-Chaker Larabi, University of Poitiers (France)

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Adnan Alattar, Digimarc (United States)

**Past Symposium Chair**
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Margaret Dolinsky, Indiana Univ.
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Zhigang Fan, Apple Inc.
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David L. Kao, NASA Ames Research Center
Takashi Kawai, Waseda Univ.
Feng Li, GoPro Inc.
Qian Lin, HP Labs
Gabriel Marcu, Apple Inc.
Ian McDowell, Fakespace Labs, Inc.
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Thrasyvoulos N. Pappas, Northwestern Univ.
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Bernice Rogowitz, Visual Perspectives
Juha Röning, Univ. of Oulu
Robert Sitnik, Warsaw Univ. of Technology
Robert L. Stevenson, Univ. of Notre Dame
Ingeborg Tastl, HP Labs
Grigorios Tsagkatakis, Institute of Computer Science, FORTH
Sreenath Rao Vantaram, Intel Corp.
Ralf Widenhorn, Portland State Univ.
Thomas Wischgoll, Wright State Univ.
Andrew J. Woods, Curtin Univ.
Buyue Zhang, Intel Corp.
Song Zhang, Mississippi State Univ.

IS&T expresses its deep appreciation to the symposium chairs, conference chairs, program committee members, session chairs, and authors who generously give their time and expertise to enrich the Symposium.
EI would not be possible without the dedicated contributions of our participants and members.

Sponsored by
Society for Imaging Science and Technology (IS&T)
7003 Kilworth Lane • Springfield, VA 22151
703/642-9090 / 703/642-9094 fax / info@imaging.org / www.imaging.org
Symposium Overview

Explore the Electronic Imaging of tomorrow

Imaging is integral to the human experience—from personal photographs taken every day with mobile devices to autonomous imaging algorithms in self-driving cars to the mixed reality technology that underlies new forms of entertainment. At EI 2017, leading researchers, developers, and entrepreneurs from around the world discuss, learn about, and share the latest imaging developments from industry and academia.

The 2017 event features 18 technical conferences and two featured sessions covering all aspects of electronic imaging, including:

- Augmented and virtual reality displays and processing
- Autonomous machine imaging algorithms
- Computational and digital photography
- Human vision, color, perception, and cognition
- Image and video processing and communication via the web
- Mobile imaging
- Imaging sensors
- Image quality
- Display and hardcopy
- Media security and forensics
- Machine vision and machine learning

Research and applications of these technologies are discussed in the fields of communications, security, transportation, education, space exploration, medicine, entertainment, and more.

Technical courses taught by experts from academia and industry augment the main technical program of symposium plenary, and conference keynote, oral, and interactive (poster) presentations.

Technology demonstrations by industry and academia participants and a focused exhibition showcase the latest developments driving next generation electronic imaging products.

Symposium Sponsors

Gold Level Sponsor

DXO

Event Sponsors

Image Engineering

Qualcomm

Exhibitors

Exhibit Hours
Tuesday 10 AM – 7 PM
Wednesday 10 AM – 4 PM
IS&T’s DIGITAL LIBRARY

your knowledge resource for imaging science and technology

Imaging Materials, Devices, Processes, Systems, and Applications • Image Quality • Color and Vision Science • Perception • Image Processing Algorithms • Image Understanding • Image Permanence • Multispectral and Hyperspectral Imaging • Digital Printing and Fabrication • Color in Devices • 3D Printing • Digital Preservation • Printed Electronics • Bio-Printing • Photo Sharing Technologies • and more . . .

LIBRARY HOLDINGS

• Journal of Imaging Science and Technology (JIST)
• Archiving Conference Proceedings
• CIC: Color and Imaging Conference Proceedings
• CGIV: European Conference on Colour in Graphics, Imaging, and Vision Proceedings
• International Symposium on Technologies for Digital Photo Fulfillment Proceedings
• Digital Printing / Digital Fabrication Conference Proceedings

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* Members have unlimited access to full papers; non-members have unlimited access to abstracts and can purchase full papers; everyone has free access to Electronic Imaging volumes beginning in 2016.

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**Plenary Speakers**

**Giga-scale 3D Computational Microscopy**

**Laura Waller** (Univ. of California, Berkeley)

Dr. Waller discusses work on computational imaging methods for fast capture of gigapixel-scale 3D intensity and phase images in a commercial microscope. Her lab’s experimental setups employ illumination-side and detection-side coding of angle (Fourier) space with simple hardware and fast acquisition. The result is high-resolution reconstructions across a large field-of-view, achieving high space-bandwidth product. Experimentally, they have achieved real-time 3D and phase imaging with digital aberration correction and mitigation of scattering effects, by sparsity-constrained nonlinear optimization methods.

Laura Waller is the Ted Van Duzer Endowed Assistant Professor of Electrical Engineering and Computer Sciences (EECS) at UC Berkeley. She is a Senior Fellow at the Berkeley Institute of Data Science, with affiliations in Bioengineering and Applied Sciences & Technology. She was a Postdoctoral Researcher and Lecturer of Physics at Princeton University (2010-2012) and received her BS (2004), MEng (2005), and PhD (2010) in EECS from the Massachusetts Institute of Technology (MIT). She is recipient of the Moore Foundation Data-Driven Investigator Award, Bakar Fellowship, Carol D. Soc Distinguished Graduate Mentoring Award, NSF CAREER Award, and Packard Fellowship for Science and Engineering.

**VR 2.0: Making Virtual Reality better than Reality**

**Gordon Wetzstein** (Stanford University)

Virtual reality is a new medium that provides unprecedented user experiences. Eventually, VR/AR systems will redefine education, communication, entertainment, collaborative work, simulation, training, telesurgery, and basic vision research. In all of these applications, the primary interface between the user and the digital world is the near-eye display. While today’s VR systems struggle to provide natural and comfortable viewing experiences, next-generation computational near-eye displays have the potential to provide visual experiences that are better than the real world. In this talk, we explore the frontiers of VR systems engineering.

Gordon Wetzstein is an assistant professor of Electrical Engineering and—by courtesy—of Computer Science at Stanford University. He is the leader of the Stanford Computational Imaging Group, an interdisciplinary research group focused on advancing imaging, microscopy, and display systems. At the intersection of computer graphics, machine vision, optics, scientific computing, and perception, Wetzstein’s research has a wide range of applications in next-generation consumer electronics, scientific imaging, human-computer interaction, remote sensing, and many other areas. Prior to joining Stanford in 2014, Wetzstein was a Research Scientist in the Camera Culture Group at the MIT Media Lab. He received a PhD in computer science from the University of British Columbia (2011) and graduated with Honors from the Bauhaus in Weimar, Germany before that. His doctoral dissertation focuses on computational light modulation for image acquisition and display and won the Alain Fournier PhD Dissertation Annual Award. He organized the IEEE 2012 and 2013 International Workshops on Computational Cameras and Displays, founded displayblocks.org as a forum for sharing computational display design instructions with the DIY community, and has presented a number of courses on computational displays and computational photography at ACM SIGGRAPH. Wetzstein is the recipient of an NSF CAREER award, International Conference on Computational Photography (ICCP) best paper awards (2011 and 2014), and a Laval Virtual Award (2005).

**Designing VR Video Camera Systems**

**Brian Cabral** (Facebook, Inc.)

Unlike traditional digital video camera systems that are fairly linear and composed of a single streaming optical and digital pipeline, VR video capture systems are not. They are composed of multiple, possibly homogenous, optical and digital components—all of which must operate as if they were one seamless optical system. The design of VR video cameras requires a whole new set of technologies and engineering approaches. The arrangement of cameras, optical choices, and SNR—all of which play important roles in every camera design—become far more complex for a VR camera and require tight coupling to the computational system components.

Brian Cabral is director of engineering at Facebook specializing in computational photography, computer vision, and computer graphics. He is the holder of numerous patents (filed and issued) and leads the Surround 360 VR camera team. He has published a number of diverse papers in the area of computer graphics and imaging including the pioneering Line Integral Convolution algorithm. Brian’s interests include computational photography, computer graphics and image processing hardware and software, numerical computation, differential geometry, hardware and software architecture, computational geometry, and statistical learning.
### Sunday January 29

<table>
<thead>
<tr>
<th>Time</th>
<th>Course</th>
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<tr>
<td>8:00 to 10:00</td>
<td>EI02 Burns/Williams - Introduction to Image Quality Testing: Targets, Software, and Standards</td>
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<tr>
<td>10:15 to 12:15</td>
<td>EI04 Hodgson - Electronic Imaging of Secure Documents</td>
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<tr>
<td>10:15 to 12:15</td>
<td>EI05 Rabbani - Advanced Image Enhancement and Deblurring</td>
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<tr>
<td>10:15 to 12:15</td>
<td>EI06 Pucha - Fundamentals of Deep Learning</td>
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<tr>
<td>10:15 to 12:15</td>
<td>EI08 Agam - 3D Imaging</td>
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<tr>
<td>10:15 to 12:15</td>
<td>EI09 Matherson/Artmann - Color and Calibration in Mobile Imaging Devices</td>
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<tr>
<td>10:15 to 12:15</td>
<td>EI10 Rizzi/McCann - High-Dynamic-Range Imaging in Cameras, Displays, and Human Vision</td>
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<tr>
<td>10:15 to 12:15</td>
<td>EI12 Viggiano - Psychophysics Lab: In Depth and Step-by-Step</td>
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<tr>
<td>10:15 to 12:15</td>
<td>EI14 Hemami/Pappas - Perceptual Metrics for Image and Video Quality in a Broader Context: From Perceptual Transparency to Structural Equivalence</td>
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<td>10:15 to 12:15</td>
<td>EI15 Darmont - Introduction to CMOS Image Sensor Technology</td>
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<tr>
<td>10:15 to 12:15</td>
<td>EI16 Ho - 3D Video Processing Techniques for Immersive Environments</td>
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<td>10:15 to 12:15</td>
<td>EI17 Rogowitz - Perception and Cognition for Imaging</td>
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<td>10:15 to 12:15</td>
<td>EI18 Matherson/Artmann - Camera Module Calibration for Mobile Imaging Devices</td>
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<td>10:15 to 12:15</td>
<td>EI19 Pulli/Gitudhuri - OpenVX: A Standard API for Accelerating Computer Vision</td>
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<tr>
<td>10:15 to 12:15</td>
<td>EI20 Ferzli - Computer Vision for Autonomous Driving</td>
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<tr>
<td>1:30 to 3:30</td>
<td>EI13 Costa - Real-time and Parameter-free Anomaly Detection from Image Streams</td>
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<tr>
<td>3:45 to 5:45</td>
<td>EI21 Sharma - Introduction to Digital Color Imaging</td>
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### Monday January 30

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<th>Time</th>
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<tr>
<td>8:30 to 12:45</td>
<td>EI22 Sharma - Introduction to Digital Color Imaging</td>
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### Tuesday February 1

<table>
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<tr>
<th>Time</th>
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<tr>
<td>8:30 to 12:45</td>
<td>EI24 Stork - Joint Design of Optics and Image Processing for Imaging Systems</td>
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</table>
Monday, January 30, 2017

**Symposium Welcome Reception**

*Atrium*

5:00 – 6:00 pm

Join colleagues for a light reception featuring beer, wine, soft drinks, and hors d’oeuvres. Make plans to enjoy dinner with old and new friends at one of the many area restaurants. Conference registration badges are required for entrance.

**SD&A Conference 3D Theater**

*Grand Peninsula Ballroom D*

6:00 – 7:30 pm

Hosted by Andrew J. Woods, Curtin Univ. (Australia)

The 3D Theater 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 Theater 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.

Tuesday, January 31, 2017

**Women in Electronic Imaging Breakfast**

Location provided at Registration Desk

7:15 – 8:45 am

Start your day with female colleagues and senior women scientists to share stories and make connections at the Women in Electronic Imaging breakfast. The complimentary breakfast is open to EI full registrants. Space is limited to 40 people. Visit the onsite registration desk for more information about this special event.

**Industry Exhibition**

*Grand Peninsula Foyer*

10:00 am – 4:00 pm

EI’s annual industry exhibit provides a unique opportunity to meet company representatives working in areas related to electronic imaging. The exhibit highlights products and services, as well as offers the opportunity to meet prospective employers.

**Interactive Paper (Poster) Session**

*Atrium*

5:30 – 7:00 pm

Conference attendees are encouraged to attend the Interactive Paper (Poster) Session where Interactive Paper authors display their posters and are available to answer questions and engage in in-depth discussions about their papers. Light refreshments are provided. Please note that conference registration badges are required for entrance and that posters may be previewed by all attendees beginning on Monday.

Authors are asked to set up their posters starting at 10:00 am on Monday. Pushpins are provided; other supplies can be obtained at the Registration Desk. Authors must remove poster materials at the conclusion of the Interactive Session. Posters not removed are considered unwanted and will be removed by staff and discarded. IS&T does not assume responsibility for posters left up before or after the Interactive Session.

Wednesday, February 1, 2017

**Industry Exhibition**

*Grand Peninsula Foyer*

10:00 am – 4:00 pm

EI’s annual industry exhibit provides a unique opportunity to meet company representatives working in areas related to electronic imaging. The exhibit highlights products and services, as well as offers the opportunity to meet prospective employers.

**Meet the Future: A Showcase of Student and Young Professionals Research**

*Atrium*

5:30 – 7:00 pm

This 1st annual event will bring invited students together with academic and industry representatives who may have opportunities to offer, and will provide each student with an opportunity to present and discuss their academic work via an interactive poster session.

Student presenters expand their professional network and explore employment opportunities with the audience of academic and industry representatives.
Monday, January 30, 2017

Conference Keynotes Talks

AVM: Key Learnings from Automated Vehicle Development

Session Chair: Buyue Zhang, Intel Corporation (United States)

8:50 – 9:50 am
Grand Peninsula Ballroom B

Architectures for automated driving, Jack Weast, Intel Corporation (United States)

Jack Weast is a Principal Engineer and the Chief Systems Engineer for Autonomous Driving Solutions at Intel Corporation. In his 17 year career at Intel, Weast has built a reputation as a change agent in new industries with significant technical and architectural contributions to a wide range of industry-first products and standards that range from one of the world’s first Digital Media Adapters to complex heterogeneous high performance compute solutions in markets that are embracing high performance computing for the first time. With an End to End Systems perspective, he combines a unique blend of embedded product experience with a knack for elegant Software and Systems design that will accelerate the adoption of Autonomous Driving. Weast is the co-author of “UPnP: Design By Example”, an Associate Professor at Portland State University, and the holder of numerous patents with dozens pending.

MWSF: Media Forensics

Session Chair: Adnan Alattar, Digimarc Corporation (United States)

8:50 – 10:10 am
Regency Ballroom A

The nimble challenges for media forensics, P. Jonathon Phillips, National Institute of Standards and Technology (NIST) (United States)

Jonathon Phillips is a leading technologist in the fields of computer vision, biometrics, and face recognition. He is at the National Institute of Standards and Technology (NIST), where he runs challenge problems and evaluations to advance biometric technology. His previous efforts include the Iris Challenge Evaluations (ICE), the Face Recognition Vendor Test (FRVT), the Face Recognition Grand Challenge and FERET. From 2000-2004, Phillips was assigned to DARPA. For his work on the FRVT 2002 he was awarded the Dept. of Commerce Gold Medal. His work has been reported in the New York Times, the BBC, and the Economist. He has appeared on NPR’s Science Friday show. In an Essential Science Indicators analysis of face recognition publication over the past decade, Phillips’ work ranks at #2 by total citations and #1 by cites per paper. In 2013, he won the inaugural Mark Everingham Prize. He is a fellow of the IEEE and IAPR.

IQSP: Automated Video Quality Measurement and Application

Session Chair: Elaine Jin, Google Inc. (United States)

10:50 – 11:30 am
Harbour

How to use video quality metrics for something other than video compression, Anil Kokaram, Google/YouTube (United States)

Anil Kokaram is the Engineering Manager for the media algorithms team in YouTube. The team is responsible for developing video processing algorithms for quality improvement in various pipelines. Kokaram is also a Professor at Trinity College Dublin, Ireland and continues to supervise a small number of students at www.sigmedia.tv in the EE Dept there. His main expertise is in the broad areas of DSP for Video Processing, Bayesian Inference, and motion estimation. He has published more than 100 refereed papers in these areas. In 2007 he was awarded a Science and Engineering Academy Award for his work in video processing for postproduction applications. He was founder of a company (GreenParrotPictures) producing video enhancement software that was acquired by Google in 2011. He is a former Associate Editor of the IEEE Transactions on CCGs and Systems for Video Technology and IEEE Transactions on Image Processing.

DPMI: Accelerated Computational Tools

Session Chair: Michael Kriss, MAK Consultants (United States)

10:50 – 11:30 am
Grand Peninsula Ballroom A

Heterogeneous computational imaging, Kari Pulli, Intel Corporation (United States)

Kari Pulli is a Senior Principal Engineer at Intel Corporation, working as the CTO of the Imaging and Camera Technologies Group. He has a long history in Computational Photography, Computer Vision, and Computer Graphics (earlier
Justyna Zander is Software Architect and Technology Lead in autonomous driving at Intel Corporation. Before joining Intel, she spent over a year working on self-driving cars, ADAS, and functional safety as a senior consultant in Germany. She engaged with Fortune 500 companies including most prestigious automotive OEMs. Prior to that, Zander was a postdoctoral researcher at Harvard University and a senior scientist at the Fraunhofer Institute in Germany. She holds PhD, MSc, and two BSc degrees in computer science and electrical engineering. Her expertise includes modeling, simulation, deep learning, validation, and verification, functional safety, computing platforms, and rapid prototyping with worldwide operations focus. A frequent public speaker, she holds 6 patents, has 8 patent applications at USPTO, and has co-authored more than 40 publications and 3 books. Her publications have been cited more than 550 times. Zander is recognized internationally with countless awards (IEEE, European Union, NIST, etc.). She regularly serves as a technical committee member for more than 50 journals and conferences, and is invited by NSF, EU Commission, and national councils to advise on government strategy and research roadmaps.

**CVAS: Computer Vision, Robotic Cameras, Sports Applications**

Session Chairs: Mustafa Jaber, NantVision Inc. (United States) and Grigorios Tsagkatakis, FORTH (Greece)

3:30 – 4:30 pm

Cypress B

**Automated sports broadcasting**, Peter Carr, Disney Research (United States)

Peter Carr is a Senior Research Engineer at Disney Research, Pittsburgh. He received his PhD from the Australian National University (2010), under the supervision of Prof. Richard Hartley. His thesis, “Enhancing Surveillance Video Captured in Inclement Weather”, explored single-view depth estimation using graph cuts, as well as real-time image processing on graphics hardware. As part of his earlier PhD work in sports analysis, Carr was a research intern at Mitsubishi Electric Research Labs. He received a Master’s in physics from the Centre for Vision Research at York University in Toronto, Canada, and a Bachelor’s of Applied Science (engineering physics) from Queen’s University in Kingston, Canada.

**AVM: Functional Safety and Security in Autonomous System Design**

Session Chair: Umit Batur, Faraday Future (United States)

3:30 – 4:30 pm

Grand Peninsula Ballroom B

**Needs and challenges analysis for reference architectures in autonomous systems**, Justyna Zander, Intel Corporation (United States)

SD&A: 3D and VR on a User’s Desk

Session Chair: Andrew Woods, Curtin University (Australia)

3:30 – 4:30 pm

Grand Peninsula Ballroom D

**Stereoscopic displays, tracking, interaction, education, and the web**, David Chavez, zSpace, Inc. (United States)

David Chavez brings 20 years of experience in startup companies, working with technologies ranging from GSM infrastructure to laptops, printers, PDAs and smartphones, in both consumer and commercial product spaces. He has managed product development teams through the full range of the product life cycle, from initial concept to volume production. Chavez has extensive experience working with suppliers and manufacturing partners worldwide, with a particular emphasis in Asia. He has held various positions in product development organizations such as pen-based computer companies GO & EO, Hewlett Packard, and Handspring.

**HVEI: Media Content Semantics - Transmitting Meaning**

Session Chair: Thrasivoulos Pappas, Northwestern University (United States)

3:30 – 4:20 pm

Regency Ballroom B

**Movies and meaning: From low-level features to mind reading (Invited)**, Sergio Benini, University of Brescia (Italy)

Sergio Benini received his MSc in electronic engineering (cum laude) at the University of Brescia (2000) with a thesis granted by Italian Academy of Science. Between ’01 and ’03 he was with Siemens Mobile Communications R&D. He received his PhD in information engineering from the University of Brescia (2006), working on video content analysis. During his PhD he spent one year in British Telecom Research, United Kingdom, working in the "Content & Coding Lab." Since 2005 he has been an Assistant Professor at the University of Brescia. In 2012, he co-founded Yonder, a spin-off company specialized in NLP, Machine learning, and Cognitive Computing.

**Tuesday, January 31, 2017**

**AVM: Autonomous Vehicle Navigation in Planetary Exploration**

Session Chair: Darnell Moore, Texas Instruments (United States)

8:50 – 9:50 am

Grand Peninsula Ballroom B

**Common themes in autonomous navigation on earth and in space**, Larry Matthies, Jet Propulsion Laboratory (United States)

Larry Matthies received his PhD in computer science from Carnegie Mellon University in 1989, then moved to the Jet Propulsion Laboratory, where he a Senior Research Scientist and supervisor the Computer Vision Group. His research interests include 3-D perception, state estimation, terrain classification, and dynamic scene analysis for autonomous navigation of unmanned vehicles.
on Earth and in space. He has been a principal investigator in many programs involving robot vision funded by NASA, Army, Navy, DARPA, and commercial sponsors. He and his group have achieved several firsts in computer vision for space exploration, including development of vision algorithms used by rovers and landers in the 2003 Mars Exploration Rover mission. He is an Adjunct Professor of Computer Science at the University of Southern California, a lecturer in computer vision at Caltech, and a member of the editorial boards of the Autonomous Robots Journal and the Journal of Field Robotics. He is a Fellow of the IEEE and was a joint winner in 2008 of the IEEE’s Robotics and Automation Award for his contributions to robotic space exploration.

Marc S. Ellens is a Senior Research Scientist with X-Rite-Pantone in Grand Rapids, MI. He received his BS in mathematics and computer science from Calvin College, and his PhD in computer aided geometric design from the University of Utah. In the past, Ellens has worked on CNC programming and at Lectra Systemes developing design applications for the textile industry. Now at X-Rite for more than 10 years, he has been involved in research and development efforts beyond color toward the capture and reproduction of appearance. Ellens has presented at the NVIDIA GPU Technology conference, Autodesk’s Automotive Innovation Forums, and the IS&T Electronic Imaging Conference. He is named in three patents related to material visualization and reproduction.

**MAAP-277**

**The future of material communication via the Appearance Exchange Format (AxF),** Marc Ellens, Gero Mueller, and Francis Lam, X-Rite, Inc. (United States)

Marc S. Ellens is a Senior Research Scientist with X-Rite-Pantone in Grand Rapids, MI. He received his BS in mathematics and computer science from Calvin College, and his PhD in computer aided geometric design from the

**MWSF: Camera Verification in Practice**

Session Chair: Nasir Memon, New York University (United States)

3:30 – 4:30 pm

Grand Peninsula Ballroom A

MWSF-339

**PRNU in practice, Walter Bruehs, Federal Bureau of Investigation (United States)**

Walter E. Bruehs is employed by the Federal Bureau of Investigation as the Supervisory Photographic Technologist in the Forensic Audio, Video, and Image Analysis Unit, where he is an Examiner of Questioned Photographic Evidence. Part of Bruehs’ responsibilities focus on seeking out and researching emerging digital imaging technologies as they apply to the Forensic arena. He heads a program designed to identify digital images to digital cameras or to other sets of digital images, based on the sensor noise of the capture device. He has a MS in electrical engineering from the University of Maine at Orono, as well as a BS in electrical engineering from Clarkson University. Prior to working at the FBI, he worked as an Imaging Scientist in the research labs of the Eastman Kodak Company, where he coauthored a patent, “Method and System for Improving an Image Characteristic Based on Image Content.”

**Wednesday February 1, 2017**

**IMSE/DPMI: Sharp High-quality Color Interpolation Joint Session**

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

8:50 – 9:30 am

Grand Peninsula Ballroom A

IMSE-077

**Bayer pattern and image quality, Jörg Kunze, Basler AG (Germany)**

Jörg Kunze has received his PhD in physics from the University of Hamburg (2004). He joined Basler in 1998, where he started as an electronics developer and where he currently is the team leader of New Technology. Kunze serves as an expert for image sensors, camera hardware, noise, color fidelity, 3D- and computational imaging and develops new algorithms for color image signal processing. The majority of the Basler patents name him as inventor.
Tobi Delbruck (IEEE M’99-SM’06-F’13) received a PhD from Caltech (1993). He is currently a professor of physics and electrical engineering at ETH Zurich in the Institute of Neuroinformatics, University of Zurich and ETH Zurich, Switzerland, where he has been since 1998. His group, which he coordinates together with Shih-Chii Liu, focuses on neuromorphic event-based sensors and sensory processing. He has co-organized the Telluride Neuromorphic Cognition Engineering summer workshop and the live demonstration sessions at ISCAS and NIPS. Delbruck is past Chair of the IEEE CAS Sensory Systems Technical Committee. He worked on electronic imaging at Arthimos, Synaptics, National Semiconductor, and Foveon and has founded 3 spin-off companies, including inilabs.com, a non-profit organization that has distributed hundreds of R&D prototype neuromorphic sensors to more than a hundred organizations around the world. He has been awarded 9 IEEE awards.

Michael Gormish is Principal Scientist at Blippar on the infrastructure team working on image retrieval and multiple computer vision products. Gormish is an image processing and computer vision scientist and engineer who invented algorithms used in products including video games, digital cinema, satellite and medical image acquisition and transport. He earned a PhD in electrical engineering dealing with image and data compression from Stanford University. In his twenty year career at Ricoh, he led several aspects of the JPEG 2000 standardization and provided key inventions used in photocopiers, digital cameras, tablets and imaging services. He was awarded the status of Ricoh Patent Master for being a co-inventor on more than 100 US patents. He has served the research community as an Associate Editor of the IEEE Signal Processing Magazine, Associate Editor of the Journal of Electronic Imaging, Program Chair of the Document Engineering Conference, and technical committee member and reviewer for numerous conferences and journals. Currently he is interested changing the world via mobile image understanding.

Boyd Fowler’s research interests include CMOS image sensors, low noise image sensors, noise analysis, data compression, and machine learning and vision. He received his MSEE (1990) and PhD (1995) from Stanford University. After finishing his PhD he stayed at Stanford University as a research associate in the Electrical Engineering Information Systems Laboratory until 1998. In 1998, Fowler founded Pixel Devices International in Sunnyvale California. Between 2005 and 2013, Fowler was CTO and VP of Technology at Fairchild Imaging. He is currently at OmniVision Technologies leading the marketing department. Fowler has authored numerous technical papers, book chapters and patents.

Tim MacMillan is an award-winning photographic artist whose career with Camera Array systems began in the 1980’s. In the 1990’s he established Time-Slice Films Ltd. to produce content and innovate array technology for clients such as the BBC, Sky TV, Discovery Channel, and many others. His distinctive approach has been influential in the development of special effects widely used today. MacMillan’s work spans both the artistic and technical, with his early camera technology now in the (United Kingdom) Science Museum. As well as architecting and designing Array systems, he has also worked in HD Broadcast Product Development with Grass Valley Cameras, and is currently Senior Manager of Advanced Products at GoPro Cameras.

Timothy Macmillan1 and David Newman2; 1Consultant and 2GoPro Inc. (United States)

SD&A: 360° Multi-Camera Content Creation
Session Chair: Gregg Favalora, Draper (United States)
11:30 am – 12:30 pm
Grand Peninsula Ballroom D
360° 3D capture: Meeting the need in VR, Timothy Macmillan I and David Newman2; 1Consultant and 2GoPro Inc. (United States)

IMSE/DPMI: Comparing CMOS Image Sensor Architectures
Session Chairs: Thomas Vogelsang, Rambus Inc., and Ralf Widenhorn, Portland State University (United States)
11:50 am – 12:40 pm
Grand Peninsula Ballroom A
This session is jointly sponsored by: Image Sensors and Imaging Systems 2017 and Digital Photography and Mobile Imaging XIII.

IMSE-082
CMOS image sensor pixel design and optimization, Boyd Fowler, OmniVision Technologies (United States)

Boyd Fowler’s research interests include CMOS image sensors, low noise image sensors, noise analysis, data compression, and machine learning and vision. He received his MSEE (1990) and PhD (1995) from Stanford University. After finishing his PhD he stayed at Stanford University as a research associate in the Electrical Engineering Information Systems Laboratory until 1998. In 1998, Fowler founded Pixel Devices International in Sunnyvale California. Between 2005 and 2013, Fowler was CTO and VP of Technology at Fairchild Imaging. He is currently at OmniVision Technologies leading the marketing department. Fowler has authored numerous technical papers, book chapters and patents.

VDA: Topological Data Analysis
Session Chair: Thomas Wischgoll, Wright State University (United States)
3:30 – 4:30 pm
Cypress B

Timothy Macmillan1 and David Newman2; 1Consultant and 2GoPro Inc. (United States)

Topological analysis at the extreme scale: Finding features in large data sets, Gunther Weber, Lawrence Berkeley National Laboratory and University of California, Davis (United States)
Gunther Weber is a Staff Scientists in LBNL’s Computational Research Division and an Adjunct Associate Professor of Computer Science at UC Davis. His research interests include computer graphics, scientific visualization, topological data analysis methods, parallelization of visualization algorithms, hierarchical data representation methods, and bioinformatics. Prior to joining LBNL, Weber worked as a Project Scientist at the Institute for Data Analysis and Visualization (IDA V) at UC Davis focusing on visualization of three-dimensional gene expression data (with researchers of LBNL’s Genomics and Life Sciences Division). He also explored the use of scalar data, and visualization of brain imaging data and experimental earthquake data. Weber earned his PhD in computer science, from the University of Kaiserslautern, Germany (2003).

Thursday, February 2, 2017

IMSE: Sensor design and technology
Session Chairs: Arnaud Peizerat, CEA, and Jean-Michel Tuaille, University Paris 13 (France)
9:50 – 10:20 am  Harbour
A 128 x 128, 34 μm pitch, 8.9mW, 190mK NETD, TECless Uncooled IR bolometer image sensor with columnwise processing, Laurent Alacoque1, Sébastien Martin1, Wilfried Rabaud1, Édith Beigné1, and Antoine Dupret2; 1Minatec Campus and 2CEA (France)
Laurent Alacoque was born in Lyon, France in 1974. He received the engineering degree in electronics and information processing from the École Superieure de Chimie Physique et Electronique de Lyon (ESCPE) (1998). In the same year, he joined the Institut National de Sciences Appliquees (INSA) on Villeurbanne Campus for a PhD on the application of Asynchronous Logic to Analogue-Digital Conversion. He received his PhD (2002), and joined the CEA/LETI in 2003, first as a postdoctoral student and then as a member of the smart-imaging laboratory. Since then, his work focuses on the imaging chain, from pixel level design, imagers-specific Analogue-Digital Conversion, to Image Signal Processing algorithms.

IMSE/AVM: History and Standards for Automotive Vision Systems
Session Chairs: Arnaud Darmont, APHESA SPRL (Belgium), and Ralf Widenhorn, Portland State University (United States)
11:50 am – 12:30 pm  Harbour
This session is jointly sponsored by: Image Sensors and Imaging Systems 2017 and Autonomous Vehicles and Machines 2017.

Automotive imaging, Patrick Denny, Valeo (Ireland)
Patrick Denny is a Senior Research Engineer and a Valeo Senior Expert and has worked for the last 15 years at Valeo Vision Systems, Ireland. He received his PhD in physics (2000) from the National University of Ireland, Galway, where he is also Adjunct Professor of Automotive Electronics. Denny has in excess of 20 years experience in scientific and technological development internationally, designing, innovating and developing automotive imaging technologies for BMW, Jaguar Land Rover, Daimler, VW, and other OEMs. His research interests include several aspects of automotive vision systems image quality, sensor components, algorithmic design, systems, machine learning and data analytics.

IMSE: Image Sensors for Devices of Internet of Things
Session Chairs: Arnaud Darmont, APHESA SPRL (Belgium), and Ralf Widenhorn, Portland State University (United States)
2:40 – 3:20 pm  Harbour
In the quest of vision-sensors-on-chip: Pre-processing sensors for data reduction, Ángel Rodríguez-Vázquez, Universidad de Sevilla (Spain)
Ángel Rodríguez-Vázquez (IEEE Fellow, 1999) conducts research on the design of analog and mixed-signal front-ends for sensing and communication, including smart imagers, vision chips and low-power sensory-processing microsystems. He received his Bachelor’s (University of Seville, 1976) and PhD in physics-electronics (University of Seville, 1982) with several national and international awards, including the IEEE Rogelio Segovia Torres Award (1981). After research stays at UC Berkeley and Texas A&M University, he became a Full Professor of Electronics at the University of Seville in 1995. He cofounded the Institute of Microelectronics of Seville, under the umbrella of the Spanish Council Research (CSIC) and the University of Seville and started a research group on Analog and Mixed-Signal Circuits for Sensors and Communications. In 2001 he was the main promoter and co-founder of the startup company AnaFocus ltd. and served as CEO, on leave from the University, until June 2009, when the company reached maturity as a worldwide provider of smart CMOS imagers and vision systems-on-chip. He has authored 11 books, 36 additional book chapters, and some 150 journal articles in peer-review specialized publications. He was elected Fellow of the IEEE for his contributions to the design of chaos-based communication chips and neuro-fuzzy chips. His research work has received some 6,954 citations; he has an h-index of 42 and an i10-index of 143.
## Monday, January 30, 2017

**Surface Appearance Modeling and Reproduction Joint Session**

Session Chair: Francisco Imai (United States)

**3:30 – 4:50 pm**

Regency Ballroom C

This session is jointly sponsored by: Material Appearance 2017 and Color Imaging XXII: Displaying, Processing, Hardcopy, and Applications.

- **3:30** MAAP-288

  **Modeling and reproducing effect paints**, Gary Meyer and Avery Musbach, Univ. of Minnesota (United States)

- **3:50** MAAP-289

  **How to design a recto-verso print displaying different images in various everyday-life lighting conditions**, Nicolas Dalloz1,2, Serge Mazauric1,3, Mathieu Hébert1, and Thierry Fournel1; 1Univ. Lyon, UJM-Saint-Etienne, CNRS, Institut d’Optique Graduate School, 2Institut d’Optique Graduate School, and 3CPE Lyon (France)

- **4:10** MAAP-290

  **Appearance decomposition and reconstruction of textured fluorescent objects**, Shoji Tomimaga, Keiji Kata, Keita Hirai, and Takahiko Horisuchi, Chiba University (Japan)

- **4:30** MAAP-291

  **Assessing the proper color of translucent materials by an extended two-flux model from measurements based on an integrating sphere**, Lionel Simonot1, Mathieu Hébert1, and Roger Hersch1; 1Université de Poitiers (France)

**Tuesday, January 31, 2017**

**Keynote: Mobile Device Camera IQ Joint Session**

Session Chairs: Susan Farnand, Rochester Institute of Technology, and Jackson Roland, Apple Inc. (United States)

**8:50 – 9:20 am**

Grand Peninsula Ballroom A

This session is jointly sponsored by: Image Quality and System Performance XIV and Human Vision and Electronic Imaging 2017.

- **8:50** HVEI-378

  **Towards the development of the IEEE P1858 CPIQ standard – A validation study**, Elaine Jin1, Jonathan Phillips1, Susan Farnand2, Margaret Belska1, Vinh Tran1, Ed Chang1, Yu Xuan Wang3, and Benjamin Tseng4; 1Google Inc. (United States), 2Rochester Institute of Technology (United States), 3NVIDIA (United States), and 4Apkudo (Australia)

  Elaine W. Jin holds a PhD in optical engineering from Zhejiang University in China, and a PhD in psychology from the University of Chicago. She has worked in the imaging industry for 15+ years including employment at Polaroid Corporation, Eastman Kodak Company, Micron Technologies, Aphtia Imaging, Marvell Semiconductors, and Intel Corporation. She currently is a staff image scientist at Google, working on developing cutting-edge consumer hardware products. Her primary research interests include imaging systems design and analysis, color imaging, and psychophysics. She has published 22 journal and conference papers, and authored 14 US patents / patent applications. She joined the CPIQ initiative (Camera Phone Image Quality) in 2006, and since then has made major contributions in the development of the softcopy quality ruler method, and the CPIQ metrics for visual noise, texture blur, spatial frequency responses, chroma level, and color uniformity. She currently leads the Color/Tone Subgroup of the IEEE CPIQ Standard Working Group.

**Human Vision and Stereoscopic Imaging Joint Session**

Session Chairs: Nicolas Holliman, University of Newcastle (United Kingdom), and Thrasyvoulos Pappas, Northwestern University (United States)

**8:50 – 10:10 am**

Grand Peninsula Ballroom D

This session is jointly sponsored by: Stereoscopic Displays and Applications XXVIII and Human Vision and Electronic Imaging 2017.

- **8:50** HVEI-379

  **Depth-compressed expression for providing natural, visual experiences with integral 3D displays**, Yasuyuki Sawahata and Toshiya Morita, Japan Broadcasting Corporation (Japan)

- **9:10** HVEI-380

  **Blind quality prediction of stereoscopic 3D images**, Jiheng Wang1, Qingbo Wu1, Abdul Rehman1, Shiqi Wang1, and Zhou Wang1; 1University of Waterloo (Canada)

- **9:30** SD&A-381

  **Pseudo-haptic by stereoscopic images and effects on muscular activity**, Takashi Kawai1, Fumiya Ohta1, Sanghyun Kim1, and Hiroki Maniwa1,2; 1Waseda University and 2Aoyama Gakuin University (Japan)

**Surface Appearance Assessment and Digital Methods Joint Session**

Session Chair: Greg Ward, Dolby Laboratories (United States)

**9:10 – 10:10 am**

Grand Peninsula Ballroom C

This session is jointly sponsored by: Material Appearance 2017 and 3D Image Processing, Measurement (3DIPM), and Applications 2017.
### Joint Sessions

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<tr>
<th>Time</th>
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<td>9:10</td>
<td>MAAP-282</td>
<td>Graininess appearance of goniochromatic samples in lighting cabinets, Paola Iacomussi, Michela Radis,</td>
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<td>9:30</td>
<td>MAAP-283</td>
<td>Measurement and evaluation method of orange peel, Takuroh Sone and Shuhei Watanabe, Ricoh Company, Ltd.</td>
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<td>9:50</td>
<td>MAAP-284</td>
<td>Enhanced RTI for gloss reproduction, Peter Fornaro, Andrea Bianco, and Lukas Rosenthaler, University of Basel (Switzerland)</td>
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### Mobile Device Camera IQ Joint Session

**Session Chairs:** Susan Farnand, Rochester Institute of Technology, and Jackson Roland, Apple Inc. (United States)

**9:20 – 10:20 am**

- **Grand Peninsula Ballroom A**
  - **9:20 IQSP-250**
    - A methodology for perceptual image quality assessment of smartphone cameras – Color quality, Susan Farnand, Rochester Institute of Technology (United States)
  - **9:40 IGSP-251**
    - Assessing the ability of simulated laboratory scenes to predict the image quality performance of HDR captures (and rendering) of exterior scenes using mobile phone cameras, Amelia Spooner1, Ashley Solter1, Fernando Voltolini de Azambuja1, Nitin Sampat1, Stephen Viggiano1, Brian Rodricks2, and Cheng Lu2; 1Rochester Institute of Technology, 2SensorSpace, LLC, and Intel Corporation (United States)

**10:00**

- **DPMI-252**
  - Cell phone rankings!, Dietmar Wueller, Image Engineering GmbH & Co. KG (Germany)

### Surface Appearance Assessment and Digital Methods II Joint Session

**Session Chair:** Mathieu Hebert, Université Jean Monnet de Saint Etienne (France)

**10:50 – 11:50 am**

- **Grand Peninsula Ballroom C**
  - **10:50 MAAP-285**
    - Consistent tool-independent virtual material appearance, Dar’ya Guarnera1, Giuseppe Claudio Guarnera1, Cornelia Denk2, and Mashhuda Glencross1; 1Loughborough University (United Kingdom), 2BMWV Research (Germany), and 3Switch That Limited (United Kingdom)
  - **11:10 MAAP-286**
    - Interactive object surface retexturing using perceptual quality indexes, Keita Hirai, Wataru Suzuki, Yoshimitsu Yamada, and Takahiko Horiuchi, Chiba University (Japan)

### MTF Joint Session

**Session Chairs:** Peter Burns, Burns Digital Imaging, and Feng Li, GoPro Inc. (United States)

**10:50 – 12:30 pm**

- **Grand Peninsula Ballroom A**
  - **10:50 IQSP-253**
    - Characterization of entire imaging plane spatial frequency response, Victor Lenchenko1, Okti Skorka1, Stan Micinski1, and Radu Ispasoiu1; ON Semiconductor (United States)
  - **11:10 IQSP-254**
    - Reverse-projection method for measuring camera MTF, Stan Birchfield, Microsoft Corporation (United States)
  - **11:30 IQSP-255**
    - Texture MTF from images of natural scenes, Riccardo Branca1, Sophie Triantaphillidou1, and Peter Burns2; 1University of Westminster (United Kingdom) and 2Burns Digital Imaging (United States)
  - **11:50 DPMI-256**
    - Camera phone texture preservation measurements with modulation transfer function: An alternative approach for noise estimation of random texture chart images, Nitin Suresh1, Joshua Prefer1, and Guanzeng Wang1; 1U.S. Food and Drug Administration and 2University of Maryland (United States)

### Image Interpolation, Restoration, and Denoising Joint Session

**Session Chairs:** Karen Egiazarian, Tampere University of Technology (Finland), and Radka Tezaur, Intel Corporation (United States)

**3:30 – 5:30 pm**

- **Grand Peninsula Ballroom A**
  - **3:30 DPMI-083**
    - BM3D-HVS: Content-adaptive denoising for improved visual quality (Invited), Karen Egiazarian1,2, Aram Danielyan2, Nikolay Ponomarenko1,2, Alessandro Foi1,2, Oleg Ieremeiev2, and Vladimir Lukin1; 1Tampere University of Technology (Finland), 2Noiseless Imaging Oy (Finland), and 3National Aerospace University (Ukraine)
  - **3:50 IPAS-084**
    - Refining raw pixel values using a value error model to drive texture synthesis, Henry Dietz, University of Kentucky (United States)
  - **4:10 IPAS-085**
    - Color interpolation based on colorization for RGB-white color filter array, Paul Oh1, Sukho Lee2, and Moon Gi Kang1; 1Yonsei University and 2Dongseo University (Republic of Korea)
  - **4:30 IPAS-086**
    - Video frame synthesizing method for HDR video capturing system with four image sensors, Takayuki Yamashita1,2 and Yoshihiro Fujita1; 1Ehime University and 2NHK (Japan)
Joint Sessions

4:50 PM DPM-088
Robust defect pixel detection and correction for Bayer Imaging Systems,
Noha El-Yamany, Intel Corporation (Finland)

Wednesday, February 1, 2017

Keynote: Sharp High-quality Color Interpolation Joint Session
Session Chairs: Kevin Matherson, Microsoft Corporation (United States),
and Dietmar Wueller, Image Engineering GmbH & Co. KG (Germany)
8:50 – 9:30 am
Grand Peninsula Ballroom A

This session is jointly sponsored by: Image Sensors and Imaging Systems 2017 and Digital Photography and Mobile Imaging XIII.

Conference Chair Opening Remarks

IMSE-077
Bayer pattern and image quality, Jörg Kunze, Basler AG (Germany)

Jörg Kunze has received his PhD in physics from the University of Hamburg (2004). He joined Basler in 1998, where he started as an electronics developer and where he currently is the team leader of New Technology. Kunze serves as an expert for image sensors, camera hardware, noise, color fidelity, 3D- and computational imaging and develops new algorithms for color image signal processing. The majority of the Basler patents name him as inventor.

Input Signal Quality & Characterization Joint Session
Session Chairs: Kevin Matherson, Microsoft Corporation (United States),
and Dietmar Wueller, Image Engineering GmbH & Co. KG (Germany)
9:30 – 10:10 am
Grand Peninsula Ballroom A

This session is jointly sponsored by: Image Sensors and Imaging Systems 2017 and Digital Photography and Mobile Imaging XIII.

9:30 IMSE-078
Accurate joint geometric camera calibration of visible and far-infrared cameras, Takashi Shibata1, Masayuki Tanaka1, and Masatoshi Okutomi1; Tokyo Institute of Technology and NEC Corporation (Japan)

9:50 DPM-079
Interferometric measurement of sensor MTF and crosstalk, Todor Georgiev, Jennifer Gille, Amber Sun, Lyubomir Baev, and Tharun Battula, Qualcomm Technologies, Inc. (United States)

Keynote: Machine Vision Retina Improvement Joint Session
Session Chairs: Thomas Vogelsang, Rambus Inc., and Ralf Widenhorn, Portland State University (United States)
10:50 – 11:30 am
Grand Peninsula Ballroom A

This session is jointly sponsored by: Image Sensors and Imaging Systems 2017 and Digital Photography and Mobile Imaging XIII.

Silicon retina technology (Invited), Tobi Delbruck, Institute for Neuroinformatics (INI) (Switzerland)

Tobi Delbruck (IEEE M’99-SM’06-F’13) received a PhD from Caltech (1993). He is currently a professor of physics and electrical engineering at ETH Zurich in the Institute of Neuroinformatics, University of Zurich and ETH Zurich, Switzerland, where he has been since 1998. His group, which he coordinates together with Shih-Chii Liu, focuses on neuromorphic event-based sensors and sensory processing. He has coorganized the Telluride Neuromorphic Cognition Engineering summer workshop and the live demonstration sessions at ISCAS and NIPS. Delbruck is past Chair of the IEEE CAS Sensor Systems Technical Committee. He worked on electronic imaging at Anritsu, Synaptics, National Semiconductor, and Foveon and has founded 3 spin-off companies, including inilabs.com, a non-for-profit organization that has distributed hundreds of R&D prototype neuromorphic sensors to more than a hundred organizations around the world. He has been awarded 9 IEEE awards.

Emerging Imaging Sensor & Hardware Joint Session
Session Chairs: Thomas Vogelsang, Rambus Inc., and Ralf Widenhorn, Portland State University (United States)
11:30 – 11:50 am
Grand Peninsula Ballroom A

This session is jointly sponsored by: Image Sensors and Imaging Systems 2017 and Digital Photography and Mobile Imaging XIII.

11:30 DPM-081
TIK: A time domain continuous imaging testbed using conventional still images and video, Henry Dietz, John Fike, Paul Eberhart, Katie Long, Clark Demaree, and Jong Wu, University of Kentucky (United States)

Keynote: Comparing CMOS Image Sensor Architectures Joint Session
Session Chairs: Thomas Vogelsang, Rambus Inc., and Ralf Widenhorn, Portland State University (United States)
11:50 am – 12:40 pm
Grand Peninsula Ballroom A

This session is jointly sponsored by: Image Sensors and Imaging Systems 2017 and Digital Photography and Mobile Imaging XIII.

IMSE-082
CMOS image sensor pixel design and optimization, Boyd Fowler, OmniVision Technologies (United States)

Image Sensors and Imaging Systems 2017 Awards

Boyd Fowler’s research interests include CMOS image sensors, low noise image sensors, noise analysis, data compression, and machine learning and vision. He received his MSEE (1990) and PhD (1995) from Stanford University. After finishing his PhD, he stayed at Stanford University as a research associate in the Electrical Engineering Information Systems Laboratory until 1998. In 1998, Fowler founded Pixel Devices International in Sunnyvale California. Between 2005 and 2013, Fowler was CTO and VP of Technology at Fairchild Imaging. He is currently at OmniVision Technologies leading the marketing department. Fowler has authored numerous technical papers, book chapters and patents.
Joint Sessions

Visualization Facilities Joint Session

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

3:30 – 5:40 pm

Grand Peninsula Ballroom D

This session is jointly sponsored by: Stereoscopic Displays and Applications XXVIII and The Engineering Reality of Virtual Reality 2017.

3:30 Designing a cloud-based 3D visualization engine for smart cities, Nicolas Holliman, Stephen Dowsland, Mark Turner, Richard Cloete, and Tom Picton, Newcastle University (United Kingdom)

3:50 Interactive computer graphics, stereo and VR practice at the Electronic Visualization Laboratory University of Illinois at Chicago, Maxine Brown, Jason Leigh, Tom DeFanti, and Daniel Sandin; The University of Illinois at Chicago, University of Hawaii at Manoa, and University of California, San Diego (United States)

4:10 Designing at the Advanced Visualization Lab at Indiana University, Margaret Dolinsky, Eric Wernert, Michael Boyles, and Chris Eller; School of Art and Design, Indiana University and Advanced Visualization Lab, Indiana University (United States)

4:30 Exploring Calit2, Jürgen Schulze and Gregory Dawe, University of California, San Diego (United States)

4:50 3D-Stereoscopic immersive analytics projects at Monash University and University of Konstanz, Björn Sommer, David G. Barnes, Sarah Boyd, Thomas Chandler, Maxime Cordelie, Karsten Klein, Toan Nguyen, Hieu Nim, Kingsley Stephens, Dany Vahl, Elliott Wilson, Jon McCormack, Kim Marriott, and Falk Schreiber; Monash University (Australia), Swinburne University of Technology (Australia), University of Konstanz (Germany), Monash Immersive Visualization Platform at Monash University (Australia), and Australian Regenerative Medicine Institute of Monash University (Australia)

5:10 Image distortions in large-scale immersive display systems – Cylinder and wedge displays, Andrew Woods, Joshua Hollick, Jesse Hellwell, and Paul Bourke; Curtin University and University of Western Australia (Australia)

5:30 SD&A Closing Remarks, Nicolas Holliman, Newcastle University (United Kingdom)

Thursday, February 2, 2017

Keynote: History and Standards for Automotive Vision Systems Performance Joint Session

Session Chairs: Arnaud Darmont, APHESA SPRL (Belgium); Ralf Widenhorn, Portland State University (United States); and Buyue Zhang, Intel (United States)

11:50 am – 12:30 pm

Harbour

This session is jointly sponsored by: Image Sensors and Imaging Systems 2017 and Autonomous Vehicles and Machines 2017.

Automotive imaging, Patrick Denny, VALEO (Ireland)

Patrick Denny is a Senior Research Engineer and a Valeo Senior Expert and has worked for the last 15 years at Valeo Vision Systems, Ireland. He received his PhD in physics (2000) from the National University of Ireland, Galway, where he is also Adjunct Professor of Automotive Electronics. Denny has in excess of 20 years experience in scientific and technological development internationally, designing, innovating and developing automotive imaging technologies for BMW, Jaguar Land Rover, Daimler, VW, and other OEMs. His research interests include several aspects of automotive vision system image quality, sensor components, algorithmic design, systems, machine learning and data analytics.

Interactive Workshop: How can COLOR imaging provide US with powerful INSIGHTS? Joint Session

Moderator: Fritz Lebowsky, STMicroelectronics (France)

2:00 – 5:00 pm

Regency Ballroom C

This session is jointly sponsored by: Color Imaging XXII: Displaying, Processing, Hardcopy, and Applications and Material Appearance 2017.

COLOR-062 Interactive Workshop: How can color imaging provide us with powerful insights?, Fritz Lebowsky, STMicroelectronics (France)

We would very much like to have you participate in a special session in which we encourage asking questions and exchange ideas that frequently trouble us during research and development projects. The presence of experts in COLOR imaging and perhaps Electronic Imaging at large will provide a unique opportunity of efficiently and lively sharing simple/stupifying ideas enabling fascinating engineering concepts which may also stimulate your own future research and development projects!
Monday, January 30, 2017

8:50 am  AVM-009  Architectures for automated driving (Weast)  
         COIMG-453  Deep neural networks for synchrotron X-ray imaging (Yang)  
         DPNI-063  Stabilized high-speed video from camera arrays (El Choubassi)  
         IQSP-218  Blind image quality assessment using multiscale local binary patterns (JIST-first) (Garcia Freitas)  
         MWSF-316  The nimble challenges for media forensics (Phillips)  
         SD&A-353  Expert viewers’ preferences for higher frame rate 3D film (JIST-first) (Allison)

9:10 am  COIMG-415  Synchrotron x-ray diffraction dynamic sampling for protein crystal centering (Simpson)  
         DPNI-064  Panoramic background estimation from RGB-D videos (Bampis)  
         HVEI-111  Vision at a glance (Invited) (Rosenholtz)  
         IQSP-219  Dimension reduction-based attributes selection in no-reference learning-based image quality algorithms (Charrier)  
         SD&A-354  Investigating aircrew depth perception standards using a stereoscopic simulation environment (Winterbottom)

9:30 am  COIMG-416  An iterative method to estimate and recover systematic and random errors in grating based x-ray phase contrast imaging (Lim)  
         DPNI-065  Accurate measurement of point to point distances in 3D camera images (Seshadrinathan)  
         IQSP-220  GPGPU based implementation of a high performing No Reference (NR)- IQA algorithm, BLINDS-II (Yadav)  
         SD&A-355  Estimation of altitude in stereoscopic-3D versus 2D real-world scenes (Deas)

9:40 am  CVAS-342  Virtual tracking shots for sports analysis (Bennett)  

9:50 am  AVM-010  3D Perception: multi-camera embedded structure-from-motion prototype for real-time mapping (Mueller)  
         COIMG-417  A model based neuron detection approach using sparse location priors (Majee)  
         DPNI-066  A novel framework for fast MRF optimization (Somanath)  
         IQSP-221  No-reference image contrast assessment based on just-noticeable-difference (Kim)

10:00 am  SD&A-356  Study of objective parameters of 3D visual fatigue based on analysis of salient area (Du)

10:00 am  CVAS-343  Aerodynamic analysis via foreground segmentation (Carey)

10:10 am  AVM-451  Measuring MTF with wedges: Pitfalls and best practices (Koren)  
         COIMG-449  Multi-resolution Data Fusion (MDF) for computational electron microscopy (Sreehari)

10:30 am  HVEI-112  Eidolons: Effects of capricious local sign (Invited) (Koenderink)  
         MWSF-317  Embedding information into objects fabricated with 3D printers by forming fine cavities inside them (Suzuki)

10:50 am  AVM-012  Free-view multicamera visualization and harmonization for automotive systems (Zlokasica)  
         COIMG-418  High spatial resolution detection method for point light source in scintillator (Xu)  
         CVAS-344  Goal! Event detection in sports video (Tsagkatakis)  
         DPNI-067  Heterogeneous computational imaging (Pulli)  
         IQSP-222  How to use video quality metrics for something other than video compression (Kokaram)  
         MAAP-273  Comparison between angularly and spectrally resolved gloss measurements with gloss measurements carried out on a national reference goniometer for gloss calibration (Charriere)  
         SD&A-357  Architectures and codecs for real-time light field streaming (JIST-first) (Kovács)  
         VIPC-398  A fast TU mode decision algorithm based on residual difference for HEVC (Li)

10:55 am  MWSF-319  High-capacity reversible data hiding in encrypted images using MSB prediction (Puteaux)

11:00 am  HVEI-113  Careful methods and measurements for comparisons between men and machines (Invited) (Wichmann)

11:10 am  AVM-013  Accelerated stereo matching for autonomous vehicles using upright pinhole camera model (Chen)
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<tr>
<td>11:20 am</td>
<td>COIMG-419</td>
<td>A randomized approach to reduce metal artifacts in x-ray computed tomography</td>
<td>Castañón</td>
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<tr>
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<td>CVAS-345</td>
<td>Pose estimation for deriving kinematic parameters of competitive swimmers</td>
<td>Zecha</td>
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<td>MAAP-274</td>
<td>A normal vector and BTF profile measurement system using a correlation camera and scanning dome illumination</td>
<td>Kimachi</td>
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<td>SD&amp;A-358</td>
<td>Wide viewing angle projection-type integral 3D display system with multiple UHD projectors</td>
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<td>VIPC-399</td>
<td>A fast intra mode decision algorithm for HEVC</td>
<td>Liao</td>
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<td>11:30 am</td>
<td>MWVF-320</td>
<td>The A Priori knowledge based secure payload estimation model for additive model</td>
<td>Ma</td>
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<td>AVM-014</td>
<td>Perspectives correct bird’s views using stereo vision</td>
<td>Christian Fuchs and Dietrich Paulus, University of Koblenz-Landau (Germany)</td>
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<td>COIMG-420</td>
<td>Joint segmentation and material recognition in dual-energy CT images</td>
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<td>Comparison of a virtual gameday experience on differing devices</td>
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<td>Is there a multicamera future? [Invited]</td>
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<td>Perceptual and engineering implications of cascaded gain control models [Invited]</td>
<td>Simoncelli</td>
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<td>IQSP-223</td>
<td>MS-UNIQUE: Multimodel and sharpness-weighted unsupervised image quality estimation</td>
<td>Prabhushankar</td>
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<td>MAAP-275</td>
<td>Polarimetric multispectral bidirectional reflectance distribution function measurements using a Fourier transform instrument</td>
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<td>SD&amp;A-359</td>
<td>A novel hardware based method for multiview glassless 3D display</td>
<td>Chen</td>
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<td>VIPC-400</td>
<td>Diamond frequency domain inter frame motion estimation for HEVC</td>
<td>Abdelazim</td>
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<td>11:50 am</td>
<td>AVM-015</td>
<td>A sense and avoid algorithm using surround stereo vision for drones</td>
<td>Godaliyadda</td>
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<td></td>
<td>COIMG-421</td>
<td>MultiGPU acceleration of branchless distance driven projection and backprojection for Clinical Helical CT [IJIST-first]</td>
<td>[Witra]</td>
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<td>CVAS-347</td>
<td>Digital playbook – A teaching tool for American football</td>
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<td>DPMI-069</td>
<td>Capturing light field video for 6DOF VR playback [Invited]</td>
<td>[Jiang]</td>
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<td>IGSP-224</td>
<td>Microarchitectural analysis of a GPU implementation of the most apparent distortion image quality assessment algorithm</td>
<td>Kannan</td>
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<td>MAAP-276</td>
<td>Optimal IED selection for multispectral lighting reproduction</td>
<td>[LeGendre]</td>
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<td>SD&amp;A-360</td>
<td>Multilevel light modulation of three-dimensional magneto-optic spatial light modulator using optically addressing method</td>
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<td>VIPC-401</td>
<td>Compression of infrared images</td>
<td>Mantel</td>
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<td>12:00 pm</td>
<td>HVEI-116</td>
<td>Emerging visual representations in deep learning networks [Invited]</td>
<td>Oliva</td>
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<td>12:10 pm</td>
<td>AVM-011</td>
<td>Real-time flight altitude estimation using phase correlation with gram polynomial decimation</td>
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<td>COIMG-422</td>
<td>Fast and robust discrete computational imaging</td>
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<td>DPMI-070</td>
<td>Representation and compression for cinematic VR [Invited]</td>
<td>Lakshman</td>
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<td>IQSP-225</td>
<td>Image quality assessment by comparing CNN features between images [IJIST-first]</td>
<td>Ali Amirshahi</td>
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<td>SD&amp;A-361</td>
<td>Integral three-dimensional display with high quality using multiple flatpanel displays</td>
<td>Okaichi</td>
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<td>VIPC-402</td>
<td>Graph regularized sparse coding by modified online dictionary learning</td>
<td>Sha</td>
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<td>2:00 pm</td>
<td>PLENARY</td>
<td>Giga-scale 3D computational microscopy</td>
<td>Waller</td>
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<td>3:30 pm</td>
<td>AVM-016</td>
<td>Needs and challenges analysis for reference architectures in autonomous systems</td>
<td>Zander</td>
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<td>COIMG-423</td>
<td>Linear mapping based inverse tone mapping</td>
<td>Kim</td>
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<td>CVAS-348</td>
<td>Automated sports broadcasting</td>
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<td>DPMI-071</td>
<td>Quantifying the luminance ratio of interior and exterior scenes: Challenges and tradeoffs in definitions, current standards, measurement methodologies and instrumentation, capturing capabilities of digital cameras, effects of veiling glare</td>
<td>Voltolini de Azambuja</td>
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<td>HVEI-117</td>
<td>Movies and meaning: From low-level features to mind reading [Invited]</td>
<td>Benini</td>
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<td>IQSP-226</td>
<td>Potential contrast – A new image quality measure</td>
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<td>MAAP-288</td>
<td>Modeling and reproducing effect paints</td>
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<td>MWSF-321</td>
<td>Benefits of combining forensic image creation and file carving</td>
<td>Steinebach</td>
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<td>SD&amp;A-362</td>
<td>Stereoscopic displays, tracking, interaction, education, and the web</td>
<td>Chavez</td>
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<td>VIPC-403</td>
<td>A coarse-to-fine framework for video object segmentation</td>
<td>Zhang</td>
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### Paper Schedule by Day/Time

| 3:50 pm | COIMG-424 | Performance of the 14 skin-colored patches to accurately estimate the human skin (Choi) |
| 3:50 pm | DPMI-072 | Sensitivity analysis applied to ISO recommended camera color calibration methods to determine how much of an advantage, if any, does spectral characterization of the camera offer over the chart-based approach (Sampat) |
| 3:50 pm | IQSP-227 | Observer calibrator for color vision research (Zhou) |
| 3:50 pm | MAAP-289 | How to design a recto-verso print displaying different images in various everyday-life lighting conditions (Dalloz) |
| 3:50 pm | VIPC-404 | A fast and accurate segmentation method for medical images (Wu) |
| 3:55 pm | MWSF-322 | Codec-embedded MP3 partial encryption for DRM (Steinebach) |
| 4:10 pm | COIMG-425 | Skin-representative region in a face for finding true skin color (Suk) |
| 4:10 pm | DPMI-073 | Perceptual optimization driven by image quality metrics (Invited) (Wang) |
| 4:10 pm | IQSP-228 | Knowledge based taxonomic scheme for full reference objective image quality measurement models (JIST-first) (Lahoulou) |
| 4:10 pm | MAAP-290 | Appearance decomposition and reconstruction of textured fluorescent objects (Tominaga) |
| 4:10 pm | VIPC-405 | Adaptive combination of local motion, appearance, and shape for video segmentation (JIST-first) (Lee) |
| 4:20 pm | HVEI-119 | On the role of color in visual saliency (Etchebehere) |
| 4:20 pm | MWSF-323 | How to recompress a JPEG crypto-compressed image? (Itier) |
| 4:30 pm | AVM-017 | Enabling functional safety ASIL compliance for autonomous driving software systems (Chitnis) |
| 4:30 pm | DPMI-074 | Looming challenges in mobile imaging quality: New technologies and new markets (Invited) (Cardinal) |
| 4:30 pm | IQSP-229 | A RGB-NIR data set for evaluating dehazing algorithms (Lüthen) |
| 4:30 pm | MAAP-291 | Assessing the proper color of translucent materials by an extended two-flux model from measurements based on an integrating sphere (Simonot) |

### Tuesday, January 31, 2017

<p>| 8:50 am | AVM-018 | Common themes in autonomous navigation on earth and in space (Matthies) |
| 8:50 am | COIMG-454 | Atomistic simulations of interface characteristics in materials systems (Rickman) |
| 8:50 am | COLOR-026 | Widergamut mobile-device displays: Gamut mapping and color enhancement challenges (Safaee-Rad) |
| 8:50 am | HVEI-378 | Depth-compressed expression for providing natural, visual experiences with integral 3D displays (Sawahata) |
| 8:50 am | IPAS-197 | Compressed sensing MRI using curvelet sparsity and nonlocal total variation (Pour Yazdanpanah) |
| 8:50 am | IQSP-249 | Towards the development of the IEEE P1858 CPIQ standard – A validation study (Jin) |
| 8:50 am | MWSF-324 | Pre-training via fitting deep neural network to rich-model features extraction procedure and its effect on deep learning for steganalysis (Zeng) |
| 8:50 am | VIPC-406 | Improvement of infrared image based on directional anisotropic wavelet transform (Jin) |
| 9:00 am | SRV-349 | Traffic light recognition and dangerous driving events detection from surveillance video of vehicle camera (Guan) |
| 9:10 am | COIMG-426 | A phase-coded aperture camera with programmable optics (Chen) |
| 9:10 am | COLOR-027 | Methods of defining a gamut boundary based on a face/vertex encoding (Green) |
| 9:10 am | HVEI-379 | Blind quality prediction of stereoscopic 3D images (Wang) |
| 9:10 am | IPAS-198 | Brand detection framework in LG wavelet domain (Wangiatoral) |
| 9:10 am | MAAP-282 | Graininess appearance of goniochromatic samples in lighting cabinets (Iacomussi) |
| 9:10 am | VIPC-407 | New diamond half-pel hexagon search algorithm for block matching motion estimation (Abdelazim) |
| 9:15 am | MWSF-325 | Histogram layer, moving convolutional neural networks towards feature-based steganalysis (Sedighianaraki) |
| 9:20 am | IQSP-250 | A methodology for perceptual image quality assessment of smartphone cameras – color quality (Farnand) |
| 9:20 am | SRV-350 | A combined HOG and deep convolution network cascade for pedestrian detection (Lipetski) |</p>
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<td>COIMG-427</td>
<td>Wavefront correction using self-interference incoherent digital holography</td>
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<td>COLOR-028</td>
<td>Gamut mapping in RGB colour spaces with the iterative ratios diffusion algorithm</td>
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<td>IPAS-199</td>
<td>Texture representations in different basis functions for image synthesis using system criteria analysis</td>
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<td>MAAP-283</td>
<td>Measurement and evaluation method of orange peel</td>
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<td>SD&amp;A-380</td>
<td>Pseudo-haptic by stereoscopic images and effects on muscular activity</td>
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<td>VIPC-408</td>
<td>Self-example-based edge enhancement algorithm for around view monitor images</td>
<td>Choi</td>
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<td>9:40 am</td>
<td>IQSP-251</td>
<td>Assessing the ability of simulated laboratory scenes to predict the image quality performance of HDR captures (and rendering) of exterior scenes using mobile phone cameras</td>
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<td>MWVSF-326</td>
<td>Model based steganography with precover</td>
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<td>SRV-352</td>
<td>A multi-scale approach to skin pixel detection</td>
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<td>AVM-019</td>
<td>Milpet – The self-driving wheelchair</td>
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<td>COIMG-428</td>
<td>Non-iterative image reconstruction for single photon image sensors</td>
<td>Chan</td>
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<td>COLOR-029</td>
<td>Checklist for daltonization methods: Requirements and characteristics of a good recoloring method</td>
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<td>Adaptive multireference prediction using a symmetric framework</td>
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<td>SRV-351</td>
<td>Detecting and estimating sound events locations through a microphone array</td>
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<td>COLOR-030</td>
<td>On the edge: A scalable daltonization method focusing on color contrasts and color edges</td>
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<td>A preliminary study on convolutional neural networks for camera model identification</td>
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<td>Single image super-interpolation using adjusted self-exemplars</td>
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<td>Estimating appearance differences of 3D objects with an RGB camera</td>
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<td>Artifact suppression in compressed images using residual-based deep convolutional network</td>
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<td>See-through projection 3D display using time-division multiplexing</td>
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<td>Semi-supervised learning feature representation for historical Chinese character recognition</td>
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<td>10:50 am</td>
<td>MWVSF-328</td>
<td>Design principles of convolutional neural networks for multimedia forensics</td>
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<td>Perceptual evaluation of psychovisual rate-distortion enhancement in video coding</td>
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<td>HVEI-122</td>
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<td>MWSF-329</td>
<td>Image recapturing detection with convolutional and recurrent neural network (Li)</td>
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<td>Deep reinforcement learning framework for autonomous driving (El Sallab)</td>
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<td>IQSP-257</td>
<td>The effects of misregistration on the dead leaves cross-correlation texture blur analysis (Burada)</td>
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<td>SD&amp;A-382</td>
<td>A low-cost static volumetric display based on layered high incidence angle scattering (Frayne)</td>
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<td>Pose estimation from rigid face landmarks for driver monitoring systems (Shankar)</td>
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<td>HVEI-125</td>
<td>Subjective evaluation of distortions in first-person videos (Bai)</td>
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<td>RENARY</td>
<td>VR 2.0: Making virtual reality better than reality (Wetzstein)</td>
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<td>2:10 pm</td>
<td>COIMG-433</td>
<td>Augmenting salient foreground detection using Fiedler vector for multi-object segmentation (Kucer)</td>
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<td>2:20 pm</td>
<td>COLOR-036</td>
<td>Color discrimination threshold for medical test devices (Hassani)</td>
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<tr>
<td>3:30 pm</td>
<td>DPMI-083</td>
<td>BM3DHVS: Content-adaptive denoising for improved visual quality (Invited) (Egiazarian)</td>
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<tr>
<td>3:40 pm</td>
<td>HVEI-127</td>
<td>Image and video compression for mobile: Is my screen small enough? (Invited) (Delp)</td>
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<tr>
<td>3:50 pm</td>
<td>COIMG-434</td>
<td>Non-destructive localization of overpaintings in Byzantine miniature illuminations (Psarrou)</td>
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<tr>
<td>4:00 pm</td>
<td>HVEI-128</td>
<td>Usage perspectives on perceptually lossless and lossy quality (Invited) (High)</td>
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<tr>
<td>4:10 pm</td>
<td>IPAS-084</td>
<td>Refining raw pixel values using a value error model to drive texture synthesis (Dietz)</td>
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<td></td>
<td>IQSP-231</td>
<td>Resolution enhancement through superimposition of projected images: An evaluation of the image quality (Hansen)</td>
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<td></td>
<td>SD&amp;A-368</td>
<td>Pixel based adaptive normalized cross correlation for illumination invariant stereo matching (Chang)</td>
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<td>4:20 pm</td>
<td>HVEI-129</td>
<td>Subjective assessment and the criteria for visually lossless compression (Invited) (Wilcox)</td>
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<tr>
<td>4:30 pm</td>
<td>COIMG-435</td>
<td>Computing height and width of in situ sorghum plants using 2.5d infrared images (Baharav)</td>
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<tr>
<td>4:40 pm</td>
<td>MWSF-339</td>
<td>Real time depth estimation method using hybrid camera system (Bai)</td>
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<tr>
<td>4:50 pm</td>
<td>SD&amp;A-367</td>
<td>The future of material communication via the Appearance Exchange Format (AxF) (Ellens)</td>
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<tr>
<td>5:00 pm</td>
<td>HVEI-126</td>
<td>The effects of misregistration on the dead leaves cross-correlation texture blur analysis (Burada)</td>
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<td>COIMG-451</td>
<td>3-D Shape recovery from real images using a symmetry prior (Jayadevan)</td>
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<td>5:20 pm</td>
<td>IPAS-203</td>
<td>ICA-based background subtraction method for an FPGA-Soc (Carrizosa-Coral)</td>
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<tr>
<td>5:30 pm</td>
<td>IQSP-255</td>
<td>Texture MTF from images of natural scenes (Branca)</td>
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<tr>
<td>5:40 pm</td>
<td>SD&amp;A-365</td>
<td>Portrait and landscape mode convertible stereoscopic display using parallax barriers (Minami)</td>
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<tr>
<td>5:50 pm</td>
<td>PLENARY</td>
<td>VR 2.0: Making virtual reality better than reality (Wetzstein)</td>
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<tr>
<td>6:00 pm</td>
<td>COLOR-035</td>
<td>Towards a perceptually-motivated color space for high dynamic range imaging (Abebe)</td>
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<td>6:10 pm</td>
<td>IPAS-204</td>
<td>A robust line segmentation for Arabic printed text with diacritics (Mohammad)</td>
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<tr>
<td>6:20 pm</td>
<td>SD&amp;A-366</td>
<td>Digital holographic display with two-dimensional and three-dimensional convertible feature by high speed switchable diffuser (Hong)</td>
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<td>6:30 pm</td>
<td>MWSF-330</td>
<td>Autoencoder with recurrent neural networks for video forgery detection (D'Avino)</td>
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<td>6:40 pm</td>
<td>AVM-024</td>
<td>Camera phone texture preservation measurements with modulation transfer function: An alternative approach for noise estimation of random texture chart images (Suresh)</td>
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<td>6:50 pm</td>
<td>HVEI-123</td>
<td>On the perceptual factors underlying the quality of post-compression enhancement of textures (Yaacob)</td>
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<td>7:00 pm</td>
<td>MWSF-339</td>
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<td>AVM-023</td>
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Paper Schedule by Day/Time
Wednesday, February 1, 2017

8:50 am
COLOR-041  Color halftoning based on Neugebauer Primary Area Coverage (Jiang)
HVEI-132  Orientation-ocularity maps: A technique for computer vision (Restrepo)
IMSE-077  Bayer pattern and image quality (Kunze)
IPAS-205  Water region extraction in thermal and RGB sequences using spatiotemporally-oriented energy features (Ghahremani)
IRIACV-258  Efficient visual loop closure detection via moment based global image descriptors (Erhan)
MOBMU-292  Introduction to WLAN-fingerprinting based indoor localization (Akopian)
MWSF-331  Videos versus still images: Asymmetric sensor pattern noise comparison on mobile phones (Galdi)
SD&A-340  Sharpness mismatch and 6 other stereoscopic artifacts measured on 10 Chinese 3D movies (Vatolin)

9:10 am
COLOR-042  Color halftoning based on multi-stage, multi-pass, clustered-DBS (Xi)
ERVR-089  Oculus rift with stereo camera for augmented reality medical intubation training (Lim)
HVEI-133  Evaluation of color prediction methods in terms of least dissimilar asymmetric matching (Roshan)
IMAWM-157  The internet on things: Delivering augmented reality experiences in context (Gormish)
IPAS-206  Cloud and shadow detection using sequential characteristics on multi-spectral satellite images (Groot)
IQSP-238  Feature ranking and selection used in a machine learning framework for predicting uniformity of printed pages (Nguyen)
IRIACV-259  Real-time mobile robot navigation based on stereo vision and low-cost GPS (Hong)
MOBMU-299  Android door and window image based measurements (Mohammad)
SD&A-370  Bringing 3DMap to the 21st century (Keith)

9:15 am
MWSF-332  Linear filter kernel estimation based on digital camera sensor noise (Liu)

9:30 am
COLOR-43  On large local error accumulation in multilevel error diffusion (IJISTfirst) (Eschbach)
ERVR-090  Virtual reality instructional modules in education based on gaming metaphor (Sharma)
<table>
<thead>
<tr>
<th>Time</th>
<th>Session/Title</th>
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<tbody>
<tr>
<td>9:40 am</td>
<td>MWSF-333 PRNU-based forgery detection with discriminative random fields (Chakraborty)</td>
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<tr>
<td>9:50 am</td>
<td>COLOR-044 Edge-preserving error diffusion for multi-toning based on dual quantization (Kiyotomo)</td>
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<td></td>
<td>DPMI-079 Interferometric measurement of sensor MTF and crosstalk (Georgiev)</td>
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<td>ERVR-092 Drawing towards virtual reality (Dolinsky)</td>
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<td>HVEI-135 Robust dynamic range computation for high dynamic range content (Hulusic)</td>
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<td>IPAS-208 Face spoofing detection based on local binary descriptors (Tsai)</td>
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<td>IRIACV-261 Targeted intelligent autonomous robotics contest: The European Roboathlon (Ronning)</td>
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<td>MOBMU-294 Blackmagic production camera raw color investigation by spectral analysis of Macbeth color charts (Hasche)</td>
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<td>SD&amp;A-373 Improved depth of field analysis of multilayer displays (Gotoda)</td>
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<tr>
<td>10:10 am</td>
<td>MOBMU-295 Liquid crystal lens characterization for integrated depth sensing and all in focus imaging application (Emberger)</td>
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<td>10:30 am</td>
<td>HVEI-136 GPU-accelerated vision modeling with the HPE cognitive computing toolkit (Invited) (Chandler)</td>
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<td>MWSF-335 Sensitivity of different correlation measures to print and scan process (Tkachenko)</td>
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<tr>
<td>10:50 am</td>
<td>COLOR-045 Selecting best ink color for sparse watermark (Reed)</td>
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<td>DPMI-080 Silicon retina technology (Invited) (Dellbruck)</td>
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<td>ERVR-093 The Destiny class CyberCANOE: a surround screen, stereoscopic, cyber-enabled collaboration analysis navigation and observation environment (Kawano)</td>
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<td>IMAWWM-158 MS-Celeb-1M: A review of large-scale face recognition (Invited) (Guo)</td>
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<td>IPAS-209 Real-time estimation of the 3D transformation between images with large viewpoint differences in cluttered environments (van de Wouw)</td>
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<td>IRIACV-240 UHD quality analyses at various viewing conditions (Lee)</td>
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<td>IRIACV-262 Application of big data analytics for recognition of microbial colonies from hyperspectral images (Yoon)</td>
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<td>SD&amp;A-374 Stereorendering of photorealistic precipitation (Hussain)</td>
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<td>11:00 am</td>
<td>MWSF-336 Scalable processing history detector for JPEG images (Baroumand)</td>
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<td>HVEI-137 A neurally-inspired algorithm for detecting ordinal depth from motion signals in video streams (Invited) (Livitz)</td>
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<td>MOBMU-296 High quality virtual lighting using image-based lighting and projection onto meshes generated from Lidar and SFM Point Clouds (Hasche)</td>
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<tr>
<td>11:10 am</td>
<td>COLOR-046 Page classification for print imaging pipeline (Xu)</td>
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<td>ERVR-094 CAVE versus head-mounted displays: On-going thoughts (Mestre)</td>
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<td>IPAS-210 Camera-to-model back-raycasting for extraction of RGBD images from pointclouds (Javan Hemmat)</td>
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<td>IRIACV-241 Image quality assessment for holographic display (Seo)</td>
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<td>IRIACV-263 Weaving pattern recognition of ancient Chinese textiles by regular bands analysis (Chan)</td>
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<td>SD&amp;A-372 Utilization of stereoscopic 3D images in elementary school social studies classes (Shibata)</td>
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<td>11:20 am</td>
<td>MOBMU-297 A billion words to remember (Nagyi)</td>
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<td>MWSF-337 Deciphering severely degraded license plates (Agarwal)</td>
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<td>11:30 am</td>
<td>COLOR-047 Indirect periodic disturbance compensator using feedforward control for image noises (Kaneko)</td>
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<td>DPMI-081 TIK: A time domain continuous imaging testbed using conventional still images and video (Dietz)</td>
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<td>ERVR-095 Distributed rendering using NVIDIA OptiX (McCarthy)</td>
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<td>HVEI-138 Computational estimation of scene structure through texture gradient cues (Invited) (Tyler)</td>
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<td>11:40 am</td>
<td>Demographic prediction based on mobile user data</td>
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<td>11:45 am</td>
<td>PCB surface fingerprints based counterfeit detection of electronic devices</td>
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<td>11:50 am</td>
<td>3D halftoning</td>
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<td>Laser illuminated projectors and the technological advancements brought forth to immersive environments</td>
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<td>Creating the world’s largest real-time camera network</td>
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<td>12:00 pm</td>
<td>Learning visual representations for active perception</td>
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<td>Optimizing video transmission for mobile devices</td>
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<td>12:10 pm</td>
<td>New VR navigation techniques to reduce cybersickness</td>
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<td>Multimedia instant messaging with real-time attribute-based encryption</td>
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<td>Education in industrial machine vision in Upper Austria University of Applied Sciences (bachelor/master) with respect to the needs by the European industry and automation engineering</td>
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<td>12:20 pm</td>
<td>Comparative visualization of the geometry of a hollow box girder using 3D LiDAR – Part 2: Reconstruction of a 3D geometric model</td>
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<td>27</td>
<td>electronicimaging.org</td>
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<td>4:30 pm</td>
<td><strong>COLOR-052</strong> Lights, camera, metameric failure (Pines)</td>
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<td><strong>ERVR-108</strong> Exploring Calit2 (Schulze)</td>
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<td><strong>HVEI-143</strong> Determining the influence of image-based cues on human</td>
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<td>skin gloss perception (Wang)</td>
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<td><strong>IWAAM-165</strong> Robust head detection with CNN (Chen)</td>
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<td><strong>IMSE-181</strong> The challenge of shot-noise limited speckle patterns</td>
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<td>statistical analysis (Tuille)</td>
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<td><strong>IQSP-247</strong> Autofocus analysis: Latency and sharpness</td>
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<td><strong>IRIACV-270</strong> Traffic Camera Dangerous Driver Detection</td>
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<td>(TCD3™): Contextually aware heuristic feature &amp; OFA density-based</td>
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<td>computer vision with movement machine learning analysis of live</td>
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<td>streaming traffic camera footage to identify anomalous &amp; dangerous</td>
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<td><strong>MOBMU-304</strong> Pokemon Go – A forensic analysis</td>
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<td><strong>VDA-384</strong> An interactive tool for Analyzing the Correlation,</td>
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<td>Uncertainty, and Clustering (ACUC) over ensembles in climate dataset</td>
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<td><strong>VDA-450</strong> Constellations of movement: An interactive application to</td>
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<td>visualise research in motor imagery decoding (Rogers)</td>
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<td><strong>COLOR-053</strong> What we see and what we know: Partners in human vision</td>
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<td><strong>HVEI-144</strong> Writer identification in modern and historical documents</td>
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<td>via binary pixel patterns, Kolmogorov-Smirnov test and</td>
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<td>Fisher’s method (JISTfirst) (Schaus)</td>
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<td><strong>IMSE-182</strong> Overview of machine vision standards (Darmont)</td>
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<td><strong>IRIACV-271</strong> An insitu defect detection system for Big Area Additive</td>
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<td>Manufacturing using laser profilometry (Goin)</td>
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<td><strong>MOBMU-305</strong> Computation of equidistant curve for the image with</td>
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<td><strong>SD&amp;A-109</strong> 3D-Stereoscopic immersive analytics projects at Monash</td>
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<td>University and University of Konstanz (Sommer)</td>
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<td><strong>HVEI-145</strong> CNN-based transfer learning for historical Chinese</td>
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<td><strong>IMSE-183</strong> Hot pixel rate behavior as pixel sizes go to 1 micron</td>
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<td><strong>IRIACV-272</strong> Outlier detection in large-scale traffic data by naive</td>
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<td>Sparse Shrink (Li)</td>
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<td><strong>SD&amp;A-110</strong> Image distortions in large-scale immersive display</td>
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<td>systems – Cylinder and wedge displays (Woods)</td>
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<td>5:20 pm</td>
<td><strong>IMSE-184</strong> Performance evaluation of the thick pinhole gamma rays</td>
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<td>diagnostic system (Kie)</td>
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<td>5:30 pm</td>
<td><strong>COIMG-439</strong> Non-iterative joint demosaicing and super resolution</td>
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<td>framework (Petrova)</td>
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<td><strong>COIMG-440</strong> Localized high dynamic range plenoptic image</td>
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<td>compression (Chang)</td>
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<td><strong>COIMG-441</strong> Image-based age estimation: Comparing hand crafted and</td>
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<td>deep features (Dornaika)</td>
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<td><strong>COIMG-442</strong> Compressive light field display using scattering</td>
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<td>polarizer (Lee)</td>
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<td><strong>COIMG-443</strong> High-resolution image reconstruction for PET using local</td>
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<td>and non-local regularizations (Ren)</td>
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<td><strong>COIMG-444</strong> 3D reconstruction based multiple view depth generation</td>
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<td>using heterogeneous cameras (Shin)</td>
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<td><strong>COIMG-445</strong> Deep convolutional neural networks for the classification</td>
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<td>of snapshot mosaic hyperspectral imagery (Fotiadou)</td>
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<td><strong>COIMG-446</strong> Space-variant smoothing in median-regularized recon-</td>
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<td>construction for transmission tomography (Jung)</td>
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<td><strong>COIMG-447</strong> A viewing direction control camera without mechanical</td>
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<td>motion based on computational imaging (Teraya)</td>
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<td><strong>COIMG-448</strong> The human sclera and pupil as the calibration targets</td>
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<td></td>
<td>(Choi)</td>
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<td><strong>DPMI-075</strong> A Canon hack development kit implementation of time</td>
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<td>domain continuous imaging (Long)</td>
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<td><strong>DPMI-076</strong> Advanced HDR fusion method for image sensor with</td>
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<td>variable pixel exposure (Uvarov)</td>
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<td><strong>IPAS-087</strong> Search the optimal border for combination of image pairs</td>
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<td>using neural networks (Semenischchev)</td>
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<td><strong>IPAS-211</strong> Feature representation learning by rank ordered autoen-</td>
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<td>decoder for multi-camera person re-identification (Makov)</td>
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<td><strong>IPAS-213</strong> Change detection from remote sensing images based on</td>
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<td>fractional integral and improved FCM (Wang)</td>
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## Thursday, February 2, 2017

**8:50 am**

- **COLOR-054** Extraordinary perceptual color stability in low cost, real-time color image compression inspired by structure tensor analysis (Lebowsky)
- **HVEI-146** Comparison of visual discomfort and visual fatigue between HMD and smartphone (Suk)
- **IMAWM-166** Analytics for body worn cameras (Invited) (Fan)
- **IMSE-185** Octagonal CMOS image sensor for endoscopic applications (Reis)
- **VDA-386** Declarative guide creation (Cottam)

**9:10 am**

- **3DIPW-001** A 3D mesh image quality metric based on features fusion (Chetouani)
- **COLOR-055** Sky color enhancement of photographic images (Zeng)
- **ERVR-098** VR journeys from the dark ages to a bright future (Dawe)
- **HVEI-147** Measuring visually induced motion sickness using wearable devices (Liu)
- **IMSE-186** Optimization of CMOS image sensor utilizing variable temporal multisampling partial transfer technique to achieve full-frame high dynamic range with superior low light and stop motion capability (Kabir)
- **VDA-387** Visual-interactive semi-supervised labeling of human motion capture data (Bernard)

**9:30 am**

- **3DIPW-002** 3D blind mesh quality assessment index (Nouri)
- **COLOR-056** A novel colour hessian and its applications (Tahery)
- **HVEI-148** Developmental changes in ambient and focal visual processing strategies (Krishna)
- **IMAWM-167** Click-based interactive segmentation with graph cut (Tai)
- **IMSE-187** A lateral electric field charge modulator with bipolar-gates for time-resolved imaging (Morikawa)
- **VDA-388** Visual-interactive creation and validation of text clustering workflows to explore document collections (Ruppert)

**9:50 am**

- **3DIPW-003** A magnifier on accurate depth jumps (Hach)
- **COLOR-057** A color image model with applications to denoising (Fuller)
- **HVEI-149** Gaze-contingent center-surround fusion of infrared images to facilitate visual search for human targets (JIST-first) (Glaholt)
- **IMAWM-168** Drone Detection by acoustic signature identification (Bernardini)
Paper Schedule by Day/Time

10:10 am
ERVR-099  The Qlik Environment (Margolis)
HVEI-150  Evaluation and prediction of evoked emotions induced by image manipulations (Yuan)
IMAWM-169  Aesthetics of fashion photographs: Effect on user preferences (Li)

10:50 am
3DIPM-004  3D microscopic image construction using high dynamic range imaging (Zheng)
COLOR-058  Addressing the colorometric redundancy in 11-ink color separation (Nyström)
ERVR-103  The Reality Wall: The aesthetics of reality disambiguation in AR/VR (Lichty)
IMAWM-170  Local boosted features for illumination invariant face recognition (Essa)
IMSE-189  Residual bulk image characterization using photon transfer techniques (Crisp)
VDA-390  Megacity: A collaborative virtual reality environment for emergency response, training, and decision making (Sharma)

11:00 am
HVEI-151  Measurement problems and measurement strategies for capturing the rich experience of art (Invited) (Carbon)

11:10 am
3DIPM-005  Digitized 3D mesh segmentation based on curvature analysis (Gauthier)
COLOR-059  Spectral band selection using a genetic algorithm based wiener filter estimation method for reconstruction of munsell spectral data (Gouton)
ERVR-104  Decoupling of real and digital content in projection based augmented reality systems using time multiplexed image capture (JIST-first) (Soomro)
IMAWM-171  High precision 3D reconstruction of the human face (Wang)
IMSE-190  RTS and photon shot noise reduction based on maximum likelihood estimate with multi-aperture optics and semi-photon-counting-level CMOS image sensors (Ishida)
VDA-391  Display systems for visualization and simulation in virtual environments (Wischgoll)

11:30 am
3DIPM-006  Small scale surface profile recovery using a tunable lens based system (Angot-Petit)
COLOR-060  Illumination and reflectance spectra separation of hyperspectral image data under multiple illumination conditions (Chen)
ERVR-100  A survey: Tools for human motion synthesis (Yan)
HVEI-152  The gist of beauty: An investigation of aesthetic perception in rapidly presented images (Invited) (Mullin)
IMAWM-172  Chromatic domain phase features with gradient and texture for efficient human detection (Ragb)
IMSE-191  Linearity analysis of a CMOS image sensor (Wang)
VDA-392  Ray traced volume clipping using multi-hit BVHTraversal (Zellmann)

11:50 am
COLOR-061  Multispectral face recognition using hybrid feature (Gouton)
ERVR-101  Exploring body gestures as natural user interface for flying in a virtual reality game with Kinect (Tong)
IMAWM-173  A real-time smile elegance detection system: A feature-level fusion and ranking SVM based approach (Lin)
IMSE-196  Automotive imaging (Denny)
VDA-393  Effectiveness of feature-driven storytelling in 3D time-varying data visualization (JIST-first) (Lu)

12:00 pm
HVEI-153  Gaze patterns in art viewing and their dependency on expertise and image characteristics (Invited) (Fedorovskaya)

12:10 pm
ERVR-102  Soft robotic glove for kinesthetic haptic feedback in virtual reality environments (Jadhav)

2:00 pm
3DIPM007  A comparison of stereo matching algorithms on multi-core digital signal processor platform (Menant)
COLOR-062  Interactive Workshop: How can color imaging provide us with powerful insights? (Lebowsky)
HVEI-154  Imaging human vision: An artistic perspective (Invited) (Pepperell)
IMAWM-174  MU, the ultra mobile visual analytic sensor for toys and IOTs (Yu)
IMSE-192  FPGA platform for testing a real-time tonemapping algorithm based on a Mantissa-exponent representation (Shahnovich)
VDA-394  A visual and statistical benchmark of graph sampling methods (Zhang)
2:20 pm

3DIPM-008  Viewing angle enhancement of a real-time integral imaging system using multi-directional projections and GPU parallel processing (Alam)

IMAWM-175  An imaging approach to online progressive addition lens retrieval (Li)

IMSE-194  Fast, low-complex, non-contact motion encoder based on the NSIP concept (Astrom)

VDA-395  Inferring partial orders of nodes for hierarchical network layout (JISTfirst) (Wu)

2:30 pm

HVEI-155  Art training matters: Enhancement of spatial cognition and brain connectivity (Invited) (Likova)

2:40 pm

IMAWM-176  Are mobile phones changing the order behavior and content for printed photo products? (Fageth)

IMSE-195  In the quest of vision-sensors-on-chip: Preprocessing sensors for data reduction (Rodríguez-Vázquez)

VDA-396  Closest point sparse octree for surface flow visualization (Kim)

3:00 pm

HVEI-156  Trading conversations between science and art: When musical improvisation enters the dialogue on stage (Invited) (Lopez-Gonzalez)

IMAWM-177  Texture re-rendering tool for remixing indoor scene images (Li)

VDA-397  Accelerating advection via approximate block exterior flow maps (Bleile)
3D Image Processing, Measurement (3DIPM), and Applications 2017

Conference overview
Scientific and technological advances during the last decade in the fields of image acquisition, processing, telecommunications, and computer graphics have contributed to the emergence of new multimedia, especially 3D digital data. Nowadays, the acquisition, processing, transmission, and visualization of 3D objects are a part of possible and realistic functionalities over the internet. Confirmed 3D processing techniques exist and a large scientific community works hard on open problems and new challenges, including 3D data processing, transmission, fast access to huge 3D databases, or content security management.

The emergence of 3D media is directly related to the emergence of 3D acquisition technologies. Indeed, recent advances in 3D scanner acquisition and 3D graphics rendering technologies boost the creation of 3D model archives for several application domains. These include archaeology, cultural heritage, computer assisted design (CAD), medicine, face recognition, video games, and bioinformatics. New devices such as time-of-flight cameras open challenging new perspectives on 3D scene analysis and reconstruction.

Three-dimensional objects are more complex to handle than other multimedia data, such as audio signals, images, or videos. Indeed, only a unique and simple 2D grid representation is associated to a 2D image. All the 2D acquisition devices generate this same representation (digital cameras, scanners, 2D medical systems). Unfortunately (for the users), but fortunately (for scientists), there exist different 3D representations for a 3D object. For example, an object can be represented on a 3D grid (digital image) or in 3D Euclidian space. In the latter, the object can be expressed by a single equation (like algebraic implicit surfaces), by a set of facets representing its boundary surface, or by a set of mathematical surfaces. One can easily imagine the numerous open problems related to these different representations and their processing, a new challenge for the image processing community.

Awards: Best Paper Award and Best Student Paper given to the author(s) of two full papers presented at the conference, selected by the Organizing Committee.
3D Image Processing, Measurement (3DIPM), and Applications 2017

Tuesday, January 31, 2017

Surface Appearance Assessment and Digital Methods I Joint Session

Session Chair: Greg Ward, Dolby Laboratories (United States)

9:10 – 10:10 am
Grand Peninsula Ballroom C

This session is jointly sponsored by: Material Appearance 2017 and 3D Image Processing, Measurement (3DIPM), and Applications 2017.

9:10 MAAP-282
Graininess appearance of goniochromatic samples in lighting cabinets, Paola Iacomussi, Michela Radis, and Giuseppe Rossi, INRIM (Italy)

9:30 MAAP-283
Measurement and evaluation method of orange peel, Takuroh Sone and Shuhei Watanabe, Ricoh Company, Ltd. (Japan)

9:50 MAAP-284
Enhanced RTI for gloss reproduction, Peter Fornaro, Andrea Bianco, and Lukas Rosenthaler, University of Basel (Switzerland)

10:00 am – 7:30 pm Industry Exhibition
10:10 – 10:50 am Coffee Break

Surface Appearance Assessment and Digital Methods II Joint Session

Session Chair: Mathieu Hebert, Université Jean Monnet de Saint Etienne (France)

10:50 – 11:50 am
Grand Peninsula Ballroom C

This session is jointly sponsored by: Material Appearance 2017 and 3D Image Processing, Measurement (3DIPM), and Applications 2017.

10:50 MAAP-285
Consistent tool-independent virtual material appearance, Dar’ya Guarnera1, Giuseppe Claudio Guarnera1, Cornelia Denk2, and Mashhuda Glencross1,3; 1Loughborough University (United Kingdom), 2BMW Research (Germany), and 3Switch That Limited (United Kingdom)

11:10 MAAP-286
Interactive object surface retexturing using perceptual quality indexes, Keita Hirai, Wataru Suzuki, Yoshimitsu Yamada, and Takahiko Horiuchi, Chiba University (Japan)

Thursday, February 2, 2017

3D Image Quality

Session Chair: Aladine Chetouani, University of Orléans (France)

9:10 – 10:10 am
Regency Ballroom A

9:10 3DIPM-001
A 3D mesh image quality metric based on features fusion, Aladine Chetouani, University of Orleans (France)

9:30 3DIPM-002
3D blind mesh quality assessment index, Anass Nouri, Christophe Charrier, and Olivier Lézoray, Normandie University (France)

9:50 3DIPM-003
A magnifier on accurate depth jumps, Thomas Hach and Sascha Knob, Arnold & Richter Cinetechnik (Germany)

10:10 – 10:50 am Coffee Break

3D Image Analysis

Session Chair: Olivier Strauss, University of Montpellier (France)

10:50 – 11:50 am
Regency Ballroom A

10:50 3DIPM-004
3D microscopic image construction using high dynamic range imaging, Chi Zheng1, Salvador Bernal Garcia2, and Guoping Gao1,2; 1University of Nottingham, Ningbo (China) and 2University of Nottingham (United Kingdom)

11:10 3DIPM-005
Digitized 3D mesh segmentation based on curvature analysis, Silvère Gauthier1,2, William Puech1, Roseline Bénier1, and Gérard Subsol1; 1University of Montpellier and 2C4W (France)

11:30 3DIPM-006
Small scale surface profile recovery using a tunable lens based system, Ludovic Angot-Petit, Industrial Technology Research Institute (Taiwan)

11:50 am – 2:00 pm Lunch Break

3D Imaging Systems

Session Chair: William Puech, University of Montpellier (France)

2:00 – 2:40 PM
Regency Ballroom A

2:00 3DIPM-007
A comparison of stereo matching algorithms on multi-core digital signal processor platform, Judicaël Menant, Jean-François Nezan, Muriel Pressigout, and Luce Morin, IETR - INSA de Rennes (France)

2:20 3DIPM-008
Viewing angle enhancement of a real-time integral imaging system using multi-directional projections and GPU parallel processing, Md. Ashraful Alam1,2, Md. Siratul Islam1, Mohd. Zishan Tareque1, Mahfuze Subhani Protik1, Md. Rashidur Rahman Rafi1, Md. Shahinur Alam2, and Nam Kim1; 1BRAC University (Bangladesh) and 2Chungbuk National University (Republic of Korea)

Meet the Future: A Showcase of Student and Young Professionals Research
3:00 – 5:00 pm
Atrium

3:20 – 4:00 pm Coffee Break
Autonomous Vehicles and Machines 2017

Conference overview
Joint advancements in sensing, computing, imaging processing, and vision are enabling unprecedented growth and interest in autonomous vehicles and intelligent machines, from self-driving cars to unmanned drones to personal service robots. These new capabilities have the potential to fundamentally change the way people live, work, commute, and connect with each other and will undoubtedly provoke entirely new applications and commercial opportunities for generations to come.

The inaugural focus of Autonomous Vehicles and Machines (AVM) will consider a broad range of topics as it relates to equipping vehicles and machines with the capacity to perceive dynamic environments, inform human participants, demonstrate situational awareness, and make unsupervised decisions on self-navigating. The conference seeks high-quality papers featuring novel research in areas intersecting sensing, imaging, vision, and perception with applications including, but not limited to, autonomous cars, ADAS (advanced driver assistance system), drones, robots, and industrial automation. In addition to the main technical program, AVM will include demonstrations and exhibits.
Keynote: Key Learnings from Automated Vehicle Development
Session Chair: Buyue Zhang, Intel Corporation (United States)
8:50 – 9:50 pm
Grand Peninsula Ballroom B

Architectures for automated driving, Jack Weast, Intel Corporation (United States)

Jack Weast is a Principal Engineer and the Chief Systems Engineer for Autonomous Driving Solutions at Intel Corporation. In his 17 year career at Intel, Weast has built a reputation as a change agent in new industries with significant technical and architectural contributions to a wide range of industry-first products and standards that range from the world’s first Digital Media Adapters to complex heterogeneous high performance compute solutions in markets that are embracing high performance computing for the first time. With an End to End Systems perspective, he combines a unique blend of embedded product experience with a knack for elegant Software and Systems design that will accelerate the adoption of Autonomous Driving. Weast is the co-author of “UPnP: Design By Example”, an Associate Professor at Portland State University, and the holder of numerous patents with dozens pending.

Multi-Camera and Embedded Systems for Autonomous Machines
Session Chair: Buyue Zhang, Intel Corporation (United States)
9:50 – 10:30 am
Grand Peninsula Ballroom B

9:50 – 10:30 am

3D Perception: Multi-camera embedded structure-from-motion prototype for real-time mapping, Martin Mueller, Vikram Appia, and Umit Batur; Texas Instruments Inc. and Faraday Future (United States)

10:10

Measuring MTF with wedges: Pitfalls and best practices, Norman Koren, Robert Sumner, and Henry Koren, Imatest LLC (United States)

10:30 – 10:50 am

Coffee Break

Multi-Camera and Embedded Systems for Autonomous Machines (cont.)
Session Chairs: Darnell Moore, Texas Instruments, and Yi Zhang, Ford Research and Innovation Center (United States)
10:50 AM – 12:30 pm
Grand Peninsula Ballroom B

10:50

Free-view multi-camera visualization and harmonization for automotive systems, Vladimir Zlokoci, Brian Deegan, Patrick Denny, Mark Griffin, and Barry Dever, Valeo (Ireland)

11:10

Accelerated stereo matching for autonomous vehicles using upright pinhole camera model, Chen Chen, Jiangbo Lu, Minh Do, Do-Kyoung Kwon, and Darnell Moore; Advanced Digital Sciences Center (Singapore), Texas Instruments (United States)

11:30

Perspective correct bird’s views using stereo vision, Christian Fuchs and Dietrich Paulus, University of Koblenz-Landau (Germany)

11:50

A sense and avoid algorithm using surround stereo vision for drones, G.M. Dilshan Godahakadada, D. Kyoung Kwon, Victor Cheng, and Darnell Moore; Purdue University and Texas Instruments (United States)

12:10

Real-time flight altitude estimation using phase correlation with gram polynomial decimation, Amir Badshah, Aadi Choudhury, and Saadullah Ammar; International Islamic University Islamabad and National University of Sciences and Technology (Pakistan)

12:30 – 2:00 pm

Lunch Break

EI 2017 Opening Plenary and Symposium Awards
Session Chairs: Joyce E. Farrell, Stanford University, and Nitin Sampat, Rochester Institute of Technology (United States)
2:00 – 3:00 pm
Grand Peninsula Ballroom D

Giga-scale 3D computational microscopy, Laura Waller, University of California, Berkeley (United States)

Laura Waller is the Ted Van Duzer Endowed Assistant Professor of Electrical Engineering and Computer Sciences (EECS) at UC Berkeley. She is a Senior Fellow at the Berkeley Institute of Data Science, and received her BS (2004), MEng (2005), and PhD (2010) in EECS from the Massachusetts Institute of Technology (MIT). Waller’s talk is on computational imaging methods for fast capture of gigapixel-scale 3D intensity and phase images in a commercial microscope that employs illumination-side and detection-side coding of angle (Fourier) space with simple hardware and fast acquisition. The result is high-resolution reconstructions across a large field-of-view, achieving high space-bandwidth-product.
Keynote: Functional Safety and Security in Autonomous System Design
Session Chair: Umit Batur, Faraday Future (United States)
3:30 – 4:30 pm
Grand Peninsula Ballroom B

Needs and challenges analysis for reference architectures in autonomous systems, Justyna Zander, Intel Corporation (United States)

Justyna Zander is Software Architect and Technology Lead in autonomous driving at Intel Corporation. Before joining Intel, she spent over a year working on self-driving cars, ADAS, and functional safety as a senior consultant in Germany. She engaged with Fortune 500 companies including most prestigious automotive OEMs. Prior to that, Zander was a postdoctoral research scientist at Harvard University and a senior scientist at the Fraunhofer Institute in Germany. She holds PhD, MSc, and two BSc degrees in computer science and electrical engineering. Her expertise includes modeling, simulation, deep learning, validation, and verification, functional safety, computing platforms, and rapid prototyping with worldwide operations focus. A frequent public speaker, she holds 6 patents, has 8 patent applications at USPTO, and has co-authored more than 40 publications and 3 books. Her publications have been cited more than 550 times. Zander is recognized internationally with countless awards (IEEE, European Union, NIST, etc). She regularly serves as a technical committee member for more than 50 journals and conferences, and is invited by NSF, EU Commission, and national councils to advise on government strategy and research roadmaps.

Tuesday, January 31, 2017

Keynote: Autonomous Vehicle Navigation in Planetary Exploration
Session Chair: Darnell Moore, Texas Instruments (United States)
8:50 – 9:50 am
Grand Peninsula Ballroom B

Common themes in autonomous navigation on earth and in space, Larry Matthies, Jet Propulsion Laboratory (United States)

Larry Matthies received his PhD in computer science from Carnegie Mellon University in 1989, then moved to the Jet Propulsion Laboratory, where he a Senior Research Scientist and supervisor the Computer Vision Group. His research interests include 3-D perception, state estimation, terrain classification, and dynamic scene analysis for autonomous navigation of unmanned vehicles on Earth and in space. He has been a principal investigator in many programs involving robot vision funded by NASA, Army, Navy, DARPA, and commercial sponsors. He and his group have achieved several firsts in computer vision for space exploration, including development of vision algorithms used by rovers and landers in the 2003 Mars Exploration Rover mission. He is an Adjunct Professor of Computer Science at the University of Southern California, a lecturer in computer vision at Caltech, and a member of the editorial boards of the Autonomous Robots journal and the Journal of Field Robotics. He is a Fellow of the IEEE and was a joint winner in 2008 of the IEEE’s Robotics and Automation Award for his contributions to robotic space exploration.

Computer Vision, Machine Learning, and Image Processing
Session Chair: Darnell Moore, Texas Instruments (United States)
9:50 – 10:10 am
Grand Peninsula Ballroom B

Milpet – The self-driving wheelchair, Samuel Echefu, Jacob Lauzon, Suvam Bag, Rasika Kangutkar, Amar Bhatt, and Raymond Ptucha, Rochester Institute of Technology (United States)

Symposium Welcome Reception
5:00 – 6:00 pm
Atrium

10:00 am – 7:30 pm  Industry Exhibition
10:10 – 10:40 am  Coffee Break
**Computer Vision, Machine Learning, and Image Processing (continued)**

Session Chairs: Markus Vill, Intel Corporation (Germany), and Buyue Zhang, Intel Corporation (United States)

10:40 am – 12:40 pm
Grand Peninsula Ballroom B

10:40 AVM-020
Efficient pre-processor for CNN, Mihir Mody, Manu Mathew, and Shyam Jagannathan, Texas Instruments India Ltd. (India)

11:00 AVM-021
Free-space detection with self-supervised and online trained fully convolutional networks, Wimlen Sanberg, Gijs Dubbelman, and Peter de With, Eindhoven University of Technology (the Netherlands)

11:20 AVM-022
Motion estimation using visual odometry and deep learning localization, Suvam Bag, Vishwas Venkatachalapathy, and Raymond Ptucha, Rochester Institute of Technology (United States)

11:40 AVM-023
Deep reinforcement learning framework for autonomous driving, Ahmad El Sallab, Mohammed Abdou, Etienne Perot, and Senthil Yogamani, Valeo (Ireland)

12:00 AVM-024
Automatic glare detection via photometric, geometric, and global positioning information, Mehran Andalibi1 and Damon Chandler2; 1Embry-Riddle Aeronautical University (United States) and 2Shizuoka University (Japan)

12:20 AVM-025
Pose estimation from rigid face landmarks for driver monitoring systems, Bhawani Shankar, Jayachandra Dakala, and Kalyan Kumar Hati, Path Partner Technology Pvt Ltd. (India)

12:40 – 2:00 pm  Lunch Break

**Symposium Demonstration Session**

5:30 – 7:30 pm
Grand Peninsula Ballroom E

**Thursday, February 2, 2017**

**Keynote: History and Standards for Automotive Vision Systems Performance**

Session Chairs: Arnaud Darmont, APHESA SPRL (Belgium); Ralf Widenhorn, Portland State University (United States); and Buyue Zhang, Intel Corporation (United States)

11:50 am – 12:30 pm
Harbour

This session is jointly sponsored by: Image Sensors and Imaging Systems 2017 and Autonomous Vehicles and Machines 2017.

**Automotive imaging, Patrick Denny, Valeo (Ireland)**

Patrick Denny is a Senior Research Engineer and a Valeo Senior Expert and has worked for the last 15 years at Valeo Vision Systems, Ireland. He received his PhD in physics (2000) from the National University of Ireland, Galway, where he is also Adjunct Professor of Automotive Electronics. Denny has in excess of 20 years experience in scientific and technological development internationally, designing, innovating and developing automotive imaging technologies for BMW, Jaguar Land Rover, Daimler, VW and other OEMs. His research interests include several aspects of automotive vision system image quality, sensor components, algorithmic design, systems, machine learning and data analytics.

12:30 – 2:00 pm  Lunch Break

**Meet the Future: A Showcase of Student and Young Professionals Research**

3:00 – 5:00 pm
Atrium
Color Imaging XXII: Displaying, Processing, Hardcopy, and Applications

Conference overview

Color imaging has historically been treated as a constant phenomenon well described by three independent parameters. Recent advances in computational resources and in the understanding of the human aspects are leading to new approaches that extend the purely metrological view towards a perceptual view of color in documents and displays. Part of this perceptual view is the incorporation of spatial aspects, adaptive color processing based on image content, and the automation of color tasks, to name a few. This dynamic nature applies to all output modalities, e.g., hardcopy devices, but to an even larger extent to soft-copy displays.

Spatially adaptive gamut and tone mapping, dynamic contrast, and color management continue to support the unprecedented development of the display hardware spreading from mobile displays to large size screens and emerging technologies. This conference provides an opportunity for presenting, as well as getting acquainted, with the most recent developments in color imaging researches, technologies, and applications. Focus of the conference is on color basic research and testing, color image input, dynamic color image output and rendering, color image automation, emphasizing color in context and color in images, and reproduction of images across local and remote devices.

The conference covers also software, media, and systems related to color. Special attention is given to applications and requirements created by and for multidisciplinary fields involving color and/or vision. The Special Session entitled “The Dark Side of Color” will group challenging questions, open issues, alternative views, paradigm shifts, bottom up experimentation, re-addressing the current state of the color science, technology, and applications. For this session, we are looking for well-asked questions rather than tangible results.

Interactive Workshop: How can COLOR imaging provide us with powerful INSIGHTS?

On Thursday afternoon we would very much like to have you participate in a special session in which we encourage asking questions and exchanging ideas that frequently trouble us during research and development projects. The presence of experts in COLOR imaging and perhaps Electronic Imaging at large will provide a unique opportunity of efficiently and lively sharing simple/stupefying ideas enabling fascinating engineering concepts which may also stimulate your own future research and development projects!

This workshop is jointly sponsored by: Color Imaging XXII: Displaying, Processing, Hardcopy, and Applications and Material Appearance 2017
Monday, January 30, 2017

EI 2017 Opening Plenary and Symposium Awards
Session Chairs: Joyce E. Farrell, Stanford University, and Nitin Sampat, Rochester Institute of Technology (United States)
2:00 – 3:00 pm
Grand Peninsula Ballroom D

Giga-scale 3D computational microscopy, Laura Waller, University of California, Berkeley (United States)

Laura Waller is the Ted Van Duzer Endowed Assistant Professor of Electrical Engineering and Computer Sciences (EECS) at UC Berkeley. She is a Senior Fellow at the Berkeley Institute of Data Science, and received her BS (2004), MEng (2005), and PhD (2010) in EECS from the Massachusetts Institute of Technology (MIT). Waller’s talk is on computational imaging methods for fast capture of gigapixel-scale 3D intensity and phase images in a commercial microscope that employs illumination-side and detection-side coding of angle (Fourier) space with simple hardware and fast acquisition. The result is high-resolution reconstructions across a large field-of-view, achieving high space-bandwidth-time product.

3:00 – 3:30 pm  Coffee Break

Surface Appearance Modeling and Reproduction Joint Session
Session Chair: Francisco Imai (United States)
3:30 – 4:50 pm
Regency Ballroom C

This session is jointly sponsored by: Material Appearance 2017 and Color Imaging XXII: Displaying, Processing, Hardcopy, and Applications.

3:30 MAAP-288
Modeling and reproducing effect paints, Gary Meyer and Avery Musbach, University of Minnesota (United States)

3:50 MAAP-289
How to design a recto-verso print displaying different images in various everyday-life lighting conditions, Nicolas Dallaz1,2, Serge Mazauric1,3, Mathieu Hebert1, and Thierry Foumel1; 1University of Lyon, UJM-Saint-Etienne, CNRS, Institut d’Optique Graduate School, 2Institut d’Optique Graduate School, and 3CPE Lyon (France)

4:10 MAAP-290
Appearance decomposition and reconstruction of textured fluorescent objects, Shoji Tomiraga, Keiji Kato, Keita Hirai, and Takahiko Horiiichi, Chiba University (Japan)

4:30 MAAP-291
Assessing the proper color of translucent materials by an extended two-flux model from measurements based on an integrating sphere, Lionel Simon1, Mathieu Hebert2, Serge Mazauric1,3, and Roger Hersch4; 1Université de Poitiers (France), 2Université Jean Monnet de Saint Etienne (France), 3CPE Lyon, Domaine Scientifique de la Doua (France), and 4École Polytechnique Fédérale de Lausanne (Switzerland)

Tuesday, January 31, 2017

7:15 – 8:45 am  Women in Electronic Imaging Breakfast

Color Management
Session Chair: Sophie Triantaphillidou, University of Westminster (United Kingdom)
8:50 – 9:50 am
Regency Ballroom C

8:50 COLOR-026
Wide-gamut mobile-device displays: Gamut-mapping and color enhancement challenges, Reza Safaei-Rad1 and Jennifer Gille2; 1Qualcomm (Canada) and 2Qualcomm Technologies, Inc. (United States)

9:10 COLOR-027
Methods of defining a gamut boundary based on a face/vertex encoding, Phil Green1, Kiran Deshpande1, Frans Gaykema2, and William Revie3; 1Norwegian University of Science and Technology (Norway), 2Multi Packaging Solutions (United Kingdom), and 3Océ Technologies (the Netherlands), and 4FFEI (United Kingdom)

9:30 COLOR-028
Gamut mapping in RGB colour spaces with the iterative ratios diffusion algorithm, Ivar Farup1 and Carlo Gatta2; 1Norwegian University of Science and Technology (Norway) and 2Computer Vision Center (Spain)

Color Vision and Deficiency
Session Chair: Sophie Triantaphillidou, University of Westminster (United Kingdom)
9:50 – 10:30 am
Regency Ballroom C

9:50 COLOR-029
Checklist for daltonization methods: Requirements and characteristics of a good recoloring method, Joschua Simon-Liedtke1, David Flatla2, and Eskild Bakken; 1Norwegian University of Science and Technology (Norway) and 2University of Dundee (United Kingdom)

10:10 COLOR-030
On the edge: A scalable daltonization method focusing on color contrasts and color edges, Joschua Simon-Liedtke1, Ivar Farup1, and Reiner Eschbach1,2; 1Norwegian University of Science and Technology (Norway) and 2Monroe Community College (United States)

10:00 am – 7:30 pm  Industry Exhibition

10:30 – 10:50 am  Coffee Break
Color Vision and Deficiency (continued)
Session Chair: Alessandro Rizzi, Università degli Studi di Milano (Italy)
10:50 – 11:50 am
Regency Ballroom C

10:50 COlOR033
Estimating appearance differences of 3D objects with an RGB camera,
Pei-Li Sun, National Taiwan University of Science and Technology (Taiwan)

11:10 COLOR034
A metric for the evaluation of color perceptual smoothness,
Cedric Marchessoux and Johan Rostang, Barco N.V. (Belgium)

11:30 COLOR035
Towards a perceptually-motivated color space for high dynamic range imaging,
Mekides Abebe1, Tania Pouli2, and Chaker Larabi1; 1Université de Poitiers (France) and 2Technicolor (United States)

11:50 am – 2:00 pm Lunch Break

EI 2017 Tuesday Plenary and Symposium Awards
Session Chairs: Joyce E. Farrell, Stanford University, and Nitin Sampat, Rochester Institute of Technology (United States)
2:00 – 3:00 pm
Grand Peninsula Ballroom D

VR 2.0: Making virtual reality better than reality, Gordon Wetzstein, Stanford University (United States)
Gordon Wetzstein is an Assistant Professor of Electrical Engineering and, by courtesy, of Computer Science, at Stanford University, and leads the Stanford Computational Imaging Group. He received a PhD in computer science from the University of British Columbia (2011) where his doctoral dissertation focused on computational light modulation for image acquisition and display. In his talk, Wetzstein explores the frontiers of VR systems engineering. Eventually, VR/AR systems will redefine communication, entertainment, education, collaborative work, simulation, training, telesurgery, and basic vision research, as next-generation computational near-eye displays evolve to deliver visual experiences that are better than the real world.

3:00 – 3:30 pm Coffee Break

Display and Display Appearance
Session Chair: Fritz Lebowsky, STMicroelectronics (France)
3:30 – 5:10 pm
Regency Ballroom C

3:30 COLOR036
Color discrimination threshold for medical test devices, Nargess Hassani and Susan Farmand, Rochester Institute of Technology (United States)

3:50 COLOR037
Content-dependent adaptation in a soft proof matching experiment, Gregory High, Phil Green, and Peter Nussbaum, Norwegian University of Science and Technology (Norway)

4:10 COLOR038
Comparisons of measures of blurriness in transparent displays, Chang-Mo Yang, Dong-Hyeok Lee, Kyoung-Soo Park, Young-Tae Kim, and Choon-Woo Kim, Inha University (Republic of Korea)

4:30 COLOR039
The smallest projection optics for the vertical shaped ultra short throw projector, Yohi Takano and Hikibi Tatsuno, Ricoh Co., Ltd. (Japan)

4:50 COLOR040
Pareto optimality in primary selection for multiprimary displays, Hao Xie, Carlos Rodriguez-Pardo, and Gaurav Sharma, University of Rochester (United States)

Symposium Demonstration Session
5:30 – 7:30 pm
Grand Peninsula Ballroom E

Wednesday, February 1, 2017

Halfoning and Printing I
Session Chair: Reiner Eschbach, Norwegian University of Science and Technology (Norway) and Monroe Community College (United States)
8:50 – 10:10 am
Regency Ballroom C

8:50 COLOR041
Color halftoning based on Neugebauer Primary Area Coverage, Wanling Jiang1, WeiJian Xi1, Utpal Sarkar2, Robert Ulichney2, and Jan Allebach1; 1Purdue University and 2HP Labs, HP Inc. (United States)

9:10 COLOR042
Color halftoning based on multi-stage, multi-pass, clustered-DBS, WeiJian Xi1, Tal Frank2, Utpal Sarkar2, Ben-Shoshan Yotam2, Robert Ulichney2, and Jan Allebach1; 1Purdue University and 2HP Labs, HP Inc. (United States)

9:30 COLOR043
On large local error accumulation in multilevel error diffusion (JIST-first), Reiner Eschbach1,2 and Marius Pedersen1; 1Norwegian University of Science and Technology (Norway) and 2Monroe Community College (United States)

9:50 COLOR044
Edge-preserving error diffusion for multi-toning based on dual quantization, Takuma Kiyotomo1, Keisuke Hoshino2, Yuki Tsukano2, Hiroki Kibushi3, and Takahiko Hinichi3; 1Chiba University and 2Tokyo Kikai Seisakusho, Ltd. (Japan)

10:10 – 10:50 am Coffee Break

Halfoning and Printing II
Session Chair: Robert Ulichney, HP Labs, HP Inc. (United States)
10:50 am – 12:10 pm
Regency Ballroom C

10:50 COLOR045
Selecting best ink color for sparse watermark, Alastair Reed1, Kristyn Falkensten1, and Edward Hattenberger2; 1Digimarc Corporation and 2X-Rite Inc. (United States)

11:10 COLOR046
Page classification for print imaging pipeline, Shaoyuan Xu1, Cheng Lu1, Peter Bauer2, Mark Shaw2, and Jan Allebach1; 1Purdue University and 2HP Inc. (United States)

10:00 am – 4:00 pm Industry Exhibition
10:10 – 10:50 am Coffee Break
Thursday, February 2, 2017

Color Image Processing

Session Chair: Gabriel Marcu, Apple Inc (United States)

8:50 – 10:10 am
Regency Ballroom C

COLOR-054
Extraordinary perceptual color stability in low cost, real time color image compression inspired by structure tensor analysis, Fritz Lebowsky and Mariano Bona, STMicroelectronics (France)

COLOR-055
Sky color enhancement of photographic images, Huanzhao Zeng, Google Inc (United States)

COLOR-056
A novel colour hessian and its applications, Saman Tahery and Mark Drew, Simon Fraser University (Canada)

COLOR-057
A color image model with applications to denoising, Megan Fuller and Jae Lim, Massachusetts Institute of Technology (United States)

10:10 – 10:50 am
Coffee Break

Spectral Selection and Separation

Session Chair: Marius Pedersen, Norwegian University of Science and Technology (Norway)

10:50 am – 12:10 pm
Regency Ballroom C

COLOR-058
Addressing the colorimetric redundancy in 11-ink color separation, Daniel Nystrom, Paula Zitinski Elias, and Sasan Gooran, Linköping University (Sweden)

COLOR-059
Spectral band selection using a genetic algorithm based wiener filter estimation method for reconstruction of munsell spectral data, Pierre Gouton, Keivan Ansari, and Jean-Baptiste Thomas, University de Bourgogne (France)

COLOR-060
Illumination and reflectance spectra separation of hyperspectral image data under multiple illumination conditions, Xiaochuan Chen, Mark Drew, and Ze-Nian Li, Simon Fraser University (Canada)

COLOR-061
Multispectral face recognition using hybrid feature, Pierre Gouton1, Mamadou Diarra2, and Jerome Kablan Adou2; 1University de Bourgogne (France) and 2Université Félix Houphouet Boigny (Côte d’Ivoire)

12:10 – 2:00 pm
Lunch Break
Interactive Workshop: How can COLOR imaging provide US with powerful INSIGHTS? Joint Session

Moderator: Fritz Lebowsky, STMicroelectronics (France)

2:00 – 3:30 pm
Regency Ballroom C

This session is jointly sponsored by: Color Imaging XXII: Displaying, Processing, Hardcopy, and Applications and Material Appearance 2017.

We would very much like to have you participate in a special session in which we encourage asking questions and exchange ideas that frequently trouble us during research and development projects. The presence of experts in COLOR imaging and perhaps Electronic Imaging at large will provide a unique opportunity of efficiently and lively sharing simple/stupefying ideas enabling fascinating engineering concepts which may also stimulate your own future research and development projects!

COLOR062

Interactive Workshop: How can color imaging provide us with powerful insights?, Fritz Lebowsky, STMicroelectronics (France)

Meet the Future: A Showcase of Student and Young Professionals Research
3:00 – 5:00 pm
Atrium

3:20 – 4:00 pm Coffee Break
Computational Imaging XIV

Conference overview
More than ever before, computers and computation are critical to the image formation process. Across diverse applications and fields, remarkably similar imaging problems appear, requiring sophisticated mathematical, statistical, and algorithmic tools. This conference focuses on imaging as a marriage of computation with physical devices. It emphasizes the interplay between mathematical theory, physical models, and computational algorithms that enable effective current and future imaging systems. Contributions to the conference are solicited on topics ranging from fundamental theoretical advances to detailed system-level implementations and case studies.
Computational Imaging XIV

Monday, January 30, 2017

Scientific Imaging

Session Chair: Garth Simpson, Purdue University (United States)

8:50 – 10:30 am
Cypress C

8:50 COIMG-453
Deep neural networks for synchrotron X-ray imaging, Francesco De Carlo, Charudatta Phatak, Vincent De Andrade, and Doğa Gürsoy, Argonne National Laboratory (United States)

9:10 COIMG-415
Synchrotron x-ray diffraction dynamic sampling for protein crystal centering, Garth Simpson, Purdue University (United States)

9:30 COIMG-416
An iterative method to estimate and recover systematic and random errors in gratings based x-ray phase contrast imaging, Teck-Yian Lim1, Minh Do2, and Amber Dagel2; 1University of Illinois at Urbana-Champaign and 2Sandia National Laboratories (United States)

9:50 COIMG-417
A model based neuron detection approach using sparse location priors, Soumendu Majee1, Dong Hye Ye2, Gregory Buzzard2, and Charles Bouman1; 1School of Electrical and Computer Engineering, Purdue University and 2Dept. of Mathematics, Purdue University (United States)

10:10 COIMG-449
Multi-resolution Data Fusion (MDF) for computational electron microscopy, Suhas Sreehari1, Jeffrey Simmons2, Lawrence Drummy2, and Charles Bouman1; 1Purdue University and 2Air Force Research Laboratory (United States)

10:30 – 10:50 am Coffee Break

Tomography

Session Chair: W. Clem Karl, Boston University (United States)

10:50 am – 12:30 PM
Cypress C

10:50 COIMG-418
High spatial resolution detection method for point light source in scintillator, Kai Xu1, Tetsuya Iizuka2, Toru Nakura2, and Kunihiro Asada2; 1The University of Tokyo and 2VLSI Design and Education Center, The University of Tokyo (Japan)

11:10 COIMG-419
A randomized approach to reduce metal artifacts in x-ray computed tomography, David Castañón and Parisa Babaei-Dezaki, Boston University (United States)

11:30 COIMG-420
Joint segmentation and material recognition in dual-energy CT images, David Castañón and Parisa Babaei-Dezaki, Boston University (United States)

11:50 COIMG-421
MultiGPU acceleration of branchless distance driven projection and backprojection for Clinical Helical CT (JIST-first), Ayan Mitra1, David Polite2, Bruce Whiting3, Jeffrey Williamson4, and Joseph O’Sullivan1; 1Washington University, 2Washington University School of Medicine, 3University of Pittsburgh, and 4Virginia Commonwealth University (United States)

12:10 COIMG-422
Fast and robust discrete computational imaging, Ahmet Tuysuzoglu1, Yuehaw Kho1, and W. Clem Karl2; 1Siemens Healthcare, 2Princeton University, and 3Boston University (United States)

12:30 – 2:00 pm Lunch Break

EI 2017 Opening Plenary and Symposium Awards

Session Chairs: Joyce E. Farrell, Stanford University, and Nitin Sampat, Rochester Institute of Technology (United States)

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

Giga-scale 3D computational microscopy, Laura Waller, University of California, Berkeley (United States)

Laura Waller is the Ted Van Duzer Endowed Assistant Professor of Electrical Engineering and Computer Sciences (EECS) at UC Berkeley. She is a Senior Fellow at the Berkeley Institute of Data Science, and received her BS (2004), MEng (2005), and PhD (2010) in EECS from the Massachusetts Institute of Technology (MIT). Waller’s talk is on computational imaging methods for fast capture of gigapixel-scale 3D intensity and phase images in a commercial microscope that employs illumination-side and detection-side coding of angle (Fourier) space with simple hardware and fast acquisition. The result is high-resolution reconstructions across a large field-of-view, achieving high space-bandwidth-time product.

3:30 – 4:30 pm Coffee Break

Computational Color

Session Chair: Charles Bouman, Purdue University (United States)

3:30 – 4:30 pm
Cypress C

3:30 COIMG-423
Linear mapping based inverse tone mapping, Dae Eun Kim and Munchul Kim, Korea Advanced Institute of Science and Technology (Republic of Korea)

3:50 COIMG-424
Performance of the 14 skin-colored patches to accurately estimate the human skin, Hyun-Cheol Choi, Kyung-Chul Choi, and Hyo-jeong Suk, Korea Advanced Institute of Science and Technology (Republic of Korea)

4:10 COIMG-425
Skin-representative region in a face for finding true skin color, Hyo-jeong Suk, Hyun-Cheol Choi, and Kyung-Chul Choi, Korea Advanced Institute of Science and Technology (Republic of Korea)
Tuesday, January 31, 2017

Computational Optics
Session Chair: Stanley Chan, Purdue University (United States)
8:50 – 10:10 am
Cypress C
8:50 COIMG-454
Atomic simulations of interface characteristics in materials systems, Jeffrey Rickman, Lehigh University (United States)
9:10 COIMG-426
A phase-coded aperture camera with programmable optics, Jieen Chen1, Michael Hirschl2, Rainer Heintzmann3, Bernhard Eberhardt4, and Hendrik Jensch1; 1University of Tuebingen, 2Max Plank Institute for Intelligent Systems, 3Leibniz Institute of Photonic Technology, and 4Stuttgart Media University (Germany)
9:30 COIMG-427
Wavefront correction using self-interference incoherent digital holography, Kiseung Bang1, Changwon Jang1, Jonghyun Kim1, Myung Kim1, and Byoungho Lee1; 1Seoul National University (Republic of Korea) and 2University of South Florida (United States)
9:50 COIMG-428
Non-iterative image reconstruction for single photon image sensors, Stanley Chan, Purdue University (United States)

Computational Photography
Session Chair: Henry Dietz, University of Kentucky (United States)
10:50 am – 12:30 pm
Cypress C
10:50 COIMG-429
Single image super-interpolation using adjusted self-exemplars, Hyun-Ho Kim, Jae-Seok Choi, and Munchurl Kim, Korea Advanced Institute of Science and Technology (Republic of Korea)
11:10 COIMG-430
Temporal super-resolution for time domain continuous imaging, Henry Dietz, John Fike, Paul Eberhart, Katie Long, and Clark Demaree, University of Kentucky (United States)
11:30 COIMG-431
Edge-aware light-field flow for depth estimation and occlusion detection, Wenhui Zhou1, Andrew Lumsdaine2, Lili Lin1, Wei Zhang2, and Rong Wang3; 1Hangzhou Dianzi University (China), 2Indiana University (United States), and 3Zhejiang Gongshang University (China)
11:50 COIMG-432
Evaluating age estimation using deep convolutional neural nets, Carlos Belver, Ignacio Arganda-Carreras, and Fadi Dornaika, University of the Basque Country (Spain)

3:30 – 5:30 pm
Cypress C
3:30 COIMG-433
Augmenting salient foreground detection using Fiedler vector for multi-object segmentation, Michael Kucer1, Nathan Cahill2, Alexander Louise2, and David Messinger1; 1Rochester Institute of Technology and 2University of Rochester (United States)
3:50 COIMG-434
Non-destructive localization of overpaintings in Byzantine miniature illuminations, Alexandra Psarrou1, Vassiliki Kokla1, Sophie Triantaphillidou1, and Lindsay MacDonald2; 1University of Westminster and 2University College London (United Kingdom)
4:10 COIMG-435
Computing height and width of in situ sorghum plants using 2.5d infrared images, Tavor Baharav, Mohini Bariya, and Avideh Zakhor, University of California, Berkeley (United States)
4:30 COIMG-436
Non-parametric texture synthesis using texture classification, Kyle Ziga1, Judy Bagchi2, Jan Allebach2, and Fengqing Zhu1; 1Purdue University and 2D.Zine Steps (United States)
4:50 COIMG-437
On-the-fly performance evaluation of large-scale fiber tracking, Hongkai Yu1, Jeffrey Simmons2, Craig Prybyla1, and Song Wang3; 1University of South Carolina and 2Air Force Research Laboratory (United States)
**Computational Imaging XIV**

5:10  COIMG-438

Point cloud based approach to biomass feature extraction, Jihui Jin and Avideh Zakhor, University of California, Berkeley (United States)

**Symposium Demonstration Session**

5:30 – 7:30 pm

Grand Peninsula Ballroom E

**Wednesday, February 1, 2017**

**EI 2017 Wednesday Plenary and Symposium Awards**

Session Chairs: Joyce E. Farrell, Stanford University, and Nitin Sampat, Rochester Institute of Technology (United States)

2:00 – 3:00 pm

Grand Peninsula Ballroom D

Designing VR video camera systems, Brian Cabral, Facebook, Inc. (United States)

Brian Cabral is Director of Engineering at Facebook, leading the Surround 360 VR camera team, specializing in computational photography, computer vision, and computer graphics. He has published a number of papers in the area of computer graphics and imaging including the pioneering Line Integral Convolution algorithm. Cabral discusses developing Facebook Surround 360, an open, high-quality 3D-360 video capture system. VR video capture systems are composed of multiple optical and digital components - all of which must operate as if they are one seamless optical system. The design of VR video cameras, optical choices, SNR, etc., require a new set of technologies and engineering approaches, with tight coupling to the computational system components.

3:00 – 3:30 pm  Coffee Break

**Computational Imaging XV Interactive Papers Session**

5:30 – 7:00 pm

Atrium

The following works will be presented at the EI 2017 Symposium Interactive Papers Session.

COIMG-439


COIMG-440

Localized high dynamic range plenoptic image compression, Chuan-Chung Chang¹, Hsin-Hsiang Lo¹, Han-Hsuan Lin¹, Zhi-Rong Fan¹, Shao-Hsuan Cheng¹, Chih-Hung Lii¹, Fu-Ming Chuang¹, and Jun-In Guo²; ¹Coretronic Corp. and ²National Chi-Nan University (Taiwan)

COIMG-441

Image-based age estimation: Comparing hand crafted and deep features, Fadi Dornaika¹, Nada Moukaddem¹, and Ammar Assoum²; ¹University of the Basque Country (Spain) and ²Lebanese University (Lebanon)

COIMG-442

Compressive light field display using scattering polarizer, Dukho Lee¹,², Byoungsoo Lee¹,², Seokil Moon¹,², Chang-Kun Lee¹,², and Gung Li¹,²; ¹Electrical and Computer Engineering, Seoul National University and ²Optical Engineering and Quantum Electronics Laboratory, Seoul National University (Republic of Korea)

COIMG-443

High-resolution image reconstruction for PET using local and non-local regularizations, Xue Ren and Soo-Jin Lee, Pai Chai University (Republic of Korea)

COIMG-444

3D reconstruction based multiple view depth generation using heterogeneous cameras, Dong-won Shin, Gwangju Institute of Science and Technology (Republic of Korea)

COIMG-445

Deep convolutional neural networks for the classification of snapshot mosaic hyperspectral imagery, Konstantina Fotiadou¹,², Grigorios Tsagkatakis¹, and Panagiotis Tsakalides¹; ¹FORTH and ²University of Crete (Greece)

COIMG-446

Space-variant smoothing in median-regularized reconstruction for transmission tomography, Ji Eun Jung and Soo-Jin Lee, Pai Chai University (Republic of Korea)

COIMG-447

A viewing direction control camera without mechanical motion based on computational imaging, Daiki Teraya and Tomohiro Yendo, Nagoya University of Technology (Japan)

COIMG-448

The human sclera and pupil as the calibration targets, Hayan Choi, Kyungah Choi, and Hyeonjeong Suk, Korea Advanced Institute of Science and Technology (Republic of Korea)
Computer Vision Applications in Sports 2017

Overview
The advances in computer vision affect how we train, perform, watch, and interact with sports and sport events. For example, using a camera feed and computer vision algorithms, 1) players can enhance their skills, 2) coaches can assess individual and team performance, 3) injuries could be analyzed and avoided, 4) real-time statistics could be generated, and 5) enhanced engaging experience could be delivered to viewers. In the Special Session on Computer Vision Applications in Sports we are interested in understanding how computer vision algorithms can help players train more effectively and sharpen their skills via real-time feedback while training. We also are interested in helping coaches build better teams via monitoring gameplay, performing objective assessment, and avoiding fractions and injuries. For the sports fan, we are looking for systems to build a personalized viewer experience on TV, mobile phones, and wearable devices. Experiences of interest would include (but are not limited to) graphical effects rendering, augmented/virtual reality, and mobile app for off-screen engagement.
Monday, January 30, 2017

Sports Imaging
Session Chairs: Mustafa Jaber, NantVision Inc. (United States), and Grigorios Tsagkatakis, FORTH (Greece)

9:30 – 10:20 am
Cypress B

9:30
Chair Opening Remarks

9:40 CVAS-342
Virtual tracking shots for sports analysis, Stuart Bennett¹, Joan Lasenby¹, and Tony Purnell¹,²; ¹University of Cambridge and ²British Cycling (United Kingdom)

10:00 CVAS-343
Aerodynamic analysis via foreground segmentation, Peter Carey¹, Stuart Bennett¹, Joan Lasenby¹, and Tony Purnell¹,²; ¹University of Cambridge and ²British Cycling (United Kingdom)

10:20 – 10:50 am Coffee Break

Sports Analysis
Session Chairs: Mustafa Jaber, NantVision Inc. (United States), and Grigorios Tsagkatakis, FORTH (Greece)

10:50 am – 12:10 pm
Cypress B

10:50 CVAS-344
Goal! Event detection in sports video, Grigorios Tsagkatakis¹, Mustafa Jaber², and Panagiotis Tsakalides³; ¹FORTH (Greece) and ²NantVision Inc. (United States)

11:10 CVAS-345
Pose estimation for deriving kinematic parameters of competitive swimmers, Dan Zecha, Christian Eggert, and Rainer Lienhart, University of Augsburg (Germany)

11:30 CVAS-346
Comparison of a virtual game-day experience on varying devices, Jack Miller, Holly Baiotto, Anastacia MacAllister, Gabriel Evans, Jonathan Schlueter, Melynda Hoover, Vijay Kalivarapu, and Eliot Winer, Iowa State University (United States)

11:50 CVAS-347
Digital playbook – A teaching tool for American football, Mario Vorstandechner and Margrit Gelautz, Technische Universität Wien (Austria)

12:10 – 2:00 pm Lunch Break

EL 2017 Opening Plenary and Symposium Awards
Session Chairs: Joyce E. Farrell, Stanford University, and Nitin Sampat, Rochester Institute of Technology (United States)
2:00 – 3:00 pm
Grand Peninsula Ballroom D

Giga-scale 3D computational microscopy, Laura Waller, University of California, Berkeley (United States)

Laura Waller is the Ted Van Duzer Endowed Assistant Professor of Electrical Engineering and Computer Sciences (EECS) at UC Berkeley. She is a Senior Fellow at the Berkeley Institute of Data Science, and received her BS (2004), MEng (2005), and PhD (2010) in EECS from the Massachusetts Institute of Technology (MIT). Waller’s talk is on computational imaging methods for fast capture of gigapixel-scale 3D intensity and phase images in a commercial microscope that employs illumination-side and detection-side coding of angle (Fourier) space with simple hardware and fast acquisition. The result is high-resolution reconstructions across a large field-of-view, achieving high space-bandwidth product.

3:00 – 3:30 pm Coffee Break

Keynote: Computer Vision, Robotic Cameras, Sports Applications
Session Chairs: Mustafa Jaber, NantVision Inc. (United States), and Grigorios Tsagkatakis, FORTH (Greece)
3:30 – 4:30 pm
Cypress B

Automated sports broadcasting, Peter Carr, Disney Research (United States)

Peter Carr is a Senior Research Engineer at Disney Research, Pittsburgh. He received his PhD from the Australian National University (2010), under the supervision of Prof. Richard Hartley. His thesis, “Enhancing Surveillance Video Captured in Inclement Weather”, explored single-view depth estimation using graph cuts, as well as real-time image processing on graphics hardware. As part of his earlier PhD work in sports analysis, Carr was a research intern at Mitsubishi Electric Research Labs. He received a Master’s in physics from the Centre for Vision Research at York University in Toronto, Canada, and a Bachelor’s of Applied Science (engineering physics) from Queen’s University in Kingston, Canada.

Symposium Welcome Reception
5:00 – 6:00 pm
Atrium
Digital Photography and Mobile Imaging XIII

Conference overview

Digital photography has revolutionized the world we live in. Both the number of still images and videos taken each year and the capabilities of current imaging devices are unprecedented. The number of cell phones produced each year exceeds one billion and the quality of images produced by them is so high that many people are happy with a cell phone as their only camera. At the same time, other types of cameras also keep improving. Advances in hardware and processing of captured images help to push boundaries of what was previously possible in consumer and fine art photography and in the huge range of applications of digital imaging in industry, science, health care, defense, and other areas. Despite the tremendous progress that has been already made, the future promises even more.

This conference serves to bring together researchers, scientists, and engineers working in the fields of traditional, mobile, and computational camera imaging to discuss recent progress in the development of digital cameras and camera modules, with all related areas like optics, sensors, in-camera still image and video processing (including traditional pipeline steps like demosaicing, color correction, and image compression, as well as high dynamic range processing, blur removal, and various other computational imaging techniques), applications of image and video processing, still image and video management and sharing applications, and methods and standards for evaluating the quality of produced images and video and of cameras used for their capture.

This conference includes paper presentations, presentation-only talks, and joint sessions with other Electronic Imaging conferences with overlapping interests.

Awards: Best Paper Award and Best Student Paper Award

Conference Sponsors

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Monday, January 30, 2017

Camera Arrays and RGB-D Imaging Algorithms

Session Chairs: Francisco Imai (United States) and Kevin Matherson, Microsoft Corporation (United States)

8:50 – 10:10 am
Grand Peninsula Ballroom A

8:50
Stabilized high-speed video from camera arrays, Maha El Choubassi and Oscar Nestares, Intel Corporation (United States)

9:10
Panoramic background estimation from RGB-D videos, Christos Bampis, Gowri Somanath, Oscar Nestares, and Jiajie Yao; 1The University of Texas at Austin (United States), 2Intel Labs, Intel Corporation (United States), and 3Intel Corporation (China)

9:30
Accurate measurement of point to point distances in 3D camera images, Kalpana Seshadrinathan, Oscar Nestares, and Yi Wu, Intel Corporation (United States)

9:50
A novel framework for fast MRF optimization, Gowri Somanath, Jiajie Yao, and Yong Jiang, Intel Corporation (United States)

10:10 – 10:50 am  Coffee Break

Keynote: Accelerated Computational Tools
Session Chair: Michael Kriss, MAK Consultants (United States)
10:50 – 11:30 am
Grand Peninsula Ballroom A

Heterogeneous computational imaging, Kari Pulli, Intel Corporation (United States)

Kari Pulli is a Senior Principal Engineer at Intel Corporation, working as the CTO of the Imaging and Camera Technologies Group. He has a long history in Computational Photography, Computer Vision, and Computer Graphics (earlier jobs include VP of Computational Imaging at Light, Sr. Director at NVIDIA Research, Nokia Fellow), with numerous publications (h-index = 30). Pulli has a PhD from the University of Washington, Seattle. He has also been a researcher / lecturer at Stanford, MIT, and University of Oulu. He has contributed to many multimedia standards at the Khronos Group, including OpenVX, and is a regular speaker and contributor at SIGGRAPH, CVPR, and many other conferences.

Emerging Architectures and Systems

Session Chair: Michael Kriss, MAK Consultants (United States)
11:30 am – 12:30 pm
Grand Peninsula Ballroom A

11:30
Is there a multi-camera future? (Invited), Timothy Macmillan, Consultant (United States)

11:50
Capturing light field video for 6-DOF VR playback (Invited), William Jiang, Lytro Inc. (United States)

12:10
Representation and compression for cinematic VR (Invited), Hari Lakshman, Dolby Labs (United States)

12:30 – 2:00 pm  Lunch Break

El 2017 Opening Plenary and Symposium Awards
Session Chairs: Joyce E. Farrell, Stanford University, and Nitin Sampat, Rochester Institute of Technology (United States)

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

Giga-scale 3D computational microscopy, Laura Waller, University of California, Berkeley (United States)

Laura Waller is the Ted Van Duzer Endowed Assistant Professor of Electrical Engineering and Computer Sciences (ECECS) at UC Berkeley. She is a Senior Fellow at the Berkeley Institute of Data Science, and received her BS (2004), MEng (2005), and PhD (2010) in EECS from the Massachusetts Institute of Technology (MIT). Waller’s talk is on computational imaging methods for fast capture of gigapixel-scale 3D intensity and phase images in a commercial microscope that employs illumination-side and detection-side coding of angle (Fourier) space with simple hardware and fast acquisition. The result is high-resolution reconstructions across a large field-of-view, achieving high space-bandwith-time product.

3:30 – 4:50 pm
Grand Peninsula Ballroom A

Quantifying the luminance ratio of interior and exterior scenes: Challenges and tradeoffs in definitions, current standards, measurement methodologies and instrumentation, capturing capabilities of digital cameras, effects of veiling glare, Fernando Volotini de Azambuja, Nitin Sampat, and Stephen Viggiano, Rochester Institute of Technology (United States)

Sensitivity analysis applied to ISO recommended camera color calibration methods to determine how much of an advantage, if any, does spectral characterization of the camera offer over the chart-based approach, Nitin Sampat, Stephen Viggiano, and Keith Borrmio, Rochester Institute of Technology (United States)

Perceptual optimization driven by image quality metrics (Invited), Zhou Wang, University of Waterloo (Canada)

Perceptual optimization driven by image quality metrics (Invited), David Cardinal, Cardinal Photo & Extremetech.com (United States)
Council Meeting
Digital Photography and Mobile Imaging XIII

**Image Interpolation, Restoration, and Denoising Joint Session**

Session Chairs: Karen Egiazarian, Tampere University of Technology (Finland), and Radka Tezaur, Intel Corporation (United States)

3:30 – 5:30 pm
Grand Peninsula Ballroom A

This session is jointly sponsored by: Digital Photography and Mobile Imaging XIII and Image Processing: Algorithms and Systems XV.

3:30 DPMI-083

**BM3D-HVS: Content-adaptive denoising for improved visual quality (Invited)**, Karen Egiazarian¹ ², Aram Danielyan³, Nikolay Ponomarenko¹ ², Alessandro Foi¹ ², Oleg Ieremeiev¹ ², and Vladimir Lukin¹ ²; ¹Tampere University of Technology (Finland), ²Noiseless Imaging Oy (Finland), and ³National Aerospace University (Ukraine)

3:50 IPAS-084

**Refining raw pixel values using a value error model to drive texture synthesis**, Henry Dietz, University of Kentucky (United States)

4:10 IPAS-085

**Color interpolation based on colorization for RGB-white color filter array**, Paul Oh¹, Sukho Lee², and Moon Gi Kang¹; ¹Yonsei University and ²Dongseo University (Republic of Korea)

4:30 IPAS-086

**Video frame synthesizing method for HDR video capturing system with four image sensors**, Takayuki Yamashita¹ ², and Yoshihiro Fujita¹; ¹Ehime University and ²NHK (Japan)

4:50 DPMI-088

**Robust defect pixel detection and correction for Bayer Imaging Systems**, Noha El-Yamany, Intel Corporation (Finland)

**Symposium Demonstration Session**

5:30 – 7:30 pm
Grand Peninsula Ballroom E

Wednesday, February 1, 2017

**Keynote: Sharp High-quality Color Interpolation Joint Session**

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

8:50 – 9:30 am
Grand Peninsula Ballroom A

This session is jointly sponsored by: Image Sensors and Imaging Systems 2017 and Digital Photography and Mobile Imaging XIII.

Conference Chair Opening Remarks

**Bayer pattern and image quality**, Jörg Kunze, Basler AG (Germany)

Jörg Kunze has received his PhD in physics from the University of Hamburg (2004). He joined Basler in 1998, where he started as an electronics developer and where he currently is the team leader of New Technology. Kunze serves as an expert for image sensors, camera hardware, noise, color fidelity, 3D and computational imaging and develops new algorithms for color image signal processing. The majority of the Basler patents name him as inventor.

**Input Signal Quality & Characterization Joint Session**

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

9:30 – 10:10 am
Grand Peninsula Ballroom A

This session is jointly sponsored by: Image Sensors and Imaging Systems 2017 and Digital Photography and Mobile Imaging XIII.

9:30 IWSE-078

**Accurate joint geometric camera calibration of visible and far-infrared cameras**, Takashi Shibata¹ ², Masayuki Tanaka¹ ², and Masatoshi Okutomi¹; ¹Tokyo Institute of Technology and ²NEC Corporation (Japan)

9:50 DPMI-079

**Interferometric measurement of sensor MTF and crosstalk**, Todor Georgiev, Jennifer Gille, Amber Sun, Lyubomir Baev, and Tharun Battula, Qualcomm Technologies, Inc. (United States)

10:00 am – 4:00 pm Industry Exhibition

10:10 – 10:50 am Coffee Break

**Keynote: Machine Vision Retina Improvement Joint Session**

Session Chairs: Thomas Vogelsang, Rambus Inc., and Ralf Widenhorn, Portland State University (United States)

10:50 – 11:30 am
Grand Peninsula Ballroom A

This session is jointly sponsored by: Image Sensors and Imaging Systems 2017 and Digital Photography and Mobile Imaging XIII.

DPMI-080

**Silicon retina technology (Invited)**, Tobi Delbruck, Institute for Neuroinformatics (INI) (Switzerland)

Tobi Delbruck received a PhD from Caltech (1993). He is currently a professor of physics and electrical engineering at ETH Zurich in the Institute of Neuroinformatics, University of Zurich and ETH Zurich, Switzerland, where he has been since 1998. His group, which he coordinates together with Shih-Chii Liu, focuses on neuromorphic event-based sensors and sensory processing. He has co-organized the Telluride Neuromorphic Cognition Engineering summer workshop and the live demonstration sessions at ISCAS and NIPS. Delbruck is past Chair of the IEEE CAS Sensory Systems Technical Committee. He worked on electronic imaging at Arithmos, Synaptics, National Semiconductor, and Foveon and has founded 3 spin-off companies, including inilabs.com, a non-profit organization that has distributed hundreds of R&D prototype neuromorphic sensors to more than a hundred organizations around the world. He has been awarded 9 IEEE awards.

**Emerging Imaging Sensor & Hardware Joint Session**

Session Chairs: Thomas Vogelsang, Rambus Inc., and Ralf Widenhorn, Portland State University (United States)

11:30 – 11:50 am
Grand Peninsula Ballroom A

This session is jointly sponsored by: Image Sensors and Imaging Systems 2017 and Digital Photography and Mobile Imaging XIII.
TIK: A time domain continuous imaging testbed using conventional still images and video, Henry Dietz, John Fike, Paul Eberhart, Katie Long, Clark Demaree, and Jong Wu, University of Kentucky (United States)

Keynote: Comparing CMOS Image Sensor Architectures Joint Session
Session Chairs: Thomas Vogelsang, Rambus Inc., and Ralf Widenhorn, Portland State University (United States)
11:50 am – 12:40 pm
Grand Peninsula Ballroom A

This session is jointly sponsored by: Image Sensors and Imaging Systems 2017 and Digital Photography and Mobile Imaging XIII.

CMOS image sensor pixel design and optimization, Boyd Fowler, OmniVision Technologies (United States)

Boyd Fowler's research interests include CMOS image sensors, low noise image sensors, noise analysis, data compression, and machine learning and vision. He received his MSEE (1990) and PhD (1995) from Stanford University. After finishing his PhD he stayed at Stanford University as a research associate in the Electrical Engineering Information Systems Laboratory until 1998. In 1998, Fowler founded Pixel Devices International in Sunnyvale California. Between 2005 and 2013, Fowler was CTO and VP of Technology at Fairchild Imaging. He is currently at OmniVision Technologies leading the marketing department. Fowler has authored numerous technical papers, book chapters and patents.

Image Sensors and Imaging Systems 2017 Awards

12:40 – 2:00 pm Lunch Break

EI 2017 Wednesday Plenary and Symposium Awards
Session Chairs: Joyce E. Farrell, Stanford University, and Nitin Sampat, Rochester Institute of Technology (United States)
2:00 – 3:00 pm
Grand Peninsula Ballroom D

Designing VR video camera systems, Brian Cabral, Facebook, Inc. (United States)

Brian Cabral is Director of Engineering at Facebook, leading the Surround 360 VR camera team, specializing in computational photography, computer vision, and computer graphics. He has published a number of papers in the area of computer graphics and imaging including the pioneering Line Integral Convolution algorithm. Cabral discusses developing Facebook Surround 360, an open, high-quality 3D-360 video capture system. VR video capture systems are composed of multiple optical and digital components - all of which must operate as if they are one seamless optical system. The design of VR video cameras, optical choices, SNR, etc., require a new set of technologies and engineering approaches, with tight coupling to the computational system components.

3:00 – 3:30 pm Coffee Break

Digital Photography and Mobile Imaging XIII Interactive Papers Session

5:30 – 7:00 pm
Atrium

The following works will be presented at the EI 2017 Symposium Interactive Papers Session.

A Canon hack development kit implementation of time domain continuous imaging, Katie Long, Clark Demaree, and Henry Dietz, University of Kentucky (United States)

Advanced HDR fusion method for image sensor with variable pixel exposure, Timofey Uvarov, OmniVision Technologies, Inc. (United States)
The Engineering Reality of Virtual Reality 2017

Conference overview
Virtual and augmented reality systems are evolving. In addition to research, the trend toward content building continues and practitioners find that technologies and disciplines must be tailored and integrated for specific visualization and interactive applications. This conference serves as a forum where advances and practical advice toward both creative activity and scientific investigation are presented and discussed. Research results can be presented and applications can be demonstrated.

Excursion
On Thursday afternoon, we have the Qlik Field Trip: Showcase for VR, AR, and Visual Analytics Applications. Todd Margolis will host the ERVR group at Qlik, located a five minute car ride or 30 min walk from the conference. Sign up in advance at the registration desk. Transportation on your own.
Wednesday, February 1, 2017

The Real World Meets VR: Case Studies
Session Chairs: Margaret Dolinsky, Indiana University, and Ian McDowall, Intuitive Surgical / Fakespace Labs (United States)

9:10 – 10:10 am
Sandpebble A

9:10 ERVR-089
Oculus rift with stereo camera for augmented reality medical intubation training, Kevin Lim, Preetham Suresh, and Jürgen Schulze, University of California, San Diego (United States)

9:30 ERVR-090
Virtual reality instructional modules in education based on gaming metaphor, Sharad Sharma and Emmanuel Ossuetta, Bowie State University (United States)

9:50 ERVR-092
Drawing towards virtual reality, Margaret Dolinsky, Indiana University (United States)

10:00 am – 4:00 pm  Industry Exhibition

10:10–10:50 am  Coffee Break

Positioning the Body in VR
Session Chairs: Margaret Dolinsky, Indiana University, and Ian McDowall, Intuitive Surgical / Fakespace Labs (United States)

10:50 am – 12:30 pm
Sandpebble A

10:50 ERVR-093
The Destiny-class CyberCANOE- a surround screen, stereoscopic, cyber-enabled collaboration analysis navigation and observation environment, Noel Kawano, Alberto Gonzalez, Jack Lam, Ryan Theriot, Ken Uchida, Eric Wu, Andrew Guagliardo, Dylan Kobayashi, and Jason Leigh, University of Hawai‘i at Manoa (United States)

11:10 ERVR-094
CAVE versus head-mounted displays: On-going thoughts, Daniel Mestre, CNRS (France)

11:30 ERVR-095
Distributed rendering using NVIDIA OptiX, Dylan McCarthy and Jürgen Schulze, University of California, San Diego (United States)

11:50 ERVR-096
Laser illuminated projectors and the technological advancements brought forth to immersive environments, Danielle Rains, Dirk Reiners, and Carolina Cruz-Neira, University of Arkansas at Little Rock (United States)

12.10 ERVR-097
New VR navigation techniques to reduce cybersickness, Andras Kemeny1,2, Paul George1, Frederic Mérenne1, and Florent Colombet2; 1Arts et Métiers ParisTech and 2Renault (France)

12:30 – 2:00 pm  Lunch Break

EI 2017 Wednesday Plenary and Symposium Awards
Session Chairs: Joyce E. Farrell, Stanford University, and Nitin Sampat, Rochester Institute of Technology (United States)

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

Designing VR video camera systems, Brian Cabral, Facebook, Inc. (United States)

Brian Cabral is Director of Engineering at Facebook, leading the Surround 360 VR camera team, specializing in computational photography, computer vision, and computer graphics. He has published a number of papers in the area of computer graphics and imaging including the pioneering Line Integral Convolution algorithm. Cabral discusses developing Facebook Surround 360, an open, high-quality 3D-360 video capture system. VR video capture systems are composed of multiple optical and digital components - all of which must operate as if they are one seamless optical system. The design of VR video cameras, optical choices, SNR, etc., require a new set of technologies and engineering approaches, with tight coupling to the computational system components.

3:00 – 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 – 5:40 pm
Grand Peninsula Ballroom D

This session is jointly sponsored by: Stereoscopic Displays and Applications XXVIII and The Engineering Reality of Virtual Reality 2017.

3:30 SD&A-105
Designing a cloud-based 3D visualization engine for smart cities, Nicolas Holliman, Stephen Dowland, Mark Turner, Richard Cloete, and Tom Picton, Newcastle University (United Kingdom)

3:50 SD&A-106
Interactive computer graphics, stereo and VR practice at the Electronic Visualization Laboratory University of Illinois at Chicago, Maxine Brown1, Jason Leigh2, Tom DeFanti3, and Daniel Sandin4; 1The University of Illinois at Chicago, 2University of Hawai‘i at Manoa, and 3University of California, San Diego (United States)
Thursday, February 2, 2017

**Symposium Interactive Papers (Poster) Session**
5:30 – 7:00 pm
Atrium

**Keynote: Immersive Visualization Room - Design and Build**
Session Chairs: Margaret Dolinsky, Indiana University, and Ian McDowell, Intuitive Surgical / Fakespace Labs (United States)
9:10 – 10:10 am
Sandpebble A

**VR journeys from the dark ages to a bright future,** Gregory Dawe, University of California, San Diego (United States)

Gregory Dawe, the design engineer who made many iterations of CAVE systems possible, will share his perspective on the progression of virtual reality from the first CRT based CAVE system and how it was enhanced during the digital projector era to where we are now with present day flat panel systems. He will discuss the technological quest to improve brightness, resolution and contrast in the crusade to exceed human acuity.

**Qlik Introduction**
Session Chair: Margaret Dolinsky, Indiana University (United States)
10:10 – 10:30 am
Sandpebble A

**The Qlik Environment,** Todd Margolis, Qlik (United States)
10:30 – 10:50 am
Coffee Break

**Kit and Kaboodle: VR Gear**
Session Chairs: Margaret Dolinsky, Indiana University, and Ian McDowall, Intuitive Surgical / Fakespace Labs (United States)
10:50 am – 12:30 pm
Sandpebble A

**The Reality Wall: The aesthetics of reality disambiguation in AR/VR,** Patrick Lichty, Zayed University (United States)
11:10 ERVR-104

**Decoupling of real and digital content in projection based augmented reality systems using time multiplexed image capture (JIST-first),** Shoaib Soomro1, Erdem Ulusoy1, and Hakan Urey2; 1Optical Microsystems Laboratory, Koc University and 2Koç University (Turkey)
11:30 ERVR-100

**Exploring body gestures as natural user interface for flying in a virtual reality game with Kinect,** Xin Tong and Diane Gromala, Simon Fraser University (Canada)
11:50 ERVR-101

**Soft robotic glove for kinesthetic haptic feedback in virtual reality environments,** Saurabh Jadhav, Vikas Kannanada, Bocheng Kang, Michael Tolley, and Jürgen Schulze, University of California, San Diego (United States)
12:10 ERVR-102

**Qlik Field Trip: Showcase for VR, AR, and Visual Analytics Applications**
Host: Todd Margolis, Qlik (United States)
Session Chairs: Margaret Dolinsky, Indiana University, and Ian McDowell, Intuitive Surgical / Fakespace Labs (United States)
2:00 – 5:00 pm
Offsite

Todd Margolis will host the ERVR group at Qlik, located a five minute car ride or 30 min walk from the conference. Sign up in advance at the registration desk. Transportation on your own.
Human Vision and Electronic Imaging 2017

Conference overview
The conference on Human Vision and Electronic Imaging explores the role of human perception and cognition in the design, analysis, and use of electronic media systems. Over the years, it has brought together researchers, technologists and artists, from all over the world, for a rich and lively exchange of ideas. We believe that understanding the human observer is fundamental to the advancement of electronic media systems, and that advances in these systems and applications drive new research into the perception and cognition of the human observer. Every year, we introduce new topics through our Special Sessions, centered on areas driving innovation at the intersection of perception and emerging media technologies. The HVEI website [http://hvei.eecs.northwestern.edu] includes additional information and updates.

Awards
Student Best Paper Award
Student Paper Honorary Mention Award

Events
Monday evening HVEI Banquet and Talk
Thursday evening Museum Field Trip to San Francisco Museum of Modern Art
Daily End-of-Day Discussions

Conference Sponsors

Conference Chairs: Bernice E. Rogowitz, Visual Perspectives (United States); Thrasyvoulos N. Pappas, Northwestern Univ. (United States); and Huib de Ridder, Technische Univ. Delft (the Netherlands)

Program Committee: Albert J. Ahumada, NASA Ames Research Center (United States); Jan P. Allebach, Purdue Univ. (United States); Erhardt Barth, Univ. zu Lubeck (Germany); Walter R. Bender, Sugar Labs (United States); Michael H. Brill, Datacolor (United States); Kjell Brunström, ACREO (Sweden); Claus-Christian Carbon, Univ. of Bamberg (Germany); Damon M. Chandler, Shizuoka Univ. (Japan); Ulrich Engelke, Commonwealth Scientific and Industrial Research Organisation (Australia); Elena A. Fedorovskaya, Rochester Institute of Technology (United States); James A. Ferwerda, Rochester Institute of Technology (United States); Jennifer L. Gille, Qualcomm Technologies, Inc. (United States); Sergio R. Goma, Qualcomm Technologies, Inc. (United States); Hari Kalva, Florida Atlantic Univ. (United States); Stanley A. Klein, Univ. of California, Berkeley (United States); Patrick Le Callet, Univ. de Nantes (France); Lora T. Likova, The Smith-Kettlewell Eye Research Institute (United States); Monica Lopez-Gonzalez, La Petite Noiseuse Productions (United States); Mark E. McCourt, North Dakota State Univ. (United States); Jeffrey B. Mulligan, NASA Ames Research Center (United States); Karol Myszkowski, Max-Planck-Institut für Informatik (Germany); Adar Pelah, Univ. of York (United Kingdom); Eliezer Peli, Schepens Eye Research Institute (United States); Sylvia Pont, Technische Univ. Delft (the Netherlands); Judith A. Redi, Technische Univ. Delft (the Netherlands); Hawley K. Rising, Consultant (United States); Sabine Süsstrunk, École Polytechnique Fédérale de Lausanne (Switzerland); Christopher W. Tyler, The Smith-Kettlewell Eye Research Institute (United States); Andrew B. Watson, NASA Ames Research Center (United States); and Michael A. Webster, Univ. of Nevada, Reno (United States).
Monday, January 30, 2017

**Chair Opening Remarks**
Session Chairs: Bernice Rogowitz, Visual Perspectives (United States), Thrasyvoulos Pappas, Northwestern University (United States), and Huib de Ridder, Delft University of Technology (the Netherlands)
9:00 – 9:10 am
Regency Ballroom B

**Keynote 1: Human Vision - Unifying Theory from Peripheral Vision**
Session Chair: Bernice Rogowitz, Visual Perspectives (United States)
9:10 – 10:00 am
Regency Ballroom B

**Vision at a glance (Invited),** Ruth Rosenholtz, MIT (United States)
Ruth Rosenholtz is a Principal Research Scientist in the Dept. of Brain and Cognitive Sciences at MIT. Her lab studies human vision, including visual search, peripheral vision, perceptual organization, and the impact of visual clutter on task performance. Rosenholtz earned her PhD in electrical engineering and computer science, University of California at Berkeley (1994). Prior to MIT, she held research positions with the (Xerox) Palo Alto Research Center, NASA Ames, and with Utrecht University.

10:00 – 10:30 am  Coffee Break

**Special Session: Decoding Visual Semantics: Perceptual Modeling and Deep Learning**
Session Chairs: Jan Koenderink, Katholieke University Leuven (Belgium), and Ruth Rosenholtz, MIT (United States)
10:30 am – 12:30 pm
Regency Ballroom B

**Eidolons: Effects of capricious local sign (Invited),** Jan Koenderink, Andrea van Doorn, Matteo Valsecchi, and Karl Gegenfurtner; 1Katholieke University Leuven (the Netherlands), 2Utrecht University (the Netherlands), and 3Giessen University (Germany)
11:00

**Careful methods and measurements for comparisons between men and machines (Invited),** Felix Wichmann, David Janssen, Robert Geirhos, Guilleermo Aguilar, Schuit Heiko, Marianne Maertens, and Matthias Bethge; 1Eberhard Karls Universität Tübingen, 2Max-Planck-Institut für Intelligente Systeme, and 3Technische Universität Berlin (Germany)
11:30

**Perceptual and engineering implications of cascaded gain control models (Invited),** Eero Simoncelli, Valero Laparra, Johannes Ballé, and Alexander Berardino; 1New York University (United States) and 2University of Valencia (Spain)
12:00

**Emerging visual representations in deep learning networks (Invited),** Aude Oliva, MIT (United States)

**EI 2017 Opening Plenary and Symposium Awards**
Session Chairs: Joyce E. Farrell, Stanford University, and Nitin Sampat, Rochester Institute of Technology (United States)
2:00 – 3:00 pm
Grand Peninsula Ballroom D

**Giga-scale 3D computational microscopy,** Laura Waller, University of California, Berkeley (United States)
Laura Waller is the Ted Van Duzer Endowed Assistant Professor of Electrical Engineering and Computer Sciences (EECS) at UC Berkeley. She is a Senior Fellow at the Berkeley Institute of Data Science, and received her BS (2004), MEng (2005), and PhD (2010) in EECS from the Massachusetts Institute of Technology (MIT). Waller’s talk is on computational imaging methods for fast capture of gigapixel-scale 3D intensity and phase images in a commercial microscope that employs illumination-side and detection-side coding of angle (Fourier) space with simple hardware and fast acquisition. The result is high-resolution reconstructions across a large field-of-view, achieving high space-bandwidth-time product.

3:00 – 3:30 pm  Coffee Break

**Keynote 2: Media Content Semantics - Transmitting Meaning**
Session Chair: Thrasyvoulos Pappas, Northwestern University (United States)
3:30 – 4:20 pm
Regency Ballroom B

**Movies and meaning: From low-level features to mind reading (Invited),** Sergio Benini, University of Brescia (Italy)
Sergio Benini received his MSc in electronic engineering (cum laude) at the University of Brescia (2000) with a thesis granted by Italian Academy of Science. Between ‘01 and ‘03 he was with Siemens Mobile Communications R&D. He received his PhD in information engineering from the University of Brescia (2006), working on video content analysis. During his PhD he spent one year in British Telecom Research, United Kingdom, working in the “Content & Coding Lab.” Since 2005 he has been an Assistant Professor at the University of Brescia. In 2012, he co-founded Yonder, a spin-off company specialized in NLP, Machine Learning, and Cognitive Computing.

4:20 – 4:40 pm
Regency Ballroom B

**On the role of color in visual saliency,** Sergio Etchebehere and Elena Fedorovskaya; 1University Jean Monnet Saint-Etienne (France) and 2Rochester Institute of Technology (United States)
DISCUSSION: From Low-Level Descriptors to Visual Semantics

4:40 – 5:40 pm
Regency Ballroom B

Every afternoon at HVEI, authors from the day’s papers gather to participate in a dynamic discussion with the audience, moderated by the conference and session chairs. Since the papers and the participants represent diverse disciplines, these interactive sessions are exciting and provocative.

Symposium Welcome Reception
5:00 – 6:00 pm
Atrium

Human Vision and Electronic Imaging 2017 Banquet

Hosts: Bernice Rogowitz, Visual Perspectives (United States), Thrasyvoulos Pappas, Northwestern University (United States), and Huib de Ridder, Delft University of Technology (the Netherlands)

7:15 – 10:00 pm
Sandpiper C,D

Deep learning for gestalt and gestalt for deep learning (Invited), Stella Yu, University of California, Berkeley (United States)

Please join us for an exciting banquet presentation and the opportunity to interact with fellow colleagues and speakers, in an informal atmosphere. You can sign up for the Banquet now, when you register.

Tuesday, January 31, 2017

Human Vision and Stereoscopic Imaging Joint Session

Session Chairs: Nicolas Holliman, University of Newcastle (United Kingdom), and Thrasyvoulos Pappas, Northwestern University (United States)

8:50 – 10:10 am
Grand Peninsula Ballroom D

This session is jointly sponsored by: Stereoscopic Displays and Applications XXVIII and Human Vision and Electronic Imaging 2017.

8:50
HVEI-378
Depth-compressed expression for providing natural, visual experiences with integral 3D displays, Yasuhito Sawahata and Toshiya Morita, Japan Broadcasting Corporation (Japan)

9:10
HVEI-379
Blind quality prediction of stereoscopic 3D images, Jiheng Wang1, Qingbo Wu2, Abdul Rehman1, Shiqi Wang1, and Zhou Wang1; 1University of Waterloo (Canada) and 2University of Electronic Science and Technology of China (China)

9:30
SD&A-380
Pseudo-haptic by stereoscopic images and effects on muscular activity, Takashi Kawase1, Fumiya Ohta1, Sanghyun Kim1, and Hirokazu Maniwa1,2; 1Waseda University and 2Aoyama Gakuin University (Japan)

9:50
SD&A-381
The effects of proximity cues on visual comfort when viewing stereoscopic contents (JIST-first), Yaohua Xie1, Dani Wang2, and Peng Qiao2; 1Chinese Academy of Sciences, 2Institute of Software, Chinese Academy of Sciences, and 3Central University of Finance and Economics (China)

10:00 am – 7:30 pm
Industry Exhibition
10:10 – 10:40 am
Coffee Break

Emerging Issues in Perceptual Image Quality

Session Chair: Huib de Ridder, Delft University of Technology (the Netherlands)

10:40 am – 12:40 pm
Regency Ballroom B

10:40
HVEI-120
Interactions between saliency and utility, Edward Scott and Sheila Hemami, Northeastern University (United States)

11:00
HVEI-121
Perceptual evaluation of psychovisual rate-distortion enhancement in video coding, Zhengfang Duanmu, Kai Zeng, Zhou Wang, and Mahzarin Esapour, University of Waterloo (Canada)

11:20
HVEI-122
Balancing Type I errors and statistical power in video quality assessment, Kjell Brunnstrom1,2 and Marcus Barkowsky1; 1Acroo Swedish ICT AB (Sweden), 2Mid Sweden University (Sweden), and 3University of Nantes (France)

12:00
HVEI-123
On the perceptual factors underlying the quality of post-compression enhancement of textures, Yusufwan Yaacob, Yi Zhang, and Damon Chandler, Shizuoka University (Japan)

12:20
HVEI-124
Do gaze disruptions indicate the perceived quality of non-uniformly coded natural scenes?, Yashas Rai and Patrick Le Callet, University of Nantes (France)

12:40 – 2:00 pm
Lunch Break

EI 2017 Tuesday Plenary and Symposium Awards

Session Chairs: Joyce E. Farrell, Stanford University, and Nitin Sampat, Rochester Institute of Technology (United States)

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

VR 2.0: Making virtual reality better than reality, Gordon Wetzstein, Stanford University (United States)

Gordon Wetzstein is an Assistant Professor of Electrical Engineering and, by courtesy, of Computer Science, at Stanford University, and leads the Stanford Computational Imaging Group. He received a PhD in computer science from the University of British Columbia (2011) where his doctoral dissertation focused on computational light modulation for image acquisition and display. In his talk, Wetzstein explores the frontiers of VR systems engineering. Eventually, VR/AR systems will redefine communication, entertainment, education, collaborative work, simulation, training, telesurgery, and basic vision research, as next-generation computational near-eye displays evolve to deliver visual experiences that are better than the real world.

3:00 – 3:30 pm
Coffee Break
SPECIAL SESSION AND PANEL: Visually Lossless Video Quality for Modern Devices: Research and Industry Perspectives
Panel Moderator: Kjell Brunnstrom, Acreo Swedish ICT AB (Sweden)
Panelists: Damon Chandler, Shizuoka University (Japan); Phil Corriveau, Intel Corporation (United States); Scott Daly, Dolby Laboratories (United States); Edward Delp, Purdue University (United States); and James Goel, Qualcomm Inc. (Canada)
3:30 – 4:20 pm
Regency Ballroom B

3:30 HVEI-126
Image and video compression for mobile: Is my screen small enough? (Invited), Edward Delp, Purdue University (United States)

3:40 HVEI-127
Business perspectives on perceptually lossless and lossy quality (Invited), Scott Daly, Dolby Laboratories (United States)

3:50 HVEI-128
Usage perspectives on perceptually lossless and lossy quality and assessment (Invited), Philip Corriveau, Juliana Knopf, Hannah Coletti, and Shun-nan Yang; Intel Corporation and Pacific University (United States)

4:00 HVEI-129
Subjective assessment and the criteria for visually lossless compression (Invited), Laurie Wilcox, Robert Allison, and James Goel; York University and Qualcomm Inc. (Canada)

4:10 HVEI-130
Masked detection of compression artifacts on laboratory, consumer, and mobile displays (Invited), Yi Zhang, Yusizwan Yaacob, and Damon Chandler, Shizuoka University (Japan)

DISCUSSION: Perceptual, Cognitive, and Affective Issues in Image Representation, Compression, and Measurement
5:20 – 6:00 pm
Regency Ballroom B
In this session, authors from the day’s papers will gather to participate in a dynamic discussion with the audience, moderated by the conference and session chairs. Since the papers and the participants represent diverse disciplines, interactive session promised to be exciting and provocative.

Symposium Demonstration Session
5:30 – 7:30 pm
Grand Peninsula Ballroom E

Wednesday, February 1, 2017

Computational Models of Human Color, Stereo, and High Dynamic Range
8:50 – 10:10 am
Regency Ballroom B

8:50 HVEI-132
Orientation-ocularity maps: A technique for computer vision, Alfredo Restrepo, Universidad de los Andes (Colombia)

9:10 HVEI-133
Evaluation of color prediction methods in terms of least dissimilar asymmetric matching, Emiris Roshan and Brian Funt, Simon Fraser University (Canada)

9:30 HVEI-134
Characterization of spatiotemporal fluctuation in absorbed light energy by an array of interleaved photosensitive elements, Shahram Peyvandi, Vebjorn Ekroll, and Alan Gilchrist; Rutgers, The State University of New Jersey (United States) and University of Leuven (Belgium)

9:50 HVEI-135
Robust dynamic range computation for high dynamic range content, Vedad Hulusic, Giuseppe Valenzise, Kurt Debattista, and Frederic Dufaux; Télécom ParisTech, Université Paris-Saclay (France) and University of Warwick (United Kingdom)

Moderated Discussion: Visually Lossless Video Quality for Modern Devices: Research and Industry Perspectives
Panel Moderator: Kjell Brunnstrom, Acreo Swedish ICT AB (Sweden)
Panelists: Damon Chandler, Shizuoka University (Japan); Phil Corriveau, Intel Corporation (United States); Scott Daly, Dolby Laboratories (United States); Edward Delp, Purdue University (United States); and James Goel, Qualcomm Inc. (Canada)
4:20 – 5:20 pm
Regency Ballroom B

The issues raised during this panel discussion, and a review of the resulting discussion, will be summarized in a proceedings manuscript, authored by all the contributing panelists:

4:20 HVEI-131
Industry and business perspectives on the distinctions between visually lossless and lossy video quality: Mobile and large format displays (Invited), Kjell Brunnstrom, Scott Daly, Damon Chandler, Phil Corriveau, Yi Zhang, Yusizwan Yaacob, Laurie Wilcox, Robert Allison, James Goel, Edward Delp, and Shun-nan Yang; Acreo Swedish ICT AB (Sweden), Wih Sweden University (Sweden), Dolby Laboratories (United States), Shizuoka University (Japan), Intel Corporation (United States), York University (Canada), Qualcomm (Canada), Purdue University (United States), and Pacific University (United States)
**Special Session: Computational Modeling Inspired by Human Vision**
Session Chair: Christopher Tyler, Smith-Kettlewell Eye Research Institute (United States)
10:30 am – 12:30 pm
Regency Ballroom B

10:30 HVEI-136
GPU-accelerated vision modeling with the HPE cognitive computing toolkit (Invited), Benjamin Chandler, Hewlett Packard Enterprise (United States)

11:00 HVEI-137
A neurally-inspired algorithm for detecting ordinal depth from motion signals in video streams (Invited), Gennady Livitz, Harald Ruda, and Ennio Mingolla, Northeastern University (United States)

11:30 HVEI-138
Computational estimation of scene structure through texture gradient cues (Invited), Christopher Tyler1,2 and Ajay Gopi3; 1Smith-Kettlewell Eye Research Institute (United States), 2City University of London (United Kingdom), and 3University of California, Berkeley (United States)

12:00 HVEI-139
Learning visual representations for active perception (Invited), Bruno Olshausen, Brian Cheung, and Eric Weiss, University of California, Berkeley (United States)

12:30 – 2:00 pm Lunch Break

**Digital Humanities: Humans and/vs. Machines**
Session Chair: Thrasyvoulos Pappas, Northwestern University (United States)
4:50 – 5:30 pm
Regency Ballroom B

4:50 HVEI-144
Writer identification in modern and historical documents via binary pixel patterns, Kolmogorov-Smirnov test and Fisher’s method (JIST-first), Arie Shaus and Eli Turek, Tel Aviv University (Israel)

5:10 HVEI-145
CNN-based transfer learning for historical Chinese seal character recognition based on artificial random samples, Hong Shang, Wei Fan, Jun Sun, and Satoshi Naoi, Fujitsu Research & Development Center (China)

**DISCUSSION: Computational Modeling, Perceptual Features, and Digital Humanities**
5:30 – 6:20 pm
Regency Ballroom B

In this session, authors from the day’s papers will gather to participate in a dynamic discussion with the audience, moderated by the conference and session chairs. Since the papers and the participants represent diverse disciplines, interactive session promised to be exciting and provocative.

**Symposium Interactive Papers (Poster) Session**
5:30 – 7:00 pm
Atrium

**Thursday, February 2, 2017**

**Measuring Fatigue and Discomfort**
Session Chair: Huib de Ridder, Delft University of Technology (the Netherlands)
8:50 – 9:30 am
Regency Ballroom B

8:50 HVEI-146
Comparison of visual discomfort and visual fatigue between HMD and smartphone, Hyojeong Suk, Jungmin Han, and Seon Hee Bae; 1Korea Advanced Institute of Science and Technology and 2Hansol Eye Clinic (Republic of Korea)
Measuring visually induced motion sickness using wearable devices, Ran Liu1, Eli Peli1, and Alex Hwang1; 1Harvard University (United States) and 2Chongqing University (China)

Attention, Individual Differences, and Emotion
Session Chair: Bernice Rogowitz, Visual Perspectives (United States)

9:30 – 10:30 am
Regency Ballroom B

Developmental changes in ambient and focal visual processing strategies, Onkar Krishna1, Toshihiko Yamasaki1, Kiyoharu Aizawa1, Andrea Helo2, and Pia Rama2; 1The University of Tokyo (Japan) and 2Université Paris Descartes (France)

9:50
Gaze-contingent center-surround fusion of infrared images to facilitate visual search for human targets (JIST-first), Mackenzie Glaholt and Grace Sim, Defence Research and Development Canada (Canada)

10:10
Evaluation and prediction of evoked emotions induced by image manipulations, Lin Yuan and Touradj Ebrahimi, EPFL (Switzerland)

10:30 – 11:00 am
Coffee Break

Special Session: Art and Aesthetics, Part I: Measuring Artistic and Aesthetic Judgments
Session Chairs: Claus-Christian Carbon, University of Bamberg (Germany), Elena Fedorovskaya, Rochester Institute of Technology (United States), and Monica Lopez-Gonzalez, La Petite Noiseuse Productions (United States)

11:00 am – 12:30 pm
Regency Ballroom B

Measurement problems and measurement strategies for capturing the rich experience of art (Invited), Claus-Christian Carbon1,2; 1University of Bamberg and 2EPAEG (Germany)

11:30
The gist of beauty: An investigation of aesthetic perception in rapidly presented images (Invited), Caitlin Mullin1,2; Gregor Hayn-Leichtcnern1, Christoph Redies1, and Johan Wagemans2; 1Massachusetts Institute of Technology (United States), 2University of Leuven (Belgium), and 3University of Jena (Germany)

12:00
Gaze patterns in art viewing and their dependency on expertise and image characteristics (Invited), Elena Fedorovskaya, Sanjana Kapisthalam, and Yinglong Bu, Rochester Institute of Technology (United States)

12:30 – 2:00 pm
Lunch Break

Special Session: Art and Aesthetics, Part II: Producing Art from the Artists’ and Scientists’ Perspectives
Session Chairs: Claus-Christian Carbon, University of Bamberg (Germany), Elena Fedorovskaya, Rochester Institute of Technology (United States), and Monica Lopez-Gonzalez, La Petite Noiseuse Productions (United States)

2:00 – 3:30 pm
Regency Ballroom B

Imaging human vision: An artistic perspective (Invited), Robert Pepperell, Cardiff Metropolitan University (United Kingdom)

2:30
Art training matters: Enhancement of spatial cognition and brain connectivity (Invited), Lora Likova, Laura Cacciamani, and Spero Nicholas, Smith-Kettlewell Eye Research Institute (United States)

3:00
Trading conversations between science and art: When musical improvisation enters the dialogue on stage (Invited), Monica Lopez-Gonzalez, La Petite Noiseuse Productions (United States)

Meet the Future: A Showcase of Student and Young Professionals Research
3:00 – 5:00 pm
Atrium

DISCUSSION: Embracing the Complexity of Human Experience
3:30 – 4:30 pm
Regency Ballroom B

In this session, authors from the day’s papers will gather to participate in a dynamic discussion with the audience, moderated by the conference and session chairs. Since the papers and the participants represent diverse disciplines, interactive session promised to be exciting and provocative.

Museum Visit: San Francisco Museum of Modern Art
5:30 – 7:30 pm
Offsite

The San Francisco Museum of Modern Art is open again, after a significant multi-year renovation. To celebrate, we will be organizing a Museum Visit and informal dinner party for Friends of HVEI. Members of the HVEI community will provide perceptual and cognitive insights into pieces in the Museum Collection. Everyone is responsible for his or her own transportation, museum entrance fees and dinner. Anyone interested can meet in the Hotel Lobby at 5:00 to arrange shared cab rides or Ubers. The tour begins at 5:30 at the ticket booth in the museum lobby.

Friends of HVEI Casual Dinner
7:30 – 9:30 pm
Offsite

This casual dinner follows immediately after the museum visit.
Image Processing: Algorithms and Systems XV

Conference overview

Image Processing: Algorithms and Systems continues the tradition of the past conference Nonlinear Image Processing and Pattern Analysis in exploring new image processing algorithms. It also reverberates the growing call for integration of the theoretical research on image processing algorithms with the more applied research on image processing systems.

Specifically, the conference aims at highlighting the importance of the interaction between linear, nonlinear, and transform-based approaches for creating sophisticated algorithms and building modern imaging systems for new and emerging applications.

Award
Best Paper
**Tuesday, January 31, 2017**

### Transform-domain Image Processing

**Session Chair:** Karen Egiazarian, Tampere University of Technology (Finland)

**8:50 – 10:10 am**

**Cypress B**

8:50  
**IPAS-197**

**Compressed sensing MRI using curvelet sparsity and nonlocal total variation,** Ali Pour Yazdanpanah, University of Nevada (United States)

9:10  
**IPAS-198**

**Brand detection framework in LG wavelet domain,** Federica Mangiardo, Andrea Bernardini, Emiliana Pallotti, and Licia Capodiferro, Fondazione Ugo Bordoni (Italy)

9:30  
**IPAS-199**

**Texture representations in different basis functions for image synthesis using system criteria analysis,** Viacheslav Voronin¹, Vladimir Ryzhov², Vladimir Marchuk¹, and Karen Egiazarian¹; ¹Don State Technical University (Russian Federation), ²Southern Federal University (Russian Federation), and ³Tampere University of Technology (Finland)

9:50  
**IPAS-200**

**2-D octonion discrete fourier transform: Fast algorithms,** Artyom Grigoryan and Sos Agaian, University of Texas at San Antonio (United States)

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### Image Processing Algorithms

**Session Chair:** Karen Egiazarian, Tampere University of Technology (Finland)

**10:50 am – 12:10 pm**

**Cypress B**

10:50  
**IPAS-201**

**Artifact suppression in compressed images using residual-based deep convolutional network,** Woo Hyun Nam, Kiheum Cho, Il Jun Ahn, Yongsup Park, and Tammy Lee, Samsung Electronics Co. Ltd. (Republic of Korea)

11:10  
**IPAS-202**

**Full-reference metrics multidistortional analysis,** Oleg Ieremeiev¹, Vladimir Lukin¹, Nikolay Ponomarenko¹, and Karen Egiazarian¹; ¹Tampere University of Technology (Finland), and ²National Aerospace University (Ukraine)

11:30  
**IPAS-203**

**ICA-based background subtraction method for an FPGA-SoC,** Fernando Carriaza-Corral, Alberto Vázquez-Cervantes, Joséu Montes Martínez, Teresa Hernández-Diaz, Jorge Soto-Cajiga, and Hugo Jiménez, Centro de Ingeniería y Desarrollo Industrial (Mexico)

11:50  
**IPAS-204**

**A robust line segmentation for Arabic printed text with diacritics,** Khader Mohammad, Birzeit University (Palestine)

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### EI 2017 Tuesday Plenary and Symposium Awards

**Session Chairs:** Joyce E. Farrell, Stanford University, and Nitin Sampat, Rochester Institute of Technology (United States)

**2:00 – 3:00 pm**

**Grand Peninsula Ballroom D**

**VR 2.0: Making virtual reality better than reality,** Gordon Wetzstein, Stanford University (United States)

Gordon Wetzstein is an Assistant Professor of Electrical Engineering and, by courtesy, of Computer Science, at Stanford University, and leads the Stanford Computational Imaging Group. He received a PhD in computer science from the University of British Columbia (2011) where his doctoral dissertation focused on computational light modulation for image acquisition and display. In his talk, Wetzstein explores the frontiers of VR systems engineering. Eventually, VR/AR systems will redefine communication, entertainment, education, collaborative work, simulation, training, telesurgery, and basic vision research, as next-generation computational near-eye displays evolve to deliver visual experiences that are better than the real world.

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### Image Interpolation, Restoration, and Denoising Joint Session

**Session Chairs:** Karen Egiazarian, Tampere University of Technology (Finland), and Radka Tezaur, Intel Corporation (United States)

**3:30 – 5:30 pm**

**Grand Peninsula Ballroom A**

This session is jointly sponsored by: Digital Photography and Mobile Imaging XIII and Image Processing: Algorithms and Systems XV.

**3:30 DPMI-083**

**BM3D-HVS: Content-adaptive denoising for improved visual quality**  
(Invited), Karen Egiazarian¹,², Aram Danielyan², Nikolay Ponomarenko¹,², Alessandro Foi¹,², Oleg Ieremeiev³, and Vladimir Lukin¹; ¹Tampere University of Technology (Finland), ²Noiseless Imaging Oy (Finland), and ³National Aerospace University (Ukraine)

**3:50 IPAS-084**

**Refining raw pixel values using a value error model to drive texture synthesis,** Henry Dietz, University of Kentucky (United States)

**4:10 IPAS-085**

**Color interpolation based on colorization for RGB-white color filter array,** Paul Oh¹, Sukho Lee¹, and Moon Gi Kang¹; ¹Yonsei University and ²Dongseo University (Republic of Korea)

**4:30 IPAS-086**

**Video frame synthesizing method for HDR video capturing system with four image sensors,** Takayuki Yamashita¹,² and Yoshihiro Fujita¹; ¹Ehime University and ²NHK (Japan)

**4:50 DPMI-088**

**Robust defect pixel detection and correction for Bayer Imaging Systems,** Noha El-Yamany, Intel Corporation (Finland)

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### Symposium Demonstration Session

**5:30 – 7:30 pm**

**Grand Peninsula Ballroom E**
Wednesday, February 1, 2017

Image Processing Applications

Session Chair: Sos Agaian, University of Texas at San Antonio (United States)

8:50 – 10:10 am

Cypress B

8:50  
Water region extraction in thermal and RGB sequences using spatiotemporally-oriented energy features, Amir Ghahremani, Egor Bondarev, and Peter De With, Eindhoven University of Technology (the Netherlands)

9:10  
Cloud and shadow detection using sequential characteristics on multispectral satellite images, Herman Groot1, Arjen Oostdijk2, Mark van Persie2, and Peter De With3; 1Eindhoven University of Technology and 2Netherlands Aerospace Centre (the Netherlands)

9:30  
Thermal facial signatures for state assessment during deception, Nilesh Powar4, Tamera Schneider5, Julie Skipper5, Douglas Petkie6, Vijayan Asari4, Rebecca Riffle4, Matthew Sherwood5, and Carl Cross6; 4University of Dayton and 5Wright State University (United States)

9:50  
Face spoofing detection based on local binary descriptors, Yao-Hong Tsai, Hsuan Chung University (Taiwan)

10:00 am – 4:00 pm  Industry Exhibition

10:10 – 10:50 am  Coffee Break

3:00 – 3:30 pm  Coffee Break

3D Sensing and Processing

Session Chair: Atanas Gotchev, Tampere University of Technology (Finland)

10:50 – 11:50 am

Cypress B

10:50  
Real-time estimation of the 3D transformation between images with large viewpoint differences in cluttered environments, Dennis van de Wouw1,2, Martin Pieck1, Gija Dubbelman1, and Peter De With1; 1Eindhoven University of Technology and 2Vincotion B.V. (the Netherlands)

11:10  
Camera-to-model back-raycasting for extraction of RGBD images from pointclouds, Farid Javan Hemmat1, Egor Bondarev2, and Peter De With3; 1Eindhoven University of Technology and 3Eindhoven University of Technology (the Netherlands)

11:30  
Depth image object extraction approach based on improved fractal dimension, Ting Cao and Weixing Wang, Chang’an University (China)

11:50 am – 2:00 pm  Lunch Break

Image Processing: Algorithms and Systems Interactive Papers Session

5:30 – 7:00 pm

Atrium

The following works will be presented at the EI 2017 Symposium Interactive Papers Session.

IPAS-213  
Change detection from remote sensing images based on fractional integral and improved FCM, Fengping Wang and Weixing Wang, Chang’an University (China)

IPAS-214  
Non-blind image deconvolution using a sampling without replacement, Jaeduk Han, Janghyun Kim, and Moon Ge Kang, Yonsei University (Republic of Korea)

IPAS-215  
Alpha-rooting method of gray-scale image enhancement in the quaternion frequency domain, Artyom Grigoryan, John Aparna, and Sos Agaian, University of Texas at San Antonio (United States)

IPAS-217  
What makes HDR the contents more realistic? Peak-luminance enhancement using the loading effect for OLED displays, Jihwan Woo and Seoyoung Lee, Samsung Electronics (Republic of Korea)

IPAS-211  
Feature representation learning by rank ordered autoencoder for multi-camera person re-identification, Sergey Makov, Vladimir Frants, Vachcheslav Voronin, and Vladimir Marchuk, Don State Technical University (Russian Federation)

IPAS-087  
Search the optimal border for combination of image pairs using neural networks, Evgeny Semenishchev, Don State Technical University (Russian Federation)

EI 2017 Wednesday Plenary and Symposium Awards

Session Chairs: Joyce E. Farrell, Stanford University, and Nitin Sampat, Rochester Institute of Technology (United States)

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

Designing VR video camera systems, Brian Cabral, Facebook, Inc. (United States)

Brian Cabral is Director of Engineering at Facebook, leading the Surround 360 VR camera team, specializing in computational photography, computer vision, and computer graphics. He has published a number of papers in the area of computer graphics and imaging including the pioneering Line Integral Convolution algorithm. Cabral discusses developing Facebook Surround 360, an open, high-quality 3D-360 video capture system. VR video capture systems are composed of multiple optical and digital components - all of which must operate as if they are one seamless optical system. The design of VR video cameras, optical choices, SNR, etc., require a new set of technologies and engineering approaches, with tight coupling to the computational system components.
Image Quality and System Performance XIV

Conference overview
We live in a visual world. The perceived quality of images is of crucial importance in industrial, medical, and entertaining application environments. Developments in camera sensors, image processing, 3D imaging, display technology, and digital printing are enabling new or enhanced possibilities for creating and conveying visual content that informs or entertains. Wireless networks and mobile devices expand the ways to share imagery.

The power of imaging rests directly on the visual quality of the images and the systems that produce them. As the images are generally intended to be viewed by humans, consideration of the role of human visual perception is intrinsic to the effective assessment of image quality.

This conference brings together engineers and scientists from industry and academia who strive to understand what makes a high-quality image and how to assess the requirements and performance of modern imaging systems. It focuses on both objective and subjective methods for evaluating the perceptual quality of images and includes applications throughout the imaging chain from image capture, through processing, to output, printed or displayed, video or still, 2D or 3D, LDR or HDR.

Awards: Best Student Paper and Best Paper

Conference Sponsors

Google

intel
Monday, January 30, 2017

No Reference Quality Measurement

Session Chair: Robin Jenkin, ON Semiconductor (United States)

8:50 – 10:10 am

Harbour

8:50 IQSP-218 Blind image quality assessment using multiscale local binary patterns (JIST-first), Pedro Garcia Freitas, Wellington Akamine, and Mylene Fanas, University of Brasilia (Brazil)

9:10 IQSP-219 Dimension reduction-based attributes selection in no-reference learning-based image quality algorithms, Christophe Charrier1, Abdelhalim Saadane2, and Christine Fernandez Malogine3; 1Normandie University, 2Université de Nantes, and 3IUM (France)

9:30 IQSP-220 GPGPU based implementation of a high performing No Reference (NR) IQA algorithm, BLINDS-II, Aman Yadav1, Sohum Sohoni1, and Damon Chandler2; 1Arizona State University (United States) and 2Shizuoka University (Japan)

9:50 IQSP-221 No-reference image contrast assessment based on just-noticeable-difference, Minsub Kim, Ki Sun Song, and Moon Gi Kang, Yonsei University (Republic of Korea)

10:10 – 10:50 am Coffee Break

Keynote: Automated Video Quality Measurement and Application Session Chair: Elaine Jin, Google Inc. (United States)

10:50 – 11:30 am

Harbour

IQSP-222 How to use video quality metrics for something other than video compression, Anil Kokaram, Google/YouTube (United States)

Anil Kokaram is the Engineering Manager for the media algorithms team in YouTube. The team is responsible for developing video processing algorithms for quality improvement in various pipelines. Kokaram is also a Professor at Trinity College Dublin, Ireland and continues to supervise a small number of students at www.sigmedia.tv in the EE Dept there. His main expertise is in the broad areas of DSP for Video Processing, Bayesian Inference, and motion estimation. He has published more than 100 refereed papers in these areas. In 2007 he was awarded a Science and Engineering Academy Award for his work in video processing for post-production applications. He was founder of a company (GreenParrotPictures) producing video enhancement software that was acquired by Google in 2011. He is a former Associate Editor of the IEEE Transactions on CCs and Systems for Video Technology and IEEE Transactions on Image Processing.

Machine Learning and Implementation of Quality Metrics

Session Chair: Elaine Jin, Google Inc. (United States)

11:30 am – 12:30 pm

Harbour

IQSP-223 MS-UNIQUE: Multi-model and sharpness-weighted unsupervised image quality estimation, Mohit Prabhushankar, Dogancan Temel, and Chassan AAlregib, Georgia Institute of Technology (United States)

IQSP-224 Microarchitectural analysis of a GPU implementation of the most apparent distortion image quality assessment algorithm, Vignesh Kannan1, Joshua Holloway1, Sohum Sohoni1, and Damon Chandler2; 1Arizona State University (India) and 2Shizuoka University (Japan)

IQSP-225 Image quality assessment by comparing CNN features between images (JIST-first), Seyed Ali Amirshahi1, Marius Pedersen2, and Stella Yu1; 1University of California, Berkeley (United States) and 2Norwegian University of Science and Technology (Norway)

12:10 – 2:00 pm Lunch Break

EI 2017 Opening Plenary and Symposium Awards

Session Chairs: Joyce E. Farrell, Stanford University, and Nitin Sampat, Rochester Institute of Technology (United States)

2:00 – 3:00 pm

Grand Peninsula Ballroom D

Giga-scale 3D computational microscopy, Laura Waller, University of California, Berkeley (United States)

Laura Waller is the Ted Van Duzer Endowed Assistant Professor of Electrical Engineering and Computer Sciences (EECS) at UC Berkeley. She is a Senior Fellow at the Berkeley Institute of Data Science, and received her BS (2004), MEng (2005), and PhD (2010) in EECS from the Massachusetts Institute of Technology (MIT). Waller’s talk is on computational imaging methods for fast capture of gigapixel-scale 3D intensity and phase images in a commercial microscope that employs illumination-side and detection-side coding of angle (Fourier) space with simple hardware and fast acquisition. The result is high-resolution reconstructions across a large field-of-view, achieving high space-bandwidth-time product.

3:00 – 3:30 pm Coffee Break

Novel Tools

Session Chair: Luke Cui, Amazon (United States)

3:30 – 4:50 pm

Harbour

IQSP-226 Potential contrast - A new image quality measure, Arie Shaus, Shira Faigenbaum-Golovin, Barak Sober, Eli Turkel, and Eli Piasezky, Tel Aviv University (Israel)
9:20 \( \text{IQSP-250} \) A methodology for perceptual image quality assessment of smartphone cameras – Color quality, Susan Farnand, Rochester Institute of Technology (United States)

9:40 \( \text{IQSP-251} \) Assessing the ability of simulated laboratory scenes to predict the image quality performance of HDR captures (and rendering) of exterior scenes using mobile phone cameras, Amelia Spooner\(^1\), Ashley Solter\(^2\), Fernando Voltolini de Azambuja\(^1\), Nitin Sampat\(^1\), Stephen Vigdoros\(^1\), Brain Rodrick\(^1\), and Cheng Lu\(^1\); \(^1\)Rochester Institute of Technology, \(^2\)SensorSpace, LLC, and \(^3\)intelligent Corporation (United States)

10:00 \( \text{DPMI-252} \) Cell phone rankings!; Dietmar Wüller, Image Engineering GmbH & Co. KG (Germany)

10:00 am – 7:30 pm  Industry Exhibition

10:20 – 10:50 am  Coffee Break

**Tuesday, January 31, 2017**

**Keynote: Mobile Device Camera IQ Joint Session**
Session Chairs: Susan Farnand, Rochester Institute of Technology, and Jackson Roland, Apple Inc. (United States)

8:50 – 9:20 am  Grand Peninsula Ballroom A

This session is jointly sponsored by: Image Quality and System Performance XIV and Digital Photography and Mobile Imaging XIII.

9:20 \( \text{IQSP-249} \) Towards the development of the IEEE P1858 CPIQ standard – A validation study, Elaine Jin\(^1\), Jonathan Phillips\(^1\), Susan Farnand\(^2\), Margaret Belska\(^3\), Vinh Tran\(^3\), Ed Chang\(^1\), Yixuan Wang\(^3\), and Benjamin Tseng\(^1\); \(^1\)Google Inc. (United States), \(^2\)Rochester Institute of Technology (United States), \(^3\)NVIDIA (United States), and \(^4\)Apkudo (Australia)

Elaine W. Jin holds a PhD in optical engineering from Zhejiang University in China, and a PhD in psychology from the University of Chicago. She has worked in the imaging industry for 15+ years including employment at Polaroid Corporation, Eastman Kodak Company, Micron Technologies, Apista Imaging, Marvell Semiconductors, and Intel Corporation. She currently is a staff image scientist at Google, working on developing cutting-edge consumer hardware products. Her primary research interests include imaging systems design and analysis, color imaging, and psychophysics. She has published 22 journal and conference papers, and authored 14 US patents / patent applications. She joined the CPIQ initiative (Camera Phone Image Quality) in 2006, and since then has made major contributions in the development of the softcopy quality ruler method, and the CPIQ metrics for visual noise, texture blur, spatial frequency responses, chroma level, and color uniformity. She currently leads the Color/Tone Subgroup of the IEEE CPIQ Standard Working Group.

**Mobile Device Camera IQ Joint Session**
Session Chairs: Susan Farnand, Rochester Institute of Technology, and Jackson Roland, Apple Inc. (United States)

9:20 – 10:20 am  Grand Peninsula Ballroom A

This session is jointly sponsored by: Image Quality and System Performance XIV and Digital Photography and Mobile Imaging XIII.
Wednesday, February 1, 2017

Print Quality

Session Chair: Chaker Larabi, Université de Poitiers (France)

9:10 – 9:50 am
Harbour

9:10 IQSP-238
Feature ranking and selection used in a machine learning framework for predicting uniformity of printed pages, Minh Nguyen and Jan Allebach, Purdue University (United States)

9:30 IQSP-239
Real-time print quality diagnostics, Zuguang Xiao1, Minh Nguyen1,2, Eric Maggard3, Mark Shaw3, Jan Allebach1, and Amy Reibman1; 1Purdue University, 3Duo Technologies, and 2HP Inc. (United States)

10:00 am – 4:00 pm Industry Exhibition

10:10 – 10:50 am Coffee Break

Display

Session Chair: Sophie Triantaphillidou, University of Westminster (United Kingdom)

10:50 am – 12:10 pm
Harbour

10:50 IQSP-240
UHD quality analyses at various viewing conditions, Chulhee Lee, Sangwook Baek, Sungwook Youn, Seongyoun Woo, and Jeongyeol Baek, Yonsei University (Republic of Korea)

11:10 IQSP-241
Image quality assessment for holographic display, Wontaek Seo, Hoon Song, Jungkwan An, Juwon Seo, Geeyoung Sung, Yun-Tae Kim, Chil-Sung Choi, Sunil Kim, Hojung Kim, Yongkyu Kim, Young Kim, Yunhee Kim, Hong-Seok Lee, and Sungwoo Hwang, Samsung Advanced Institute of Technology (Republic of Korea)

11:30 IQSP-242
Subjective viewer preference model for automatic HDR down conversion, Lucien Lenzen and Mike Christmann, Hochschule RheinMain (Germany)

11:50 IQSP-243
A foveated just noticeable difference model for virtual reality, Yuqiao Deng, Yingxue Zhang, Daiqin Yang, and Zhenzhong Chen, Wuhan University (China)

12:10 – 2:00 pm Lunch Break
**EI 2017 Wednesday Plenary and Symposium Awards**
Session Chairs: Joyce E. Farrell, Stanford University, and Nitin Sampat, Rochester Institute of Technology (United States)
2:00 – 3:00 pm
Grand Peninsula Ballroom D

**Designing VR video camera systems,** Brian Cabral, Facebook, Inc. (United States)

Brian Cabral is Director of Engineering at Facebook, leading the Surround 360 VR camera team, specializing in computational photography, computer vision, and computer graphics. He has published a number of papers in the area of computer graphics and imaging including the pioneering Line Integral Convolution algorithm. Cabral discusses developing Facebook Surround 360, an open, high-quality 3D-360 video capture system. VR video capture systems are composed of multiple optical and digital components - all of which must operate as if they are one seamless optical system. The design of VR video cameras, optical choices, SNR, etc., require a new set of technologies and engineering approaches, with tight coupling to the computational system components.

3:00 – 3:30 pm Coffee Break

**Camera 3A**

Session Chair: Jonathan Phillips, Google Inc. (United States)
3:30 – 4:50 pm Harbour

**A framework for auto-exposure subjective comparison,** Seungseok Oh1, Clayton Passmore1,2, Bobby Gold1, Taylor Skilling1,3, Sean Pieper1, Taek Kim1, and Margaret Belska1; 1NVIDIA (United States), 2University of Waterloo (Canada), and 3Northeastern University (United States)

3.50 IQSP-245

**Autofocus measurement for imaging devices,** Pierre Robisson, DxO (France)

4.10 IQSP-246

**Auto Focus Performance - What can we expect from today’s cameras?**, Uwe Artmann, Image Engineering GmbH & Co KG (Germany)

4.30 IQSP-247

**Autofocus analysis: Latency and sharpness,** Katrina Passarella, Brett Frymire, and Ed Chang, Google, Inc (United States)

**Panel: Image Quality Discussion**
Panel Moderators: Robin Jenkin, ON Semiconductor, and Elaine Jin, Google Inc. (United States)
4:50 – 5:30 pm Harbour

**Image Quality and System Performance XIV Interactive Papers Session**
5:30 – 7:00 pm Atrium

The following works will be presented at the EI 2017 Symposium Interactive Papers Session.

**Estimation and compensation of reconstructed image in digital holographic display,** Hyun-Eui Kim, Electronics and Telecommunications Research Institute (Republic of Korea)

**Solid-mottle method for measuring in laser-printers,** Daegun Ko, Samsung Electronics (Republic of Korea)
Image Sensors and Imaging Systems 2017

Conference overview
Solid state optical sensors and solid state cameras have established themselves as the imaging systems of choice for many demanding professional applications such as scientific and industrial applications. The advantages of low-power, low-noise, high-resolution, high-geometric fidelity, broad spectral sensitivity, and extremely high quantum efficiency have led to a number of revolutionary uses.

This conference aims at being a place of exchanges and at giving the opportunity to a quick publication of new works in the areas of solid state detectors, solid state cameras, new optical concepts, and novel applications. To encourage young talent, a best student paper contest is organized.

Awards: Best Paper, Best Student Paper

Conference Sponsors
Wednesday, February 1, 2017

**Keynote: History and Standards for Automotive Vision Systems Performance**

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

**8:50 – 9:30 am**

Grand Peninsula Ballroom A

This session is jointly sponsored by: Image Sensors and Imaging Systems 2017 and Digital Photography and Mobile Imaging XIII.

**Conference Chair Opening Remarks**

**Bayer pattern and image quality**, Jörg Kunze, Basler AG (Germany)

Jörg Kunze has received his PhD in physics from the University of Hamburg (2004). He joined Basler in 1998, where he started as an electronics developer and where he currently is the team leader of New Technology. Kunze serves as an expert for image sensors, camera hardware, noise, color fidelity, 3D- and computational imaging and develops new algorithms for color image signal processing. The majority of the Basler patents name him as inventor.

**Input Signal Quality & Characterization**

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

**9:30 – 10:10 am**

Grand Peninsula Ballroom A

This session is jointly sponsored by: Image Sensors and Imaging Systems 2017 and Digital Photography and Mobile Imaging XIII.

**Accurate joint geometric camera calibration of visible and far-infrared cameras**, Takashi Shibata¹,², Masayuki Tanaka¹, and Masatoshi Okutomi¹; ¹Tokyo Institute of Technology and ²NEC Corporation (Japan)

**9:50**

**Interferometric measurement of sensor MTF and crosstalk**, Todor Georgiev, Jennifer Gille, Amber Sun, Lyubomir Baev, and Tharun Battula, Qualcomm Technologies, Inc. (United States)

**Emerging Imaging Sensor & Hardware**

Session Chairs: Thomas Vogelsang, Rambus Inc., and Ralf Widenhorn, Portland State University (United States)

**10:50 – 11:30 am**

Grand Peninsula Ballroom A

This session is jointly sponsored by: Image Sensors and Imaging Systems 2017 and Digital Photography and Mobile Imaging XIII.

**Silicon retina technology (Invited)**, Tobi Delbruck, Institute for Neuroinformatics (INI) (Switzerland)

Tobi Delbruck (IEEE M’99-SM’06-F’13) received a PhD from Caltech (1993). He is currently a professor of physics and electrical engineering at ETH Zurich in the Institute of Neuroinformatics, University of Zurich and ETH Zurich, Switzerland, where he has been since 1998. His group, which he coordinates together with Shih-Chii Liu, focuses on neuromorphic event-based sensors and sensory processing. He has co-organized the Telluride Neuromorphic Cognition Engineering summer workshop and the live demonstration sessions at ISCAS and NIPS. Delbruck is past Chair of the IEEE CAS Sensory Systems Technical Committee. He worked on electronic imaging at Arithmos, Synaptic, National Semiconductor, and Foveon and has founded 3 spin-off companies, including inilabs.com, a non-profit organization that has distributed hundreds of R&D prototype neuromorphic sensors to more than a hundred organizations around the world. He has been awarded 9 IEEE awards.

**TIK: A time domain continuous imaging testbed using conventional still images and video**, Henry Dietz, John Fike, Paul Eberhart, Katie Long, Clark Demaree, and Jong Wu, University of Kentucky (United States)

**11:30 – 11:50 am**

Grand Peninsula Ballroom A

This session is jointly sponsored by: Image Sensors and Imaging Systems 2017 and Digital Photography and Mobile Imaging XIII.

**11:00 am – 4:00 pm**

Industry Exhibition

**10:10 – 10:50 am**

Coffee Break
Keynote: Comparing CMOS Image Sensor Architectures
Session Chairs: Thomas Vogelsang, Rambus Inc., and Ralf Widenhorn, Portland State University (United States)
11:50 am – 12:40 pm
Grand Peninsula Ballroom A

This session is jointly sponsored by: Image Sensors and Imaging Systems 2017 and Digital Photography and Mobile Imaging XIII.

IMSE-082
CMOS image sensor pixel design and optimization, Boyd Fowler, OmniVision Technologies (United States)

Boyd Fowler's research interests include CMOS image sensors, low noise image sensors, noise analysis, data compression, and machine learning and vision. He received his MSEE (1990) and PhD (1995) from Stanford University. After finishing his PhD he stayed at Stanford University as a research associate in the Electrical Engineering Information Systems Laboratory until 1998. In 1998, Fowler founded Pixel Devices International in Sunnyvale California. Between 2005 and 2013, Fowler was CTO and VP of Technology at Fairchild Imaging. He is currently at OmniVision Technologies leading the marketing department. Fowler has authored numerous technical papers, book chapters and patents.

Image Sensors and Imaging Systems 2017 Awards

12:40 – 2:00 pm Lunch Break

EI 2017 Wednesday Plenary and Symposium Awards
Session Chairs: Joyce E. Farrell, Stanford University, and Nitin Sampat, Rochester Institute of Technology (United States)
2:00 – 3:00 pm Grand Peninsula Ballroom D

Designing VR video camera systems, Brian Cabral, Facebook, Inc. (United States)

Brian Cabral is Director of Engineering at Facebook, leading the Surround 360 VR camera team, specializing in computational photography, computer vision, and computer graphics. He has published a number of papers in the area of computer graphics and imaging including the pioneering Line Integral Convolution algorithm. Cabral discusses developing Facebook Surround 360, an open, high-quality 30-360 video capture system. VR video capture systems are composed of multiple optical and digital components - all of which must operate as if they are one seamless optical system. The design of VR video cameras, optical choices, SNR, etc., require a new set of technologies and engineering approaches, with tight coupling to the computational system components.

3:00 – 3:30 pm Coffee Break

High Performance Imaging
Session Chairs: Rihito Kuroda, Tohoku University (Japan), and Alice Reinheimer, e2v (United States)
3:30 – 5:00 pm Grand Peninsula Ballroom A

3:30 IMSE-178
High sensitivity and high readout speed electron beam detector using steep pn Junction Si diode for low acceleration voltage, Yasumasa Koda, Rihito Kuroda, Masaya Hara, Hiroyuki Tsunoda, and Shigetoshi Sugawa, Tohoku University (Japan)

3:50 IMSE-179
A full-resolution 8K single-chip portable camera system, Tomohiro Nakamura, Takahiro Yamasaki, Ryosuke Funatsu, and Hiroshi Shimamoto, NHK Science and Technology Research Laboratories (Japan)

4:10 IMSE-180
Filter selection for multispectral imaging optimizing spectral, colorimetric and image quality, Yixuan Wang, Rochester Institute of Technology (United States)

4:30 IMSE-181
The challenge of shot-noise limited speckle patterns statistical analysis, Jean-Michel Tualle, Kinia Barjean, Eric Tinet, and Dominique Ettori, University Paris 13 (France)

4:50 IMSE-182
Overview of machine vision standards, Arnaud Darmont, APHESA SPRL (Belgium)

Image Sensors and Imaging Systems 2017 Interactive Papers Oral Previews
Session Chairs: Arnaud Darmont, APHESA SPRL (Belgium), and Ralf Widenhorn, Portland State University (United States)
5:00 – 5:30 pm Grand Peninsula Ballroom A

In this session interactive poster authors will each provide a brief oral preview of their poster presentation, which will be presented fully in the Image Sensors and Imaging Systems 2017 portion of the Symposium Interactive Papers Session at 5:30 pm on Wednesday.

5:00 Session Chair Remarks

5:10 IMSE-183
Hot pixel rate behavior as pixel sizes go to 1 micron, Glenn Chapman1, Rahul Thomas1, Israel Koren2, and Zahava Koren2; 1Simon Fraser University (Canada) and 2University of Massachusetts Amherst (United States)

5:20 IMSE-184
Performance evaluation of the thick pinhole gamma rays diagnostic system, Hongwei Xie, Institute of Nuclear Physics and Chemistry (China)

Symposium Interactive Papers [Poster] Session
5:30 – 7:30 pm
Atrium
**Thursday, February 2, 2017**

**Sensor Design and Technology**

Session Chairs: Arnaud Peizerat, CEA, and Jean-Michel Tualle, University Paris 13 (France)

8:50 – 9:50 am

Harbour

**Octagonal CMOS image sensor for endoscopic applications**, Elena Reis, Alice Andrade, Martin Wäny, Pedro Santos, Ricardo M. Sousa, and Natércia Sousa, Awaiba, Lda (Portugal)

9:10

**Optimization of CMOS image sensor utilizing variable temporal multi-sampling partial transfer technique to achieve full-frame high dynamic range with superior low light and stop motion capability**, Salman Kabir, Craig Smith, Gerrit Barnard, Alex Schneider, Frank Armstrong, Michael Guidash, Thomas Vogelsang, and Jay Endsley, Rambus Inc. (United States)

9:30

**A lateral electric field charge modulator with bipolar-gates for time-resolved imaging**, Yuki Morikawa, Keita Yasutomi, Shoma Imanishi, Taishi Takasawa, Keiichiro Kagawa, Nobukazu Teranishi, and Shoji Kawahito, Shizuoka University (Japan)

**Keynote: Sensor design and technology**

Session Chairs: Arnaud Peizerat, CEA, and Jean-Michel Tualle, University Paris 13 (France)

9:50 – 10:20 am

Harbour

**A 128x128, 34μm pitch, 8.9mW, 190mK NETD, TECless Uncooled IR bolometer image sensor with columnwise processing**, Laurent Alacoque1, Sébastien Martin1, Wilfried Rabaud1, Édith Beigné1, and Antoine Dupret2; 1Minatec Campus and 2CEA (France)

Laurent Alacoque was born in Lyon, France in 1974. He received the engineering degree in electronics and information processing from the Ecole Superieure de Chimie Physique et Electronique de Lyon (ESCPE) (1998). In the same year, he joined the Institut National de Sciences Appliquees (INSIA) on Villeurbanne Campus for a PhD on the application of Asynchronous Logic to Analogue-Digital Conversion. He received his PhD (2002), and joined the CELaR in 2003, first as a postdoctoral student and then as a member of the smart-imaging laboratory. Since then, his work focuses on the imaging chain, from pixel level design, imager-specific Analogue-Digital Conversion, to Image Signal Processing algorithms.

**Keynote: History and Standards for Automotive Vision Systems Performance**

Session Chairs: Arnaud Darmont, APHESA SPRL (Belgium), Ralf Widenhorn, Portland State University (United States), and Buyue Zhang, Intel Corp. (United States)

11:50 am – 12:30 pm

Harbour

This session is jointly sponsored by: Image Sensors and Imaging Systems 2017 and Autonomous Vehicles and Machines 2017.

**Automotive imaging**, Patrick Denny, Valeo (Ireland)

Patrick Denny is a Senior Research Engineer and a Valeo Senior Expert and has worked for the last 15 years at Valeo Vision Systems, Ireland. He received his PhD in physics (2000) from the National University of Ireland, Galway, where he is also Adjunct Professor of Automotive Electronics. Denny has in excess of 20 years experience in scientific and technological development internationally, designing, innovating and developing automotive imaging technologies for BMW, Jaguar Land Rover, Daimler, VW, and other OEMs. His research interests include several aspects of automotive vision system image quality, sensor components, algorithmic design, systems, machine learning and data analytics.

12:30 – 2:00 pm

Lunch Break
Image Sensors and Imaging Systems 2017

Image and Sensor Applications

Session Chairs: Glenn Chapman, Simon Fraser University (Canada), and Xinyang Wang, Gpixel Inc. (China)

2:00 – 2:40 pm
Harbour

2:00 IMSE-192
FPGA platform for testing a real-time tone-mapping algorithm based on a Mantissa-exponent representation, Ulian Shahnovich and Orly Yadid-Pecht, University of Calgary (Canada)

2:20 IMSE-194
Fast, low-complex, non-contact motion encoder based on the NSIP concept, Anders Astrom1 and Robert Forchheimer2; 1Combitech AB and 2Linkoping University (Sweden)

Keynote: Image Sensors for Devices of Internet of Things
Session Chairs: Arnaud Darmont, APHESA SPRL (Belgium), and Ralf Widenhorn, Portland State University (United States)

2:40 – 3:20 PM
Harbour

IMSE-195
In the quest of vision-sensors-on-chip: Pre-processing sensors for data reduction, Ángel Rodríguez-Vázquez, Universidad de Sevilla (Spain)

Ángel Rodríguez-Vázquez (IEEE Fellow, 1999) conducts research on the design of analog and mixed-signal front-ends for sensing and communication, including smart imagers, vision chips and low-power sensory-processing microsystems. He received his Bachelor’s (University of Seville, 1976) and PhD in physics-electronics (University of Seville, 1982) with several national and international awards, including the IEEE Rogelia Segovia Torres Award (1981). After research stays at UC Berkeley and Texas A&M University, he became a Full Professor of Electronics at the University of Seville in 1995. He co-founded the Institute of Microelectronics of Seville, under the umbrella of the Spanish Council Research (CSIC) and the University of Seville and started a research group on Analog and Mixed-Signal Circuits for Sensors and Communications. In 2001 he was the main promotor and co-founder of the startup company AnaFocus Ltd. and served as CEO, on leave from the University, until June 2009, when the company reached maturity as a worldwide provider of smart CMOS imagers and vision systems-on-chip. He has authored 11 books, 30 additional book chapters, and some 150 journal articles in peer-review specialized publications. He was elected Fellow of the IEEE for his contributions to the design of chaos-based communication chips and neuro-fuzzy chips. His research work has received some 6,954 citations; he has an h-index of 42 and an i10-index of 143.

Meet the Future: A Showcase of Student and Young Professionals Research
3:00 – 5:00 pm
Atrium

3:20 – 4:00 pm  Coffee Break
Imaging and Multimedia Analytics in a Web and Mobile World 2017

Conference overview

The recent progress in web, social networks, and mobile capture and presentation technologies has created a new wave of interest in imaging and multimedia topics, from multimedia analytics to content creation and repurposing, from engineering challenges to aesthetics and legal issues, from content sharing on social networks to content access from Smart Phones with cloud-based content repositories and services. Compared to many subjects in traditional imaging, these topics are more multi-disciplinary in nature. This conference provides a forum for researchers and engineers from various related areas, both academic and industrial to exchange ideas and share research results in this rapidly evolving field.

Conference Chairs: Jan P. Allebach, Purdue Univ. (United States); Zhigang Fan, Apple Inc. (United States); and Qian Lin, Hp Labs, Hp Inc. (United States);

Program Committee: Gady Agam, Illinois Institute of Technology (United States); Vijayan K. Asari, Univ. of Dayton (United States); Reiner Fageth, CEVE Stifung & Co. KGaA (Germany); Yi Fang, New York Univ Abu Dhabi (United States); Michael J. Gormish, Ricoh Innovations, Inc. (United States); Yandong Guo, Microsoft Corp. (United States); Ali Jahanian, MIT CSAIL Lab (United States); Ramakrishna Kakarola, Picartio Inc. (United States); Xiaofan Lin, A9.com, Inc. (United States); Chansong Liu, Tsinghua Univ. (China); Yung-Hsiang Lu, Purdue Univ. (United States); Binu Nair, Univ. of Dayton Research Institute (United States); Mu Qiao, Shutterfly, Inc. (United States); Alastair M. Reed, Digimarc Corp. (United States); Andreas Savakis, RIT (United States); Bin Shen, Google Inc. (United States); Wiley H. Wang, Ditto.com (United States); Jane You, The Hong Kong Polytechnic Univ. (Hong Kong, China); and Buyue Zhang, Intel Corporation (United States)
**Wednesday, February 1, 2017**

**Keynote: Web Scale Multimedia Analysis I**
Session Chair: Jan Allebach, Purdue University (United States)
9:10 – 10:10 am
Cypress A

IAMAWM-157

The internet on things: Delivering augmented reality experiences in context, Michael Gormish, Blippar (United States)

Michael Gormish is Principal Scientist at Blippar on the infrastructure team working on image retrieval and multiple computer vision products. Gormish is an imaging processing and computer vision scientist and engineer who invented algorithms used in products including video games, digital cinema, satellite and medical image acquisition and transport. He earned a PhD in electrical engineering dealing with image and data compression from Stanford University. In his twenty year career at Ricoh, he led several aspects of the JPEG 2000 standardization and provided key inventions used in photocopiers, digital cameras, tablets and imaging services. He was awarded the status of Ricoh Patent Master for being a co-inventor on more than 100 US patents. He has served the research community as an Associate Editor of the IEEE Signal Processing Magazine, Associate Editor of the Journal of Electronic Imaging, Program Chair of the Document Engineering Conference, and technical committee member and reviewer for numerous conferences and journals. Currently he is interested changing the world via mobile image understanding.

10:00 am – 4:00 pm  Industry Exhibition

10:10 – 10:50 am  Coffee Break

**Web Scale Multimedia Analysis II**
Session Chair: Binu Nair, University of Dayton Research Institute (United States)
10:50 am – 12:30 pm
Cypress A

IAMAWM-158

MS-Celeb-1M: A review of large-scale face recognition (Invited), Yandong Guo and Lei Zhang, Microsoft Research (United States)

IAMAWM-159

Evaluation of Hadoop and HPCC for multimedia big data analysis, Vishnu Chinta, Hari Kalva, and Borko Furht, Florida Atlantic University (United States)

IAMAWM-160

Creating the world’s largest real-time camera network, Ryan Dailey, Shengli Sui, Chan Wengyan, Thomas Norling, Sanghyun Joo, and Yung-Hsiang Lu, Purdue University (United States)

IAMAWM-161

Multimedia instant messaging with real-time attribute-based encryption, Xunyu Fan and Christopher Gill, Frostburg State University (United States)

3:00 – 3:30 pm  Coffee Break

**Deep Learning**
Session Chair: Zhigang Fan, Apple Inc. (United States)
3:30 – 4:50 pm
Cypress A

IAMAWM-162

Distracted driver detection: Deep learning vs handcrafted features, Murtadha Hssayeni, Sagar Saxena, Raymond Ptucha, and Andreas Savakis, Rochester Institute of Technology (United States)

IAMAWM-163

Logo recognition using data augmentation techniques, Daniel Mas Montserrat, Qian Lin, Jan Allebach, and Edward Delp, Purdue University and HP Inc. (United States)

IAMAWM-164

Detection and characterization of Coordinate Measuring Machine (CMM) probes using deep networks for improved quality assurance of machine parts, Binu Nair, Vidur Prasad, and Nilesh Powar, University of Dayton Research Institute and University of Michigan (United States)

IAMAWM-165

Robust head detection with CNN, Ming Chen, Qian Lin, Fengqing Zhu, and Jan Allebach, Purdue University and HP Inc. (United States)

Symposium Interactive Papers (Poster) Session
5:30 – 7:00 pm
Atrium
Thursday, February 2, 2017

Multimedia Analysis
Session Chair: Reiner Fageth, CEWE Stiftung & Co. KGAA (Germany)
8:50 – 10:30 am
Cypress A
8:50 IMAWM-166
Analytics for body worn cameras (Invited), Quanfu Fan, Thomas J.
Watson Research Center (United States)

Click-based interactive segmentation with graph cut, Chunjing Tai1, Tongyang Liu1, Judy Bagchi2, Fengqing Zhu1, and Jan Allebach1; 1Purdue University and 2DzineSteps (United States)

9:30 IMAWM-167
Drone Detection by acoustic signature identification, Andrea Bernardini, Federica Mangiatiordi, Emiliano Pallotti, and Licia Capodiferro, Fondazione Ugo Bordoni (Italy)

9:50 IMAWM-168
Aesthetics of fashion photographs: Effect on user preferences, Zhi Li1, Shuheng Lin1, Yang Cheng1, Gautam Golwala2, Sathiya Sundaram2, and Jan Allebach1; 1Purdue University and 2Poshmark Inc. (United States)

10:10 – 10:30 am Coffee Break

Face / Body Detection and Recognition
Session Chair: Andreas Savakis, Rochester Institute of Technology (United States)

10:50 am – 12:10 pm
Cypress A
10:50 IMAWM-170
Local boosted features for illumination invariant face recognition, Almabrok Essa and Vijayan Asari, University of Dayton (United States)

11:00 IMAWM-171
High precision 3D reconstruction of the human face, Michael Wang, Daran He, Frankie Li, Wiley Wang, and Sergey Sukov, Ditto Technologies (United States)

11:30 IMAWM-172
Chromatic domain phase features with gradient and texture for efficient human detection, Hussin Ragb, University of Dayton (United States)

11:50 IMAWM-173
A real-time smile elegance detection system: A feature-level fusion and ranking SVM based approach, bli Lin1, Yiwen Zhang1, Weini Zhang1, Xinxin Liu1, Yan Yan1, and Tianli Yu2; 1Department of Computer Science, Xiamen University (China) and 2 Independent Consultant (United States)

12:10 – 2:00 pm Lunch Break

Analytics for Mobile Applications
Session Chair: Qian Lin, HP Labs, HP Inc. (United States)

2:00 – 3:20 pm
Cypress A
2:00 IMAWM-174
MU, the ultra mobile visual analytic sensor for toys and IOTs, Tianli Yu, Morpx Inc. (United States)

2:20 IMAWM-175
An imaging approach to online progressive addition lens retrieval, Qin Li1, Ruchan Zhan1, Zhenhua Guo1, and Jane You2; 1The Shenzhen Institute of Information Technology (China), 2The Hong Kong Polytechnic University (Hong Kong), and 1Graduate School at Shenzhen, Tsinghua University (China)

2:40 IMAWM-176
Are mobile phones changing the order behavior and content for printed photo products?, Reiner Fageth, CEWE Stiftung & Co. KGAA (Germany)

3:00 IMAWM-177
Texture re-rendering tool for re-mixing indoor scene images, Tongyang Liu1, Chunjing Tai1, Fengqing Zhu1, Judy Bagchi2, and Jan Allebach1; 1Purdue University and 2DzineSteps (United States)

Meet the Future: A Showcase of Student and Young Professionals Research
3:00 – 5:00 pm
Atrium

3:20 – 4:00 pm Coffee Break
Intelligent Robotics and Industrial Applications using Computer Vision 2017

Conference overview
This conference brings together real-world practitioners and researchers in intelligent robots and computer vision to share recent applications and developments. Topics of interest include the integration of imaging sensors supporting hardware, computers, and algorithms for intelligent robots, manufacturing inspection, characterization, and/or control.

The decreased cost of computational power and vision sensors has motivated the rapid proliferation of machine vision technology in a variety of industries, including aluminum, automotive, forest products, textiles, glass, steel, metal casting, aircraft, chemicals, food, fishing, agriculture, archaeological products, medical products, artistic products, etc. Other industries, such as semiconductor and electronics manufacturing, have been employing machine vision technology for several decades. Machine vision supporting handling robots is another main topic. With respect to intelligent robotics another approach is sensor fusion - combining multi-modal sensors in audio, location, image and video data for signal processing, machine learning and computer vision, and additionally other 3D capturing devices.

There is a need of accurate, fast, and robust detection of objects and their position in space. Their surface, the background and illumination is uncontrollable, in most cases the objects of interest are within a bulk of many others. For both new and existing industrial users of machine vision, there are numerous innovative methods to improve productivity, quality, and compliance with product standards. There are several broad problem areas that have received significant attention in recent years. For example, some industries are collecting enormous amounts of image data from product monitoring systems. New and efficient methods are required to extract insight and to perform process diagnostics based on this historical record. Regarding the physical scale of the measurements, microscopy techniques are nearing resolution limits in fields such as semiconductors, biology, and other nano-scale technologies. Techniques such as resolution enhancement, model-based methods, and statistical imaging may provide the means to extend these systems beyond current capabilities. Furthermore, obtaining real-time and robust measurements in-line or off-line in harsh industrial environments is a challenge for machine vision researchers, especially when the manufacturer cannot make significant changes to their facility or process.
Wednesday, February 1, 2017

Autonomous Robotics

Session Chair: Juha Röning, University of Oulu (Finland)

8:50 – 10:10 am
Cypress C

8:50 IRIACV-258 Efficient visual loop closure detection via moment based global image descriptors, Can Erhan1, Evangelos Sariyanidi1, Onur Sencan2, and Hakan Temeltas3; 1Istanbul Teknik Univ. (Turkey) and 2Queen Mary, University of London (United Kingdom)

9:10 IRIACV-259 Real-time mobile robot navigation based on stereo vision and low-cost GPS, Soonhac Hong, Ming Li, Miao Liao, and Peter van Beek, Sharp Labs of America (United States)

9:50 IRIACV-260 The acceleration effect to the perception of velocity difference in passive elbow flexion movement, Fumihiro Akatsuka and Yoshihiko Nomura, Mie University (Japan)

10:00 am – 4:00 pm Industry Exhibition

10:10 – 10:50 am Coffee Break

Machine Vision and Imaging

Session Chair: Kurt Niel, University of Applied Sciences Upper Austria (Austria)

10:50 am – 12:30 pm Cypress C

10:50 IRIACV-262 Application of big data analytics for recognition of microbial colonies from hyperspectral images, Seung-Chul Yoon, Kurt Lawrence, Bossoon Park, and Gary Gamble, US Department of Agriculture-Agricultural Research Service (United States)

11:10 IRIACV-263 Weaving pattern recognition of ancient Chinese textiles by regular bands analysis, Connie C.W. Chan, K. S. (Sammy) Li, and Henry Ngan, Hong Kong Baptist University (Hong Kong)

11:30 IRIACV-264 Finding a needle in a haystack: Recognizing surgical instruments through vision and manipulation, Tian Zhou and Juan Wachs, Purdue University (United States)

11:50 IRIACV-265 Automatic detection of plant roots in multispectral images, Nisha Srinivas, Justin Baba, Colleen Iverson, Joanne Childs, Richard Norby, and Vincent Paquit, Oak Ridge National Laboratory (United States)

12:10 IRIACV-266 Education in industrial machine vision in Upper Austria University of Applied Sciences (bachelor/master) with respect to the needs by the European industry and automation engineering, Kurt Niel, University of Applied Sciences Upper Austria (Austria)

12:30 – 2:00 pm Lunch Break

El 2017 Wednesday Plenary and Symposium Awards

Session Chairs: Joyce E. Farrell, Stanford University, and Nitin Sampat, Rochester Institute of Technology (United States)

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

Designing VR video camera systems, Brian Cabral, Facebook, Inc. (United States)

Brian Cabral is Director of Engineering at Facebook, leading the Surround 360 VR camera team, specializing in computational photography, computer vision, and computer graphics. He has published a number of papers in the area of computer graphics and imaging including the pioneering Line Integral Convolution algorithm. Cabral discusses developing Facebook Surround 360, an open, high-quality 3D-360 video capture system. VR video capture systems are composed of multiple optical and digital components – all of which must operate as if they are one seamless optical system. The design of VR video cameras, optical choices, SNR, etc., require a new set of technologies and engineering approaches, with tight coupling to the computational system components.

3:00 – 3:30 pm Coffee Break

Pattern Recognition and Inspection

Session Chair: Henry Ngan, Hong Kong Baptist University (Hong Kong)

3:30 – 5:30 pm Cypress C

3:30 IRIACV-267 Unsupervised video segmentation and its application to region-based local contrast enhancement, Sungbum Park1, Wooseung Shim1, and Yong Seok Heo2; 1Ajou University (Republic of Korea)

3:50 IRIACV-268 High-precision 3D sensing with hybrid light field & photometric stereo approach in multi-line scan framework, Doris Antensteiner1, Svorad Stolc1, Kristian Valentín1, Bernhard Blaschitz1, Reinhold Huber-Mörk1, and Thomas Pock2; 1AIST Austrian Institute of Technology GmbH and 2Graz University of Technology (Austria)

4:10 IRIACV-269 Line-scan stereo using binary descriptor matching and regularization, Svorad Stolc1, Kristian Valentín1, Bernhard Blaschitz1, and Reinhold Huber-Mörk1, AIST Austrian Institute of Technology GmbH (Austria)
Traffic Camera Dangerous Driver Detection (TCDD™): Contextually aware heuristic feature & OFA density-based computer vision with movement machine learning analysis of live streaming traffic camera footage to identify anomalous & dangerous driving, Vidur Prasad, University of Michigan (United States)

An in-situ defect detection system for Big Area Additive Manufacturing using laser profilometry, Michael Goin1, Vincent Paquit1, Andrzej Nycz1, Brian Post1, Peter Lloyd1, Randall Lind2, and Lonnie Love2; 1University of Tennessee and 2Oak Ridge National Laboratory (United States)

Outlier detection in large-scale traffic data by naïve bayes method and Gaussian mixture model method, Philip Lam1, Lili Wang1, Henry Ngan1, Nelson H.C. Yung2, and Anthony G. O. Yeh2; 1Hong Kong Baptist University and 2The University of Hong Kong (Hong Kong)
Material Appearance 2017

Conference overview
The rapid and continuous development of rendering devices such as displays and printers offers interesting challenges related to how materials are understood. Over the years, researchers from different disciplines have studied the interaction of incident light with the texture and surface geometry of a given object, as well as the optical properties of distinct materials. Thanks to those efforts, we have been able to render with high accuracy 2.5D and 3D objects and scenes.

Given the day-to-day technological improvements of materials and devices along with the advances in the areas of visual and tactile perception, modeling how light interacts with materials and techniques for measuring material properties, the field of material appearance is in constant evolution.

This conference offers the possibility to share research results and establish new collaborations among academic and industrial researchers from these related fields.

Award: Best Student Paper
Material Appearance 2017

Monday, January 30, 2017

Surface Measurement and Lighting Systems

Session Chairs: Mathieu Hebert, Université Jean Monnet de Saint Etienne (France), Francisco Imai, (United States), and Ingeborg Tasl, HP Labs, HP Inc. (United States)

10:50 am – 12:10 pm
Regency Ballroom C

10:50 MAAP-273
Comparison between angularly and spectrally resolved gloss measurements with gloss measurements carried out on a national reference goniometer for gloss calibration, Renee Charriere1,2 and Maria Nadal1; 1National Institute for Standards and Technology (United States) and 2Ecole des Mines de Saint-Etienne (France)

11:10 MAAP-274
A normal vector and BTF profile measurement system using a correlation camera and scanning dome illumination, Akira Kimachi, Motonori Doi, and Shogo Nishi, Osaka Electro-Communication University (Japan)

11:30 MAAP-275
Polarimetric multispectral bidirectional reflectance distribution function measurements using a Fourier transform instrument, Pierre Boher, Thierry Leroux, Ludwine Cave, Thibault Bignon, and Veronique Collomb-Patton, ELDIV (France)

11:50 MAAP-276
Optimal LED selection for multispectral lighting reproduction, Chloe LeGendre, Xueming Yu, and Paul Debevec, USC Institute for Creative Technologies (United States)

12:10 – 2:00 pm  Lunch Break

EI 2017 Opening Plenary and Symposium Awards

Session Chairs: Joyce E. Farrell, Stanford University, and Nitin Sampat, Rochester Institute of Technology (United States)

2:00 – 3:00 pm
Grand Peninsula Ballroom C

Giga-scale 3D computational microscopy, Laura Waller, University of California, Berkeley (United States)

Laura Waller is the Ted Van Duzer Endowed Assistant Professor of Electrical Engineering and Computer Sciences (EECS) at UC Berkeley. She is a Senior Fellow at the Berkeley Institute of Data Science, and received her BS (2004), MEng (2005), and PhD (2010) in EECS from the Massachusetts Institute of Technology (MIT). Waller’s talk is on computational imaging methods for fast capture of gigapixel-scale 3D intensity and phase images in a commercial microscope that employs illumination-side and detection-side coding of angle (Fourier) space with simple hardware and fast acquisition. The result is high-resolution reconstructions across a large field-of-view, achieving high space-bandwidth-product.

3:00 – 3:30 pm  Coffee Break

Tuesday, January 31, 2017

Surface Appearance Assessment and Digital Methods I

Session Chair: Greg Ward, Dolby Laboratories (United States)

9:10 – 10:10 am
Grand Peninsula Ballroom C

Graininess appearance of goniochromatic samples in lighting cabinets, Paola lacommini, Michela Radis, and Giuseppe Rossi, INRIM (Italy)

This session is jointly sponsored by: Material Appearance 2017 and 3D Image Processing, Measurement (3DIPM), and Applications 2017.

9:30 MAAP-282
Measurement and evaluation method of orange peel, Takuroh Sone and Shuhei Watanabe, Ricoh Company, Ltd. (Japan)
Enhanced RTI for gloss reproduction, Peter Fornaro, Andrea Bianco, and Lukas Rosenthaler, University of Basel (Switzerland)

Material Appearance 2017

9:50 MAAP-284

Surface Appearance Assessment and Digital Methods II Joint Session

Session Chair: Mathieu Hebert, Université Jean Monnet de Saint Etienne (France)

10:50 – 11:30 am

Grand Peninsula Ballroom C

This session is jointly sponsored by: Material Appearance 2017 and 3D Image Processing, Measurement (3DIPM), and Applications 2017.

10:50 MAAP-285

Consistent tool-independent virtual material appearance, Dar’ya Guarnera1, Giuseppe Claudio Guarnera2, Cornelia Denk2, and Mashhuda Glencross1,3; 1Loughborough University (United Kingdom), 2BMW Research (Germany), and 3Switch That Limited (United Kingdom)

11:10 MAAP-286

Interactive object surface retexturing using perceptual quality indexes, Keita Hirai, Wataru Suzuki, Yoshimitsu Yamada, and Takahiko Honuchi, Chiba University (Japan)

3:00 – 3:30 pm Coffee Break

Keynote: Communicating Material Appearance

Session Chair: Ingeborg Tastl, HP Labs, HP Inc. (United States)

3:30 – 4:10 pm

Grand Peninsula Ballroom C

The future of material communication via the Appearance Exchange Format (AxF), Marc Ellens, Geiro Mueller, and Francis Lamy, X-Rite, Inc. (United States)

Marc S. Ellens is a Senior Research Scientist with X-Rite-Pantone in Grand Rapids, MI. He received his BS in mathematics and computer science from Calvin College, and his PhD in computer aided geometric design from the University of Utah. In the past, Ellens has worked on CNC programming and at Lectra Systemes developing design applications for the textile industry. Now at X-Rite for more than 10 years, he has been involved in research and development efforts beyond color toward the capture and reproduction of appearance. Ellens has presented at the NVIDIA GPU Technology conference, Autodesk’s Automotive Innovation Forums, and the IS&T Electronic Imaging Conference. He is named in three patents related to material visualization and reproduction.

Material Characterization

Session Chair: Ingeborg Tastl, HP Labs, HP Inc. (United States)

4:10 – 5:30 pm

Grand Peninsula Ballroom C

4:10 MAAP-278

Material with visual effects: Study of the gonioapparency of the anodized titanium, Quentin Cridling1,2, Renee Charriere1, Maria Pia Pedeferr12, Maria Vittoria Diamanti1, and David Delafosse1; 1Ecole des Mines de Saint Etienne (France), and 2Politecnico di Milano (Italy)

4:30 MAAP-279

Adapted modulation transfer function method for characterization and improvement of 2.5D printing, Marine Page1,2,3, Clélia Bouat4, Gael Ghezin5, Anniek Ravez6, and Maria Ortiz Segovia7; 1C²² - Canon Group, 2Centre de Recherche et de Restauration des Musées de France, and 3Conservatoire National des Arts et Métiers (France)

4:50 MAAP-280

Evaluating an image based multi-angle measurement setup using different reflection models, Aditya Sole, Ivor Farup, and Peter Nussbaum, Norwegian University of Science and Technology (Norway)

5:10 MAAP-281

Model-based skin pigment cartography by high-resolution hyperspectral imaging (JIST-first), Pierre Seroul1, Mathieu Hebert2, Marie Chere1, Romain Vernet1, and Matthieu Jomier1; 1Newtome Technologies and 2Université Jean Monnet de Saint Etienne (France)

Symposium Demonstration Session

5:30 – 7:30 pm

Grand Peninsula Ballroom E
Thursday, February 2, 2017

Interactive Workshop: How can COLOR imaging provide US with powerful INSIGHTS?  
Moderator: Fritz Lebowsky, STMicroelectronics (France)
2:00 – 3:30 pm
Regency Ballroom C

This session is jointly sponsored by: Color Imaging XXII: Displaying, Processing, Hardcopy, and Applications and Material Appearance 2017.

We would very much like to have you participate in a special session in which we encourage asking questions and exchange ideas that frequently trouble us during research and development projects. The presence of experts in COLOR imaging and perhaps Electronic Imaging at large will provide a unique opportunity of efficiently and lively sharing simple/stupeying ideas enabling fascinating engineering concepts which may also stimulate your own future research and development projects!

Interactive Workshop: How can COLOR imaging provide US with powerful INSIGHTS? (continued)

Moderator: Fritz Lebowsky, STMicroelectronics (France)
4:00 – 5:00 pm
Regency Ballroom C

This continuation of the workshop session is jointly sponsored by: Color Imaging XXII: Displaying, Processing, Hardcopy, and Applications, and Material Appearance 2017.
Media Watermarking, Security, and Forensics 2017

Conference overview
The ease of capturing, manipulating, distributing, and consuming digital media (e.g. images, audio, video, graphics, and text) has raised a number of important security challenges to the forefront. These issues have prompted significant research and development activities in the areas of digital watermarking, steganography, data hiding, forensics, media identification, and encryption to protect the authenticity, security, and ownership of media objects. Research results in these areas have translated into new paradigms and applications to monetize media objects without violating their ownership rights.

The Media Watermarking, Security, and Forensics conference is a premier destination for disseminating high-quality, cutting-edge research in these areas. The conference provides an excellent venue for researchers and practitioners to present their innovative work as well as to keep abreast with the latest developments in watermarking, security, and forensics. A unique feature of the conference is that the submission process only requires a structured abstract describing the work in progress, with the full paper to be submitted only a few weeks before the event. This allows researchers to present early results and fresh ideas from the laboratory to motivate new research directions in a timely manner.

A strong focus on how research results are applied in practice by the industry gives the conference its unique flavor.
Monday, January 30, 2017

Keynote 1: Media Forensics
Session Chair: Adnan Alattar, Digimarc Corporation (United States)
8:50 – 10:10 am
Regency Ballroom A

The nimble challenges for media forensics, P. Jonathon Phillips,
National Institute of Standards and Technology (NIST) (United States)

Jonathon Phillips is a leading technologist in the fields of computer
vision, biometrics, and face recognition. He is at National Institute of
Standards and Technology (NIST), where he runs challenge problems
and evaluations to advance biometric technology. His previous efforts
include the Iris Challenge Evaluations (ICE), the Face Recognition
Vendor Test (FRVT), the Face Recognition Grand Challenge and FERET.
From 2000-2004, Phillips was assigned to DARPA. For his work on
the FRVT 2002 he was awarded the Dept. of Commerce Gold Medal.
His work has been reported in the New York Times, the BBC, and
the Economist. He has appeared on NPR’s Science Friday show. In
an Essential Science Indicators analysis of face recognition publica-
tion over the past decade, Phillips’ work ranks at #2 by total citations
and #1 by cites per paper. In 2013, he won the inaugural Mark
Everingham Prize. He is a fellow of the IEEE and IAPR.

10:10 – 10:30 am  Coffee Break

Watermarking
Session Chair: William Puech, University of Montpellier [France]
10:30 – 11:45 am
Regency Ballroom A

Embedding information into objects fabricated with 3-D printers
by forming fine cavities inside them, Masahiro Suzuki1, Piyarat
Silapasuphakornwong1, Pasin Dechrueng2, SoravitTechavichian1,
Hideyuki Torii1, and Kazutake Uehira1; 1Kanagawa Institute of Technology
(Japan) and 2Chulalongkorn University (Thailand)

High-capacity reversible data hiding in encrypted images using MSB
prediction, Pauline Puteaux and William Puech, University of Montpellier
(France)

11:20

The A Priori knowledge based secure payload estimation for additive
model, Sai Ma1,2, Xianfeng Zhao1,2, Qingxiao Guan1,2, and Chengdou
Zhao1,2; 1Institute of Information Engineering, Chinese Academy of
Sciences and 2University of Chinese Academy of Sciences (China)

3:00 – 3:30 pm  Coffee Break

Encryption
Session Chair: Gaurav Sharma, University of Rochester [United States]
3:30 – 4:50 pm
Regency Ballroom A

Benefits of combining forensic image creation and file carving,
Martin Steinebach, Fraunhofer SIT (Germany)

Codec-embedded MP3 partial encryption for DRM, Martin Steinebach,
Fraunhofer SIT (Germany)

How to recompress a JPEG crypto-compressed image?, Vincent Itier1 and
William Puech2; 1LIRMM and 2University of Montpellier (France)

Symposium Welcome Reception
5:00 – 6:00 pm
Atrium

Tuesday, January 31, 2017

Deep Learning Steganalysis
Session Chair: Jessica Fridrich, SUNY Binghamton [United States]
8:50 – 10:10 am
Regency Ballroom A

Pre-training via fitting deep neural network to rich-model features
extraction procedure and its effect on deep learning for steganalysis, Jishen
Zeng, Shunquan Tan, Bin Li, and Jiwu Huang, Shenzhen University (China)
Media Watermarking, Security, and Forensics 2017

9:15 MWSF-325
Histogram layer, moving convolutional neural networks towards feature-based steganalysis, Vahid Sedighianaraki and Jessica Fridrich, Binghamton University (United States)

9:40 MWSF-326
Model based steganography with precover, Tomas Denemark and Jessica Fridrich, SUNY Binghamton (United States)

10:00 am – 7:30 pm Industry Exhibition
10:10 – 10:30 am Coffee Break

CNN and RNN Forensics
Session Chair: Marc Chaumont, LIRMM Montpellier France (France)
10:30 am – 12:10 pm Regency Ballroom A
10:30 MWSF-327
A preliminary study on convolutional neural networks for camera model identification, Luca Bondi1, David Guerra Cabo2, Luca Baroffio1, Paolo Bestagini1, Edward Delp2, and Stefano Tubaro1; 1Politecnico di Milano (Italy) and 2Purdue University (United States)
10:55 MWSF-328
Design principles of convolutional neural networks for multimedia forensics, Belhassen Bayar and Matthew Stamm, Drexel University (United States)
11:20 MWSF-329
Image recapturing detection with convolutional and recurrent neural network, Haoliang Li, Shiqi Wang, and Alex Kot, Nanyang Technological University (Singapore)
11:45 MWSF-330
Autoencoder with recurrent neural networks for video forgery detection, Dario D’Avino, Davide Cozzolino, Giovanni Paggi, and Luisa Verdoliva, University Federico II of Naples (Italy)

12:10 – 2:00 pm Lunch Break

Ei 2017 Tuesday Plenary and Symposium Awards
Session Chairs: Joyce E. Farrell, Stanford University, and Nitin Sampat, Rochester Institute of Technology (United States)
2:00 – 3:00 pm Grand Peninsula Ballroom D

VR 2.0: Making virtual reality better than reality, Gordon Wetzstein, Stanford University (United States)

VR 2.0: Making virtual reality better than reality, Gordon Wetzstein, Stanford University (United States)

Gordon Wetzstein is an Assistant Professor of Electrical Engineering and, by courtesy, of Computer Science, at Stanford University, and leads the Stanford Computational Imaging Group. He received a PhD in computer science from the University of British Columbia (2011) where his doctoral dissertation focused on computational light modulation for image acquisition and display. In his talk, Wetzstein explores the frontiers of VR systems engineering. Eventually, VR/AR systems will redefine communication, entertainment, education, collaborative work, simulation, training, telemedicine, and basic vision research, as next-generation computational near-eye displays evolve to deliver visual experiences that are better than the real world.

3:00 – 3:30 pm Coffee Break

Keynote 2: Camera Verification in Practice
Session Chair: Nasir Memon, New York University (United States)
3:30 – 4:30 pm Regency Ballroom A
MWSF-339
PRNU in practice, Walter Bruehs, Federal Bureau of Investigation (United States)

Walter E. Bruehs is employed by the Federal Bureau of Investigation as the Supervisory Photographic Technologist in the Forensic Audio, Video, and Image Analysis Unit, where he is an Examiner of Questioned Photographic Evidence. Part of Bruehs’ responsibilities focus on seeking out and researching emerging digital imaging technologies as they apply to the Forensic arena. He heads a program designed to identify digital images to digital cameras or to other sets of digital images, based on the sensor noise of the capture device. He has a MS in electrical engineering from the University of Maine at Orono, as well as a BS in electrical engineering from Clarkson University. Prior to working at the FBI, he worked as an Imaging Scientist in the research labs of the Eastman Kodak Company, where he coauthored a patent, “Method and System for Improving an Image Characteristic Based on Image Content.”

Media Watermarking, Security, and Forensics Program Committee Meeting
4:40 – 6:00 pm Regency Ballroom A

Symposium Demonstration Session
5:30 – 7:30 pm Grand Peninsula Ballroom E

Wednesday, February 1, 2017

Sensor Noise Forensics
Session Chair: Robert Ulrichney, HP Labs, HP Inc. (United States)
8:50 – 10:10 am Regency Ballroom A
8:50 MWSF-331
Videos versus still images: Asymmetric sensor pattern noise comparison on mobile phones, Chiara Galdi1, Frank Hartung2, and Jean-Luc Dugelay1; 1Eurecom (France) and 2FH Aachen (Germany)

9:15 MWSF-332
Linear filter kernel estimation based on digital camera sensor noise, Chang Liu and Matthias Kirchner, Binghamton University (United States)

9:40 MWSF-333
PRNU-based forgery detection with discriminative random fields, Sujoy Chakraborty and Matthias Kirchner, Binghamton University (United States)

10:00 am – 4:00 pm Industry Exhibition
10:10 – 10:30 am Coffee Break
Forensics & Authentication

Session Chair: Matthias Kirchner, Binghamton University (United States)

10:30 am – 12:15 pm
Regency Ballroom A

10:30
Sensitivity of different correlation measures to print-and-scan process, Iuliia Tkachenko1, Christophe Destruel1, Olivier Strauss2, and William Puech2; 1Authentication Industries and 2University of Montpellier (France)

10:55
Scalable processing history detector for JPEG images, Mehdi Boroumand and Jessica Fridrich, SUNY Binghamton (United States)

11:20
Deciphering severely degraded license plates, Shruti Agarwal, Du Tran, Lorenzo Torresani, and Hany Farid, Dartmouth College (United States)

11:45
PCB surface fingerprints based counterfeit detection of electronic devices, Taswar Iqbal1 and Kai-Dietrich Wolf2; 1Exmemer ISS and 2University of Wuppertal, Institute for Security Sytems (Germany)

12:10
Conference Closing Remarks

12:15 – 2:00 pm
Lunch Break

EI 2017 Wednesday Plenary and Symposium Awards
Session Chairs: Joyce E. Farrell, Stanford University, and Nitin Sampat, Rochester Institute of Technology (United States)

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

Designing VR video camera systems, Brian Cabral, Facebook, Inc. (United States)

Brian Cabral is Director of Engineering at Facebook, leading the Surround 360 VR camera team, specializing in computational photography, computer vision, and computer graphics. He has published a number of papers in the area of computer graphics and imaging including the pioneering Line Integral Convolution algorithm. Cabral discusses developing Facebook Surround 360, an open, high-quality 3D-360 video capture system. VR video capture systems are composed of multiple optical and digital components - all of which must operate as if they are one seamless optical system. The design of VR video cameras, optical choices, SNR, etc., require a new set of technologies and engineering approaches, with tight coupling to the computational system components.

3:00 – 3:30 pm
Coffee Break

Symposium Interactive Papers (Poster) Session
5:30 – 7:00 pm
Atrium

Conference overview
The goal of this conference is to provide an international forum for presenting recent research results on multimedia for mobile devices and to bring together experts from both academia and industry for a fruitful exchange of ideas and discussion on future challenges. The authors are encouraged to submit work-in-progress papers as well as updates on previously reported systems. Outstanding papers may be recommended for the publication in the Journal Electronic Imaging or Journal of Imaging Science and Technology.

Awards: Best Paper and Best Student Paper

**Wednesday, February 1, 2017**

**Mobile Sensors, Localization, and Applications**

Session Chair: David Akopian, The University of Texas at San Antonio (United States)

8:50 – 10:10 am
Grand Peninsula Ballroom B

8:50 MOBMU-292
Introduction to WLAN-fingerprinting based indoor localization, David Akopian, Ali Khalajmehrabadi, and Nikolaos Gatsis, The University of Texas at San Antonio (United States)

9:10 MOBMU-299
Android door and window image based measurements, Khader Mohammad, Birzeit University (Palestine)

9:30 MOBMU-293
Usability of smart mobile micro photonic sensor systems for industrial and non-industrial quality assurance, Paul-Gerald Dittrich1,2 and Dietrich Hofmann1, Technologie- und Innovationspark Jena GmbH and Technische Universität Ilmenau (Germany)

9:50 MOBMU-294
Blackmagic production camera raw color investigation by spectral analysis of Macbeth color charts, Eberhard Hasche, Patrick Ingwer, Reiner Creutzburg, Thomas Schrader, Frederick Laube, and Timo Sigwarth, Technische Hochschule Brandenburg - Brandenburg University of Applied Sciences (Germany)

10:10 MOBMU-295
Liquid crystal lens characterization for integrated depth sensing and all in focus imaging application, Simon Emberger1, Laurent Alacoque1, Antoine Dupret1, Jean Louis de Bougrenet de la Tournoy1, Capucine Lecat2, Mathieu de Boissac2, and Nicolas Fraval3, LETI, CEA, USTLéti, CEA, Telecom Bretagne, and Evosens (France)

10:00 am – 4:00 pm
Industry Exhibition

10:30 – 11:00 am
Coffee Break

**Emerging Applications and Methods**

Session Chair: Reiner Creutzburg, Brandenburg University of Applied Sciences (Germany)

11:00 am – 12:40 pm
Grand Peninsula Ballroom B

11:20 MOBMU-297
A billion words to remember, George Nagy, Rensselaer Polytechnic Institute (United States)

11:40 MOBMU-298
Demographic prediction based on mobile user data, Lyubov Podoymitsina, Alexander Romanenko, and Konstantin Kryzanovskiy, Samsung R&D Institute (Russian Federation)

12:00 MOBMU-300
Optimizing video transmission for mobile devices, Chulhee Lee1, Sangwook Bae2, Guivon Seo2, Kyung-Won Kang2, and Jaein Ryu1; 1Yonsei University and 2Yonsei University (Republic of Korea)

12:20 MOBMU-308
Comparative visualization of the geometry of a hollow box girder using 3D-LiDAR – Part 2: Reconstruction of a 3D geometric model, Stefan Maack1, Jenny Knackmuss2, and Reiner Creutzburg2; 1Bundesanstalt für Materialprüfung and 2Technische Hochschule Brandenburg (Germany)

12:40 – 2:00 pm
Lunch Break

**EI 2017 Wednesday Plenary and Symposium Awards**

Session Chairs: Joyce E. Farrell, Stanford University, and Nitin Sampat, Rochester Institute of Technology (United States)

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

**Designing VR video camera systems, Brian Cabral, Facebook, Inc. (United States)**

Brian Cabral is Director of Engineering at Facebook, leading the Surround 360 VR camera team, specializing in computational photography, computer vision, and computer graphics. He has published a number of papers in the area of computer graphics and imaging including the pioneering Line Integral Convolution algorithm. Cabral discusses developing Facebook Surround 360, an open, high-quality, 3D-360 video capture system. VR video capture systems are composed of multiple optical and digital components – all of which must operate as if they are one seamless optical system. The design of VR video cameras, optical choices, SNR, etc., require a new set of technologies and engineering approaches, with tight coupling to the computational system components.

3:00 – 3:30 pm
Coffee Break
Mobile Security, Safety, Privacy, Forensics

Session Chair: David Akopian, The University of Texas at San Antonio (United States)

3:30 – 4:50 am
Grand Peninsula Ballroom B

3:30 MOBMU-301
Investigation of three security relevant aspects of Android eHealth Apps - Permissions, storage properties, and data transmission, Jenny Knackmuss¹, Eric Clausing², and Reiner Creutzburg¹; ¹Technische Hochschule Brandenburg and ²AV-Test GmbH (Germany)

3:50 MOBMU-302
Privacy issues in mobile health applications - Assessment of current Android Health Apps, Anett Hoppe¹, Jenny Knackmuss², Maik Morgenstern¹, and Reiner Creutzburg¹; ¹AV-Test GmbH and ²Technische Hochschule Brandenburg (Germany)

4:10 MOBMU-303
A forensic mobile application designed for both steganalysis and steganography in digital images, Enping Li¹ and Jun Yu²; ¹Bridgewater State University and ²Marvell Semiconductors, Inc. (United States)

4:30 MOBMU-304
Pokemon Go - A forensic analysis, Reiner Creutzburg, Technische Hochschule Brandenburg (Germany)

Mobile Computing and Data Processing

Session Chair: Reiner Creutzburg, Brandenburg University of Applied Sciences (Germany)

4:50 – 5:30 pm
Grand Peninsula Ballroom B

4:50 MOBMU-305
Computation of equidistant curve for the image with blurred contours, Evgeny Semenishchev and Viacheslav Voronin, Don State Technical University (Russian Federation)

5:10 MOBMU-306
Prune the convolutional neural networks with Sparse Shrink, Xin Li and Changsong Liu, Tsinghua University (China)


5:30 – 7:00 pm
Atrium

The following works will be presented at the EI 2017 Symposium Interactive Papers Session.

Automated segmentation of ophthalmological OCT images, Friedrich Müller¹ and Reiner Creutzburg²; ¹Nürnberger Str. 24a and ²Technische Hochschule Brandenburg (Germany)

Concept for software-based configuration of the organizational and technical security of a company of arbitrary size, Thomas Möller¹, Tanja Leschke¹, Knut Bellin¹, and Reiner Creutzburg²; ¹Assecor GmbH and ²Technische Hochschule Brandenburg (Germany)

Facilitated polling approach for SMS and IP messaging applications, Shruti Mahadik, Rodrigo Escobar, Sahak Kaghyan, and David Akopian, The University of Texas at San Antonio (United States)

A multi-platform characterization of delays inherent in Message Queue Telemetry Transport (MQTT) communications, Brian Bendele and David Akopian, The University of Texas at San Antonio (United States)

Semi-automatic generation of multilingual lecture notes - Wikipedia books on different subjects in various languages, Reiner Creutzburg, Technische Hochschule Brandenburg (Germany)

The strange world of keyloggers - An overview, Reiner Creutzburg, Technische Hochschule Brandenburg (Germany)

The study of algorithms reducing the level of out-of-band radiation and inter carrier interference of the OFDM signal, Valentin Fedosov¹, Anna Lomakina¹, Andrey Legin¹, Danila Kovtun¹, and Viacheslav Voronin²; ¹South Federal University and ²Don State Technical University (Russian Federation)

Two-tier state-machine programming for messaging applications, Jafet Morales, Rodrigo Escobar, Sahak Kaghyan, Girish Vaidyanathan Natarajan, and David Akopian, The University of Texas at San Antonio (United States)
Stereoscopic Displays and Applications XXVIII

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. A 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) and Best film (live action)

Events: Monday evening 3D Theater

Conference Sponsors

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

Program Committee: Neil A. Dodgson, Victoria Univ. of Wellington (New Zealand); Davide Gadia, Univ. degli Studi di Milano (Italy); Hideki Kakeya, Univ. of Tsukuba (Japan); Stephan R. Keith, SRK Graphics Research (United States); Michael Klug, Magic Leap, Inc. (United States); 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)
Stereoscopic Displays and Applications XXVIII

Monday, January 30, 2017

Stereoscopic Human Factors and Applications

Session Chair: Takashi Kawai, Waseda University (Japan)

8:50 – 10:20 am
Grand Peninsula Ballroom D

8:50 SD&A-353
Expert viewers’ preferences for higher frame rate 3D film (JIST-first),
Robert Allison1, Laurie Wilcox2, Roy Anthony3, John Helliker4, and Bert Dunk5; 1York University, 2Centre for Vision Research, York University, 3Christie Digital, and 4Sheridan College (Canada)

9:10 SD&A-354
Investigating aircrew depth perception standards using a stereoscopic simulation environment, Marc Winterbottom1, Charles Lloyd2, James Gaska3, Logan Williams4, Elizabeth Shoda5, and Steven Hadley6; 1U.S. Air Force School of Aerospace Medicine, 2Visual Performance LLC, and 3Wyle Laboratories (United States)

9:30 SD&A-355
Estimation of altitude in stereoscopic-3D versus 2D real-world scenes, Lesley Deas1, Robert Allison1, Britteny Harrell1, Elizabeth Irving1, Mackenzie Glaholt2, and Laurie Wilcox1; 1York University, 2University of Waterloo, and 3Defence Research and Development Canada (Canada)

9:50 SD&A-356
Study of objective parameters of 3D visual fatigue based on analysis of salient area, Minghan Du, Yue Liu, Yongtian Wang, and Bochao Zou, Beijing Institute of Technology (China)

10:10 SD&A Opening Remarks, Andrew Woods, Curtin University (Australia)

10:20 – 10:50 am Coffee Break

Autostereoscopic Displays I

Session Chair: Gregg Favalora, Draper (United States)

10:50 am – 12:30 pm
Grand Peninsula Ballroom D

10:50 SD&A-357
Architectures and codecs for real-time light field streaming (JIST-first), Péter Kovács1,2, Alireza Zare3,4, Tibor Bologh5, Robert Bregovic6, and Atanas Ganchev7; 1Tampere University of Technology (Finland), 2Holografika (Hungary), and 3Nokia Technologies (Finland)

11:10 SD&A-358
Wide viewing angle projection-type integral 3D display system with multiple UHD projectors, Hayato Watanabe, Masahiro Kawakita, Naoto Okaichi, Hisayuki Sasaki, Masanori Kano, Jun Arai, and Tomoyuki Mishina, Science and Technology Research Laboratories, NHK (Japan Broadcasting Corporation) (Japan)

11:30 SD&A-359
A novel hardware based method for multiview glassless 3D display, Laurence Lujun Chen, 4D perception LLC (United States)

11:50 SD&A-360
Multilevel light modulation of three-dimensional magneto-optic spatial light modulator using optically addressing method, Kazuki Nakamura1, Kazuki Yamazaki2, Hiroyuki Takagi3, Taichi Goto4, Fang Boey Lim5, Hirohara Uchida6, and Mitsuteru Inoue7; 1Toyohashi University of Technology and 2JST PRESTO (Japan)

12:10 SD&A-361
Integral three-dimensional display with high image quality using multiple flat-panel displays, Naoto Okaichi, Hayato Watanabe, Hisayuki Sasaki, Jun Arai, Masahiro Kawakita, and Tomoyuki Mishina, Science and Technology Research Laboratories, NHK (Japan Broadcasting Corporation) (Japan)

12:30 – 2:00 pm Lunch Break

El 2017 Opening Plenary and Symposium Awards

Session Chairs: Joyce E. Farrell, Stanford University, and Nitin Sampat, Rochester Institute of Technology (United States)

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

Giga-scale 3D computational microscopy, Laura Waller, University of California, Berkeley (United States)

Laura Waller is the Ted Van Duzer Endowed Assistant Professor of Electrical Engineering and Computer Sciences (EECS) at UC Berkeley. She is a Senior Fellow at the Berkeley Institute of Data Science, and received her BS (2004), MEng (2005), and PhD (2010) in EECS from the Massachusetts Institute of Technology (MIT). Waller’s talk is on computational imaging methods for fast capture of gigapixel-scale 3D intensity and phase images in a commercial microscope that employs illumination-side and detection-side coding of angle (fourier) space with simple hardware and fast acquisition. The result is high-resolution reconstructions across a large field-of-view, achieving high space-bandwith-time product.

3:00 – 3:30 pm Coffee Break

SD&A Keynote I: 3D and VR on a User’s Desk

Session Chair: Andrew Woods, Curtin University (Australia)

3:30 – 4:30 pm
Grand Peninsula Ballroom D

Steroscopic displays, tracking, interaction, education, and the web, David Chavez, zSpace, Inc. (United States)

David Chavez brings 20 years of experience in startup companies, working with technologies ranging from GSM infrastructure to laptops, printers, PDAs and smartphones in both consumer and commercial product spaces. He has managed product development teams through the full range of the product life cycle, from initial concept to volume production. Chavez has extensive experience working with suppliers and manufacturing partners worldwide, with a particular emphasis in Asia. He has held various positions in product development organizations such as partner based computer companies GO & EO, Hewlett Packard, and Handspring.

Symposium Welcome Reception

5:00 – 6:00 pm
Atrium
SD&A Conference 3D Theater

Session Chairs: John Stern, Intuitive Surgical, Inc. (United States), Chris Ward, Lightspeed Design, Inc. (United States), and Andrew Woods, Curtin University (Australia)

6:00 – 7:30 pm
Grand Peninsula Ballroom 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 Theater 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.

Tuesday, January 31, 2017

7:15 – 8:45 am  Women in Electronic Imaging Breakfast

Human Vision and Stereoscopic Imaging Joint Session

Session Chairs: Nicolas Holliman, University of Newcastle (United Kingdom), and Thrasyvoulos Pappas, Northwestern University (United States)

8:50 – 10:10 am
Grand Peninsula Ballroom D

This session is jointly sponsored by: Stereoscopic Displays and Applications XXVIII and Human Vision and Electronic Imaging 2017.

8:50 HVEI-378
Depth-compressed expression for providing natural, visual experiences with integral 3D displays, Yasuhito Sawahata and Toshiya Morita, Japan Broadcasting Corporation (Japan)

9:10 HVEI-379
Blind quality prediction of stereoscopic 3D images, Jiheng Wang1, Qingbo Wu2, Abdul Rehman3, Shiqi Wang2, and Zhou Wang1; 1University of Waterloo (Canada) and 2University of Electronic Science and Technology of China (China)

9:30 SD&A-380
Pseudo-haptic by stereoscopic images and effects on muscular activity, Takashi Kawai1, Fumiya Ohta1, Sanghyun Kim1, and Hiroaki Monkawa2; 1Waseda University and 2Aoyama Gakuin University (Japan)

9:50 SD&A-381
The effects of proximity cues on visual comfort when viewing stereoscopic contents (JIST-first), Yaohua Xie1, Danli Wang2, and Heng Qiao2; 1Chinese Academy of Sciences, 2Institute of Software, Chinese Academy of Sciences, and 3Central University of Finance and Economics (China)

10:00 am – 7:30 pm  Industry Exhibition
10:10 – 10:50 am  Coffee Break

Autostereoscopic Displays II

Session Chair: Michael Klug, Magic Leap, Inc. (United States)

10:50 am – 12:30 pm
Grand Peninsula Ballroom D

10:50
See-through projection 3D display using time-division multiplexing, Masahiro Kayimoto, Hiroki Kamoshita, and Tomohiro Yendo, Nagasaki University of Technology (Japan)

11:10 SD&A-363
Flat autostereoscopic 3D display with enhanced resolution using a static color filter barrier, Silvio Jurk, Matthias Kühnle, Roland Barmann, Bernd Duckstein, and René de la Barré, Fraunhofer Heinrich-Hertz-Institute (Germany)

11:30 SD&A-365
Portrait and landscape mode convertible stereoscopic display using parallax barriers, Yusuke Minami, Saki Osafune, Goro Hamagishi, Kayo Yoshimoto, and Hideya Takahashi, Osaka City University (Japan)

12:10 SD&A-382
A low-cost static volumetric display based on layered high incidence angle scattering, Shawn Frayne, Looking Glass Factory, Inc. (United States)

12:30 – 2:00 pm  Lunch Break

El 2017 Tuesday Plenary and Symposium Awards

Session Chairs: Joyce E. Farrell, Stanford University, and Nitin Sampat, Rochester Institute of Technology (United States)

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

VR 2.0: Making virtual reality better than reality, Gordon Wetzstein, Stanford University (United States)

Gordon Wetzstein is an Assistant Professor of Electrical Engineering and, by courtesy, of Computer Science, at Stanford University, and leads the Stanford Computational Imaging Group. He received a PhD in computer science from the University of British Columbia (2011) where his doctoral dissertation focused on computational light modulation for image acquisition and display. In his talk, Wetzstein explores the frontiers of VR systems engineering. Eventually, VR/AR systems will redefine communication, entertainment, education, collaborative work, simulation, training, telesurgery, and basic vision research, as next-generation computational near-eye displays evolve to deliver visual experiences that are better than the real world.

3:00 – 3:30 pm  Coffee Break
Stereo-cameras and Stereo-matching
Session Chair: Neil Dodgson, University of Cambridge (United Kingdom)
3:30 – 4:30 pm
Grand Peninsula Ballroom D

3:30 SD&A-367
Real time depth estimation method using hybrid camera system, Eu-Tteum Baek and Yo-Sung Ho, Gwangju Institute of Science and Technology (Republic of Korea)

3:50 SD&A-368
Pixel based adaptive normalized cross correlation for illumination invariant stereo matching, Yongjun Chang and Yo-Sung Ho, Gwangju Institute of Science and Technology (Republic of Korea)

4:10 SD&A-369
Guide image filtering based disparity range control in stereo vision, Ji-Hun Mun and Yo-Sung Ho, Gwangju Institute of Science and Technology (Republic of Korea)

DISCUSSION: SD&A Forum
Moderator: Neil Dodgson, University of Cambridge (United Kingdom)
4:30 – 5:30 pm
Grand Peninsula Ballroom D
This session is a chance for a hot topic to be discussed by a panel of distinguished guests. Topic and panelists to be announced.

Symposium Demonstration Session
5:30 – 7:30 pm
Grand Peninsula Ballroom E

Wednesday, February 1, 2017

Steroscopic Image Quality
Session Chair: Björn Sommer, University of Konstanz (Germany)
8:50 – 10:10 am
Grand Peninsula Ballroom D

8:50 SD&A-340
Sharpness mismatch and 6 other stereoscopic artifacts measured on 10 Chinese 3D movies, Dmitry Vatolin, Lomonosov Moscow State University (Russian Federation)

9:10 SD&A-370
Bringing 3DMap to the 21st century, Stephen Keith1 and Andrew Woods; 1Independent Consultant (United States) and “Curtin University (Australia)

9:30 SD&A-371
Subjective and objective study of the relation between 3D and 2D views based on depth and bit rate, Balasubramaniam Appina, IIT Hyderabad (India)

9:50 SD&A-373
Improved depth of field analysis of multilayer displays, Hironobu Gotoda, National Institute of Informatics (Japan)

10:00 am – 4:00 pm Industry Exhibition
10:10 – 10:50 am Coffee Break

3D Developments
Session Chair: Takashi Kawai, Waseda University (Japan)
10:50 – 11:30 am
Grand Peninsula Ballroom D

10:50 SD&A-374
Stereo rendering of photorealistic precipitation, Syed Hussain and David McAllister, North Carolina State University (United States)

11:10 SD&A-372
Utilization of stereoscopic 3D images in elementary school social studies classes, Takashi Shibata1, Yoshihi Ishihara1, Kazunori Sato2,3, and Ryoshei Iekiri4; 1Tokyo University of Social Welfare, 2Takaido-higashi Elementary School, 3Tohoku University, and 4The University of Tokyo (Japan)

SD&A Keynote II: 360° Multi-Camera Content Creation
Session Chair: Gregg Favalora, Draper (United States)
11:30 am – 12:30 pm
Grand Peninsula Ballroom D

360° 3D capture: Meeting the need in VR, Timothy Macmillan1 and David Newman2; 1Consultant and 2GoPro Inc. (United States)

Tim MacMillan is an award-winning photographic artist whose career with Camera Array systems began in the 1980’s. In the 1990’s he established Time-Slice Films Ltd. to produce content and innovate array technology for clients such as the BBC, Sky TV, Discovery Channel, and many others. His distinctive approach has been influential in the development of special effects widely used today. MacMillan’s work spans both the artistic and technical, with his early camera technology now in the (United Kingdom) Science Museum. As well as architecting and designing Array systems, he has also worked in HD Broadcast Product Development with Grass Valley Cameras, and is currently Senior Manager of Advanced Products at GoPro Cameras.

12:30 – 2:00 pm Lunch Break

EI 2017 Wednesday Plenary and Symposium Awards
Session Chairs: Joyce E. Farrell, Stanford University, and Nitin Sampat, Rochester Institute of Technology (United States)
2:00 – 3:00 pm
Grand Peninsula Ballroom D
Designing VR video camera systems, Brian Cabral, Facebook, Inc. (United States)

Brian Cabral is Director of Engineering at Facebook, leading the Surround 360 VR camera team, specializing in computational photography, computer vision, and computer graphics. He has published a number of papers in the area of camera and image processing, photography, computer vision, and computer graphics. He has published a number of papers on the area of computational algorithms and imaging including the pioneering line Integral Convolution algorithms. Cabral discusses developing Facebook Surround 360, an open, high-quality 3D-360 video capture system. VR video capture systems are composed of multiple optical and digital components – all of which must operate as if they are one seamless optical system. The design of VR video cameras, optical choices, SNR, etc., require a new set of technologies and engineering approaches, with tight coupling to the computational system components.

3:00 – 3:30 pm Coffee Break
SD&A-105
Designing a cloud-based 3D visualization engine for smart cities,
Nicolas Holliman, Stephen Dowsland, Mark Turner, Richard Cloete, and
Tom Picton, Newcastle University (United Kingdom)

3:50 SD&A-106
Interactive computer graphics, stereo and VR practice at the Electronic
Visualization Laboratory University of Illinois at Chicago,
Maxine Brown1, Jason Leigh2, Tom DeFanti3, and Daniel Sandin4; 1The University
of Illinois at Chicago, 2University of Hawaii at Manoa, and 3University of
California, San Diego (United States)

4:10 ERVR-107
Designing at the Advanced Visualization Lab at Indiana University,
Margaret Dolinsky1, Eric Wernert2, Michael Boyles3, and Chris Eller4; 1School of Art and Design, Indiana University and 2Advanced Visualization
Lab, Indiana University (United States)

4:30 ERVR-108
Exploring Calit2, Jürgen Schulze and Gregory Dawe, University of
California, San Diego (United States)

5:10 SD&A-110
Image distortions in large-scale immersive display systems – Cylinder
and wedge displays, Andrew Woods1, Joshua Hollick2, Jesse Hellwell3, and
Paul Bourke4; 1Curtin University and 2University of Western Australia
(Australia)

5:30 SD&A Closing Remarks, Nicolas Holliman, Newcastle University
(United Kingdom)

SD&A-376
Analysis of retinal images for retinal projection type super multi-view
3D head-mounted display, Takashi Emoto, Tadayuki Konda, Kayo
Yoshimoto, and Hideya Takahashi, Osaka City University (Japan)

SD&A-377
A new design and algorithm for lenticular lenses display, René de la
Barré, Roland Bartmann, Mathias Kuhlrey, Bernd Duckstein, and Silvio
Junk, Fraunhofer HHI (Germany)
Surveillance: Applications and Algorithms 2017

Overview
With the advent of low-cost/high-performance video sensors, imaging platforms, and computational equipment, it has become increasingly possible to process video streams in real-time on affordable cloud computational servers, desktop systems, and various handheld mobile devices. Applications of these technologies are changing the landscape in security and surveillance systems. Automated video understanding can enhance surveillance/monitoring systems beyond what is possible for human operators alone. These systems are being developed to maintain long-term surveillance on large numbers of video streams for various applications with minimal or no manual intervention. In addition, automated systems can coordinate multiple cameras and provide “synopsis” views of activities that can be used to predict/analyze potential events pre or post mortem. Over the past two decades, various video analytics algorithms have been proposed for autonomous understanding of events for a variety of surveillance applications. While most of the earlier solutions started from raw data and followed with the interpretation at increasing levels of semantic complexity, more recent techniques attempt to bridge the gap between signal-level and semantic level processing. Technological solutions to problems in surveillance have the potential for significant societal impacts on many fronts from airport/stadium/building/city security to patient/elderly care. There is an emerging global effort to develop effective surveillance systems. This Special Session Call for Papers is intended to bring together world class researchers and practitioners that develop and deploy imaging and video technologies to enable novel solutions in the surveillance and security arenas.
Surveillance: Applications and Algorithms 2017 Session

Tuesday, January 31, 2017

Surveillance: Applications and Algorithms Topics

Session Chair: Sreenath Vantaram, Intel Corporation (United States)

8:50 – 10:20 am
Harbour

8:50
Chair Opening Remarks

9:00
SRV-349
Traffic light recognition and dangerous driving events detection from surveillance video of vehicle camera, Haike Guan, Ryohsuke Kasahara, and Tomoaki Yano, Ricoh Company, Ltd. (Japan)

9:20
SRV-350
A combined HOG and deep convolution network cascade for pedestrian detection, Yuriy Lipetski and Oliver Sidla, SLR Engineering GmbH (Austria)

9:40
SRV-352
A multi-scale approach to skin pixel detection, Siddharth Roheda and Hari Kalva; 1 North Carolina State University and 2 Florida Atlantic University (United States)

10:00
SRV-351
Detecting and estimating sound events locations through a microphone array, Josafat Martínez-García, Beatriz Juárez-Arreortúa, Alberto Vázquez-Cervantes, and Hugo Jimenez, Centro de Ingeniería y Desarrollo Industrial (Mexico)

10:00 am – 7:30 pm
Industry Exhibition

10:20 – 10:50 am
Coffee Break

3:00 – 3:30 pm
Coffee Break

EI 2017 Tuesday Plenary and Symposium Awards
Session Chairs: Joyce E. Farrell, Stanford University, and Nitin Sampat, Rochester Institute of Technology (United States)
2:00 – 3:00 pm
Grand Peninsula Ballroom D

VR 2.0: Making virtual reality better than reality, Gordon Wetzstein, Stanford University (United States)

Gordon Wetzstein is an Assistant Professor of Electrical Engineering and, by courtesy, of Computer Science, at Stanford University, and leads the Stanford Computational Imaging Group. He received a PhD in computer science from the University of British Columbia (2011) where his doctoral dissertation focused on computational light modulation for image acquisition and display. In his talk, Wetzstein explores the frontiers of VR systems engineering. Eventually, VR/AR systems will redefine communication, entertainment, education, collaborative work, simulation, training, telesurgery, and basic vision research, as next-generation computational near-eye displays evolve to deliver visual experiences that are better than the real world.

Symposium Demonstration Session
5:30 – 7:30 pm
Grand Peninsula Ballroom E
Visual Information Processing and Communication VIII

Conference overview
Processing, storage, and transmission of many types of visual information, including photos and stereo images, video, graphics, light fields, volumetric, spectral, etc., have become important engineering areas that attract interdisciplinary research interest. This conference is designed as a forum for presenting important research results as well as applications.

Topics include:
• Compression of visual information: image, video, graphics, and lightfield coding, compression standards, very-low bit rate coding, high quality image/video/graphics coding, volumetric data coding
• Media over networks: media streaming, video over wireless networks, error resilience, scalability, quality of service, cross-layer optimization for improved media delivery, streaming media delivery networks
• Visual information processing: filtering, interpolation (e.g. deinterlacing, frame-rate conversion), restoration, compressed-domain processing, superresolution, multimodal media processing
• Visual information representations: multiresolution analysis, subbands, wavelets, sparse decompositions for visual data, related estimation, analysis, and reconstruction algorithms
• Pattern matching of visual data: machine learning, augmented reality, mobile applications
• Object-based methods: segmentation and tracking, feature extraction
• Synthetic imaging and rendering: stereo, multiview and 3D video, synthetic image/video and graphics representations, 3D and animated 3D models, virtual reality, visualization and display techniques
• Application systems: DTV, electronic cinema, multimedia content retrieval, man-machine interface, imaging/video surveillance
• Media system design: hardware and software architectures and implementation issues, scalable computations, low-power implementations, multicore algorithm design
• Compression of medical imaging information
• Other timely topics related to visual information communication and processing

Conference Chairs: Edward Delp, Purdue Univ. (United States); and Robert L. Stevenson, Univ. of Notre Dame (United States)

Program Committee: John Apostolopoulos, HP Inc. (United States); Vasudev Bhaskaran, Qualcomm Technologies, Inc. (United States); Mireille Boutn, Purdue Univ. (United States); Chang Wen Chen, The State Univ. of New York at Buffalo (United States); Gerard de Haan, Philips Research Nederland B.V. (the Netherlands); Eric Dubois, Univ. of Ottawa (Canada); Frederic Ducaux, Télécom ParisTech (France); Keigo Hirakawa, Univ. of Dayton (United States); Marta Karczewicz, Qualcomm Technologies, Inc. (United States); Lisimachos Kondi, Univ. of Ioannina (Greece); Janusz Konrad, Boston Univ. (United States); Chun-Chieh Jay Kuo, The Univ. of Southern California (United States); Peyman Milanfar, Univ. of California, Santa Cruz (United States); Antonio Ortega, The Univ. of Southern California (United States); Thrasyvoulos Pappas, Northwestern Univ. (United States); William Pearlman, Rensselaer Polytechnic Institute (United States); Fernando Pereira, Instituto de Telecomunicações (Portugal); Béatrice Pesquet-Popescu, Télécom ParisTech (France); Majid Rabban, Consultant (United States); Eli Saber, Rochester Institute of Technology (United States); Amir Said, Qualcomm Technologies Inc. (United States); Dan Schonfeld, Univ. of Illinois at Chicago (United States); Andrew Segall, Sharp Labs of America, Inc. (United States); Gaurav Sharma, Univ. of Rochester (United States); Andrew Tescher, AGT Associates (United States); Anthony Vetro, Mitsubishi Electric Research Labs (United States); John Woods, Rensselaer Polytechnic Institute (United States); and Wenwu Zhu, Tsinghua Univ. (China)
Monday, January 30, 2017

Image and Video Compression

10:50 am – 12:30 pm
Cypress A

10:50 VIPC-398
A fast TU mode decision algorithm based on residual difference for HEVC, Nian-Rong Li1, Kai-Wen Liang1, Zong-Yi Chen1, Hui-Yu Jiang1, Jiunn-Tsair Fang2, and Pao-Chi Chang; 1National Central University and 2Ming Chuan University (Taiwan)

11:10 VIPC-399
A fast intra mode decision algorithm for HEVC, Weihang Liao, Daiqin Yang, and Zhenzhong Chen, Wuhan University (China)

11:30 VIPC-400
Diamond frequency domain inter frame motion estimation for HEVC, Abdelrahman Abdelazim1, Ahmed Hanza2, Mohamed Hefieda1, and Djamel Ait-Boudaoud2; 1The American University of the Middle East (Kuwait) and 2University of Portsmouth (United Kingdom)

11:50 VIPC-401
Compression of infrared images, Claire Mantel and Soren Forchhammer, Denmark Technical University (Denmark)

12:10 VIPC-402
Graph regularized sparse coding by modified online dictionary learning, Lingdao Sha, Jing Wang, and Dan Schonfeld, University of Illinois at Chicago (United States)

12:30 – 2:00 pm Lunch Break

Tuesday, January 31, 2017

Techniques for Image and Video Processing

8:50 – 10:10 am
Cypress A

8:50 VIPC-406
Improvement of infrared image based on directional anisotropic wavelet transform, Hongbin Jin1, Chunxiao Fan1, Quanxin Wang2, and Yong Li1; 1Beijing University of Posts and Telecommunications and 2Ultimedical, Inc (China)

9:10 VIPC-407
New diamond half-pel hexagon serach algorithm for block matching motion estimation, Abdelrahman Abdelazim1, Ahmed Hanza2, Bassam Noaman1, and Djamel Ait-Boudaoud2; 1The American University of the Middle East (Kuwait) and 2University of Portsmouth (United Kingdom)

9:30 VIPC-408
Self-example-based edge enhancement algorithm for around view monitor images, Dong Yoon Choi1, Ji Hoon Choi1, Jin Woook Choi2, and Byung Cheol Song1; 1Inha University and 2Hyundai Motor Company (Republic of Korea)

9:50 VIPC-409
Adaptive multireference prediction using a symmetric framework, Zoe Liu1, Debarghya Mukherjee1, Wei-Ting Lin2, Paul Wilkins3, Jingning Pan1, Yaowu Xu1, and James Bankoski1; 1Google Inc. and 2University of California, Santa Barbara (United States)

10:00 am – 7:30 pm Industry Exhibition

10:10 – 10:50 am Coffee Break
Databases and Classification

10:50 – 11:30 am
Cypress A

10:50 VIPC-411
Semi-supervised learning feature representation for historical Chinese character recognition, Xiaoyi Yu, Wei Fan, and Jun Sun, Fujitsu R&D Co. Limited (China)

11:10 VIPC-412
Document image classification on the basis of layout information, Sergey Zavalishin, Andrey But, Ilya Kurilin, and Michael Rychagov; 1Samsung R&D Institute Russia, 2Ryazan State Radio Electronics University (RSREY), and 3Kaspersky Lab (Russian Federation)

11:30 am – 2:00 pm  Lunch Break

EI 2017 Tuesday Plenary and Symposium Awards
Session Chairs: Joyce E. Farrell, Stanford University, and Nitin Sampat, Rochester Institute of Technology (United States)

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

VR 2.0: Making virtual reality better than reality, Gordon Wetzstein, Stanford University (United States)

Gordon Wetzstein is an Assistant Professor of Electrical Engineering and, by courtesy, of Computer Science, at Stanford University, and leads the Stanford Computational Imaging Group. He received a PhD in computer science from the University of British Columbia (2011) where his doctoral dissertation focused on computational light modulation for image acquisition and display. In his talk, Wetzstein explores the frontiers of VR systems engineering. Eventually, VR/AR systems will redefine communication, entertainment, education, collaborative work, simulation, training, telesurgery, and basic vision research, as next-generation computational near-eye displays evolve to deliver visual experiences that are better than the real world.

3:00 – 3:30 pm  Coffee Break

Symposium Demonstration Session
5:30 – 7:30 pm
Grand Peninsula Ballroom E
Visualization and Data Analysis 2017

Conference overview
The Conference on Visualization and Data Analysis (VDA) 2017 covers all research and development and application aspects of data visualization and visual analytics. Since the first VDA conference was held in 1994, the annual event has grown steadily into a major venue for visualization researchers and practitioners from around the world to present their work and share their experiences.

Award: Kostas Pantazos Memorial Award for Outstanding Paper

Conference Sponsor

Kitware
Wednesday, February 1, 2017

EI 2017 Wednesday Plenary and Symposium Awards
Session Chairs: Joyce E. Farrell, Stanford University, and Nitin Sampat, Rochester Institute of Technology (United States)
2:00 – 3:00 pm
Grand Peninsula Ballroom D

Designing VR video camera systems, Brian Cabral, Facebook, Inc. (United States)
Brian Cabral is Director of Engineering at Facebook, leading the Surround 360 VR camera team, specializing in computational photography, computer vision, and computer graphics. He has published a number of papers in the area of computer graphics and imaging including the pioneering Line Integral Convolution algorithm. Cabral discusses developing Facebook Surround 360, an open, high-quality 3D-360 video capture system. VR video capture systems are composed of multiple optical and digital components - all of which must operate as if they are one seamless optical system. The design of VR video cameras, optical choices, SNR, etc., require a new set of technologies and engineering approaches, with tight coupling to the computational system components.

3:00 – 3:30 pm  Coffee Break

Keynote: Topological Data Analysis
Session Chair: Thomas Wischgoll, Wright State University (United States)
3:30 – 4:30 pm
Cypress B

Topological analysis at the extreme scale: Finding features in large data sets, Gunther Weber, Lawrence Berkeley National Laboratory and University of California, Davis (United States)
Gunther Weber is a Staff Scientists in LBNL's Computational Research Division and an Adjunct Associate Professor of Computer Science at UC Davis. His research interests include computer graphics, scientific visualization, topological data analysis methods, parallelization of visualization algorithms, hierarchical data representation methods, and bioinformatics. Prior to joining LBNL, Weber worked as a Project Scientist at the Institute for Data Analysis and Visualization (IDAV) at UC Davis focusing on visualization of three-dimensional gene expression data (with researchers of LBNL's Genomics and Life Sciences divisions), topological exploration of scalar data, and visualization of brain imaging data and experimental earthquake data. Weber earned his PhD in computer science, from the University of Kaiserslautern, Germany (2003).

4:30 VDA-384
An interactive tool for Analyzing the Correlation, Uncertainty, and Clustering (ACUC) over ensembles in climate dataset, Najmeh Abedzadeh, Mississippi State University (United States)

4:36 VDA-385
Analysis enhanced particle-based flow visualization, Lieyu Shi, Lei Zhang, Wei Cao, and Guoning Chen, University of Houston (United States)

4:42 VDA-450
Constellations of movement: An interactive application to visualise research in motor imagery decoding, Jennifer Rogers1, Matthieu Poyade1, and Frank Pollick2; 1Glasgow School of Art and 2University of Glasgow (United Kingdom)

Panel: Application Papers: What are they and how should they be evaluated?
Panel Moderator: Gunther Weber, Lawrence Berkeley National Laboratory (United States)
4:50 – 5:30 pm
Cypress B
This panel will start a discussion in the community about what goals an application paper ought to have, what its main contributions to the state of art of visualization should be, and how it ought to be evaluated by reviewers. How do we as a community generate clear evaluation criteria for this type of paper?

Symposium Interactive Papers (Poster) Session
5:30 – 7:00 pm
Atrium

Thursday, February 2, 2017

Information Visualization
Session Chair: Song Zhang, Mississippi State University (United States)
8:50 – 10:10 am
Cypress B

8:50 VDA-386
Declarative guide creation, Joseph Cottam and Andrew Lumsdaine, Indiana University (United States)

9:10 VDA-387
Visual-interactive semi-supervised labeling of human motion capture data, Jürgen Bernard1, Eduard Dobemann1, Anna Vögele2, Björn Krüger3, Jörn Kohlhammer4, and Dieter Fellner1; 1Technische Universität Darmstadt (Germany), 2University of Bonn (Germany), 3Gakuhale Method Institute (United States), and 4Fraunhofer Institute for Computer Graphics Research IGD (Germany)

9:30 VDA-388
Visual-interactive creation and validation of text clustering workflows to explore document collections, Tobias Rupper1, Michael Staab2, Andreas Bannach1, Hendrik Lüke-Tieke1, Jürgen Bernard2, Arjan Kuiper1,2, and Jörn Kohlhammer1,2; 1Fraunhofer Institute for Computer Graphics Research IGD and 2Technische Universität Darmstadt (Germany)
Visualization and Data Analysis 2017

9:50 VDA-389
AssisTag: Seamless integration of content-based and keyword-based image exploration for category search (JIST-first), Kazuyo Mizuno, Daisuke Sakamoto, and Takeo Igarashi, The University of Tokyo (Japan)

10:10 – 10:50 am Coffee Break

Virtual Reality
Session Chair: Song Zhang, Mississippi State University (United States)

10:50 – 11:30 am Cypress B
10:50 VDA-390
Megacity: A collaborative virtual reality environment for emergency response, training, and decision making, Sharad Sharma1, Phillip Devreux1, David Scribner1, Jock Orynovick2, and Peter Grazaitis3; 1Bowie State University and 2Army Research Laboratory (United States)

11:10 VDA-391
Display systems for visualization and simulation in virtual environments, Thomas Wischgoll, Wright State University (United States)

Scientific Visualization
Session Chair: David Kao, NASA Ames Research Center (United States)

11:30 am – 12:10 pm Cypress B
11:20 VDA-392
Ray traced volume clipping using multi-hit BVH Traversal, Stefan Zellmann1, Mauritius Hoevels2, and Ulrich Lang3; 1University of Cologne and 2University Hospital of Cologne (Germany)

11:50 VDA-393
Effectiveness of feature-driven storytelling in 3D time-varying data visualization (JIST-first), Aidong Lu, Li Yu, and Lane Harrison, University of North Carolina at Charlotte (United States)

12:10 – 2:00 pm Lunch Break

Graphs and Hierarchies
Session Chair: Thomas Wischgoll, Wright State University (United States)

2:00 – 2:40 pm Cypress B
2:00 VDA-394
A visual and statistical benchmark of graph sampling methods, Fangyan Zhang1, Song Zhang1, and Pak Wong2; 1Mississippi State University and 2Pacific Northwest National Laboratory (United States)

2:20 VDA-395
Inferring partial orders of nodes for hierarchical network layout (JIST-first), Hsiang-Yun Wu1, Shigeo Takahashi1, Hiroko Myamuro1, Satoshi Ohzahata1, and Akihiro Nakao2; 1Keio University, 2Japan Atomic Energy Agency, 1The University of Electro-Communications, and 2The University of Tokyo (Japan)

Flow Visualization
Session Chair: David Kao, NASA Ames Research Center (United States)

2:40 – 3:20 pm Cypress B
2:40 VDA-396
Closest point sparse octree for surface flow visualization, Mark Kim and Charles Hansen, University of Utah (United States)

3:00 VDA-397
Accelerating advection via approximate block exterior flow maps, Ryan Bleile1, Linda Sugiyama2, Christoph Garth3, and Hank Childs1; 1University of Oregon (United States), 2Massachusetts Institute of Technology (United States), and 3University of Kaiserslautern (Germany)

Meet the Future: A Showcase of Student and Young Professionals Research
3:00 – 5:00 pm Atrium

3:20 – 4:00 pm Coffee Break
**Short Courses**

**Sunday, January 29, 2017**

**EI01: Stereoscopic Display Application Issues**

**Instructors:** John Merritt, The Merritt Group (United States) and Andrew Woods, Curtin University (Australia)

**8:00 am – 5:45 pm (8 hours)**

**Course Level:** Intermediate

**Fee:** Member fee*: $465 / Non-member fee: $510 / Student fee: $185 *(after January 9, 2017 prices for all courses increase by $50, $25 for students)*

When correctly implemented, stereoscopic 3D video displays can provide significant benefits in many areas, including endoscopy and other medical imaging, remote-control vehicles and telemanipulators, stereo 3D CAD, molecular modeling, 3D computer graphics, 3D visualization, and video-based training. This course conveys a concrete understanding of basic principles and pitfalls that should be considered in transitioning from 2D to 3D displays, and in testing for performance improvements. In addition to the traditional lecture sessions, there is a “workshop” session to demonstrate stereoscopic hardware and 3D imaging/display principles, emphasizing the key issues in an ortho-stereoscopic video display setup, and showing video from a wide variety of applied stereoscopic imaging systems.

**Benefits:**
- List critical human factors guidelines for stereoscopic display configuration & implementation.
- Calculate optimal camera focal length, separation, display size, and viewing distance to achieve a desired level of depth acuity.
- Calculate comfort limits for focus/fixation mismatch and on-screen parallax values, as a function of focal length, separation, convergence, display size, and viewing distance factors.
- Set up a large-screen stereo display system using AV equipment readily available at most conference sites for slides and for fulldemotion video.
- Evaluate the trade-offs among currently available stereoscopic display technologies for your proposed applications.
- List the often-overlooked side-benefits of stereoscopic displays that should be included in a cost/benefit analysis for proposed 3D applications.
- Avoid common pitfalls in designing tests to compare 2D vs. 3D displays.
- Calculate and demonstrate the distortions in perceived 3D space due to camera and display parameters.
- Design and set up an orthostereoscopic 3D imaging/display system.
- Understand the projective geometry involved in stereo modeling.
- Understand the trade-offs among currently available stereoscopic display system technologies and determine which will best match a particular application.

**Intended Audience:** Engineers, scientists, and program managers involved with video display systems for applications such as: medical imaging & endoscopic surgery, simulators & training systems, teleoperation systems (remote-control vehicles & manipulators), computer graphics, 3D CAD systems, data-space exploration and visualization, and virtual reality.

John O. Merritt is a display systems consultant at The Merritt Group, Williamsburg, MA, with more than 25 years’ experience in the design and human-factors evaluation of stereoscopic video displays for teleseness and telerobotics, scientific visualization, and medical imaging.

**EI02: Introduction to Image Quality Testing: Targets, Software, and Standards**

**Instructors:** Peter Burns, Burns Digital Imaging (United States) and Don Williams, Image Science Associates (United States)

**8:00 – 10:00 am (2 hours)**

**Course Level:** Introductory

**Fee:** Member fee*: $165 / Non-member fee: $195 / Student fee: $60 *(after January 9, 2017 prices for all courses increase by $50, $25 for students)*

This course introduces imaging performance evaluation for image capture and provides a foundation for more advanced topics, e.g., system characterization and performance benchmarking. We adopt a scenario-based approach by describing several situations where imaging performance needs evaluation. Each of these, from design to quality assurance for manufacturing, is addressed in terms of suggested methods, color test charts, and standard reporting. For several important attributes, we describe international standards, guidelines, and current best practice. We demonstrate how testing standards can be adopted to evaluate capture devices ranging from cameras to scientific detectors. Examples are drawn from various applications, including consumer, museum, mobile, and clinical imaging.

**Benefits:**
- Understand the difference between imaging performance and image quality.
- Describe performance standards, guidelines, and current best practices.
- Understand how color-encoding, image resolution, distortion, and noise are evaluated.
- Compare various commercial analysis software products and (color, resolution) test charts.
- Select evaluation methods and test targets to meet your project needs.
- Identify sources of system variability and understand measurement error.

**Intended Audience:** This course is intended for a wide audience: image scientists, quality engineers, and others evaluating digital camera and scanner performance. No background in imaging performance (optical distortion, color error, MTF, etc.) evaluation will be assumed.

Peter Burns is a consultant working in imaging system evaluation, modeling, and image processing. Previously he worked for Carestream Health, Xerox, and Eastman Kodak. A frequent instructor and speaker at technical conferences, he has contributed to several imaging standards. He has taught imaging courses at Kodak, SPIE, and IS&T technical conferences, and at the Center for Imaging Science, RIT.

Don Williams, founder of Image Science Associates, was with Kodak Research Laboratories. His work focuses on quantitative signal and noise performance metrics for digital capture imaging devices and imaging fidelity issues. He co-leads the TC 42 standardization efforts on digital print and film scanner resolution (ISO 16067-1, ISO 16067-2), scanner dynamic range (ISO 21.550), and is the editor for the second edition to digital camera resolution (ISO 12233).

Instructors: Uwe Artmann, Image Engineering GmbH & Co KG (Germany) and Kevin Matherson, Microsoft Corporation (United States)

8:00 – 10:00 am (2 hours)

Course Level: Introductory/Intermediate
Fee: Member fee*: $165 / Non-member fee: $195 / Student fee: $60 *(after January 9, 2017 prices for all courses increase by $50, $25 for students)

Resolution is often used to describe image quality of electronic imaging systems. Components of an imaging system such as lenses, sensors, and image processing impact the overall resolution and image quality achieved in devices such as digital and mobile phone cameras. While image processing can in some cases improve the resolution of an electronic camera, it can also introduce artifacts as well. This course is an overview of spatial resolution methods used to evaluate electronic imaging devices and the impact of image processing on the final system resolution. The course covers the basics of resolution and impacts of image processing, international standards used for the evaluation of spatial resolution, and practical aspects of measuring resolution in electronic imaging devices such as target choice, lighting, sensor resolution, and proper measurement techniques.

Benefits:
• Understand terminology used to describe resolution of electronic imaging devices.
• Describe the basic methods of measuring resolution in electronic imaging devices and their pros and cons.
• Understand point spread function and modulation transfer function.
• Learn slanted edge spatial frequency response (SFR).
• Learn Siemens Star SFR.
• Contrast transfer function.
• Difference between and use of object space and image space resolution.
• Describe the impact of image processing functions on spatial resolution.
• Understand practical issues associated with resolution measurements.
• Understand targets, lighting, and measurement setup.
• Learn measurement of lens resolution and sensor resolution.
• Appreciate RAW vs. processed image resolution measurements.
• Learn cascade properties of resolution measurements.
• Understand measurement of camera resolution.

Intended Audience: Managers, engineers, and technicians involved in the design and evaluation of image quality of digital cameras, mobile cameras, video cameras, and scanners would benefit from participation. Technical staff of manufacturers, managers of digital imaging projects, as well as journalists and students studying imaging technology are among the intended audience.

Kevin J. Matherson is a director of optical engineering at Microsoft Corporation working on advanced optical technologies for consumer products. Prior to Microsoft, he participated in the design and development of compact cameras at HP and has more than 1.5 years of experience developing miniature cameras for consumer products. His primary research interests focus on sensor characterization, optical system design and analysis, and the optimization of camera image quality. Matherson holds a Masters and PhD in optical sciences from the University of Arizona.

EIO4: Electronic Imaging of Secure Documents

Instructor: Alan Hodgson, Alan Hodgson Consulting Ltd. (United Kingdom)

8:00 – 10:00 am (2 hours)

Course Level: Introductory
Fee: Member fee*: $165 / Non-member fee: $195 / Student fee: $60 *(after January 9, 2017 prices for all courses increase by $50, $25 for students)

This short course highlights the opportunities for electronic imaging technology in the broad secure documents market. There are specific opportunities for a broad range of electronic imaging technologies for the inspection and verification of a wide selection of secure documents.

For the purposes of this short course we consider the market for secure documents to encompass brand protection, packaging, and high security documents. The course is illustrated with examples from the high security end as personal identification documents provide a great illustration of the features and challenges in this sector.

This course is a mirror of one given to the high security printing community on the threats and opportunities that the technologies presented at this conference bring to secure documents. The benefits that this interaction brings is that the course is tuned to reflect the needs and opportunities for both communities.

Benefits:
• Understand the fundamentals driving security printing opportunities.
• Identify opportunities for electronic imaging solutions in this market segment.
• Gain an overview of how mobile imaging, machine vision, and multispectral characterization can be used in the security print market sector.

Intended Audience: Imaging scientists, systems developers, and engineers who are looking for applications of their technology in the field of security documents, from brand protection to personal identification. It is likely to be of particular interest to those with a background in visual perception, mobile imaging, and image processing as these will figure as potential application areas in this short course.

Alan has 35 years’ experience in imaging science and printing, initially from the photography industry. Working on holography and scientific imaging he made the transition to digital imaging through astrophotography, conservation and security printing. He recently spent seven years at 3M, specializing in print solutions for high security documents such as passports and identity cards. He has since returned to his consultancy business, working on projects that include security, imaging, and printed electronics applications. Alan has a BSc in colour chemistry and a PhD in instrumentation, both from the department of chemistry at the University of Manchester. After a 30 year gap he has returned to the university as a Visiting Academic, investigating technology opportunities for secure documents. He is immediate Past President of IS&T and a Fellow of The Royal Photographic Society.
EIO5: Advanced Image Enhancement and Deblurring

Instructor: Majid Rabbani, Consultant (United States)

8:00 am – 12:15 pm (4 hours)

Course Level: Advanced

Fee: Member fee*: $260 / Nonmember fee: $290 / Student fee: $90 *(after January 9, 2017 prices for all courses increase by $50, $25 for students)

This course explains some of the advanced algorithms used for contrast enhancement, noise reduction, and sharpening and deblurring of still images and video. Applications include consumer and professional imaging, medical imaging, forensic imaging, surveillance, and astronomical imaging. Many image examples complement the technical descriptions.

Benefits:
• Understand advanced algorithms used for contrast enhancement such as CLAHE, Photoshop Shadows/Highlights, and Dynamic Range Compression (DRC).
• Understand advanced techniques used in image sharpening such as advanced variations of nonlinear unsharp masking, etc.
• Understand recent advancements in image noise removal, such as bilateral filtering and nonlocal means.
• Understand how motion information can be utilized in image sequences to improve the performance of various enhancement techniques.
• Understand Wiener filtering and its variations for performing image deblurring (restoration).

Intended Audience: Scientists, engineers, and technical managers who need to understand and/or apply the techniques employed in digital image processing in various products in a diverse set of applications such as medical imaging, professional and consumer imaging, forensic imaging, etc. will benefit from this course. Some knowledge of digital filtering (convolution) and frequency decomposition is necessary for understanding the deblurring concepts.

Majid Rabbani has 35 years of experience in digital imaging. After a 33-year career at Kodak Research labs, he retired in 2016 with the rank of Kodak Fellow. Currently, he is a visiting professor at Rochester Institute of Technology (RIT). He is the co-recipient of the 2005 and 1988 Kodak C. E. K. Mees Awards and the co-recipient of two Emmy Engineering Awards (1990 and 1996). He has 44 issued US patents and is the co-author of the book Digital Image Compression Techniques published in 1991 and the creator of six video/CDROM courses in the area of digital imaging. Rabbani is a Fellow of SPIE and IEEE and a Kodak Distinguished Inventor. He has been an active educator in the digital imaging community for the past 30 years.

EIO6: Fundamentals of Deep Learning

Instructor: Raymond Ptucha, Rochester Institute of Technology (United States)

8:00 am – 12:15 pm (4 hours)

Course Level: Intermediate. Basic machine learning exposure and prior experience programming using a scripting language helpful.

Fee: Member fee*: $260 / Nonmember fee: $290 / Student fee: $90 *(after January 9, 2017 prices for all courses increase by $50, $25 for students)

Deep learning has been revolutionizing the machine learning community winning numerous competitions in computer vision and pattern recognition. Success in this space spans many domains including object detection, classification, speech recognition, natural language processing, action recognition and scene understanding. In some cases, results are on par with and even surpassing the abilities of humans. Activity in this space is pervasive, ranging from academic institutions to small startups to large corporations. This short course encompasses the two hottest deep learning fields: convolutional neural networks (CNNs) and recurrent neural networks (RNNs), and then gives attendees hands-on training on how to build custom models using popular open source deep learning frameworks. CNNs are end-to-end, learning low level visual features and classifier simultaneously in a supervised fashion, giving substantial advantage over methods using independently solved features and classifiers. RNNs inject temporal feedback into neural networks. The best performing RNN framework, Long Short Term Memory modules, are able to both remember long term sequences and forget more recent events. This short course describes what deep networks are, how they evolved over the years, and how they differ from competing technologies. Examples are given demonstrating their widespread usage in imaging, and as this technology is described, indicating their effectiveness in many applications.

There are an abundance of approaches to getting started with deep learning, ranging from writing C++ code to editing text with the use of popular frameworks. After understanding how these networks are able to learn complex systems, a hands-on portion provided by NVIDIA’s Deep Learning Institute, we demonstrate usage with popular open source utilities to build state-of-the-art models. An overview of popular network configurations and how to use them with frameworks is discussed. The session concludes with tips and techniques for creating and training deep neural networks to perform classification on imagery, assessing performance of a trained network, and modifications for improved performance.

Benefits:
• To become familiar with deep learning concepts and applications.
• To understand how deep learning methods, specifically convolutional neural networks and recurrent neural networks work.
• To gain hands-on experience building, testing, and improving the performance of deep networks using popular open source utilities.

Intended Audience: The short course is intended for engineers, scientists, students, and managers interested in acquiring a broad understanding of deep learning. Prior familiarity with basics of machine learning and a scripting language are helpful.

Raymond Ptucha is an assistant professor in computer engineering at the Rochester Institute of Technology specializing in machine learning, computer vision, robotics, and embedded control. Ptucha was a research scientist with Eastman Kodak Company for 20 years where he worked on computational imaging algorithms and was awarded 26 US patents with another 23 applications on file. He graduated from SUNY/Buffalo with a BS in computer science (1988) and a BS in electrical engineering (1989). He earned a MS in image science (2002) and PhD in computer science from RIT (2013). He was awarded an NSF Graduate Research Fellowship in 2010 and his PhD research earned the 2014 Best RIT Doctoral Dissertation Award. Ptucha is a passionate supporter of STEM education and is an active member of his local IEEE chapter and FIRST robotics organizations.

EIO8: 3D Imaging

Instructor: Gady Agam, Illinois Institute of Technology (United States)

8:00 am – 12:15 pm (4 hours)

Course Level: Introductory

Fee: Member fee*: $260 / Nonmember fee: $290 / Student fee: $90 *(after January 9, 2017 prices for all courses increase by $50, $25 for students)

The purpose of this course is to introduce algorithms for 3D structure inference from 2D images. In many applications, inferring 3D structure from
2D images can provide crucial sensing information. The course begins by reviewing geometric image formation and mathematical concepts that are used to describe it, and then moves to discuss algorithms for 3D model reconstruction.

The problem of 3D model reconstruction is an inverse problem in which we need to infer 3D information based on incomplete (2D) observations. We discuss reconstruction algorithms which utilize information from multiple views. Reconstruction requires the knowledge of some intrinsic and extrinsic camera parameters and the establishment of correspondence between views. Also discussed are algorithms for determining camera parameters (camera calibration) and for obtaining correspondence using epipolar constraints between views. The course introduces relevant 3D imaging software components available through the industry standard OpenCV library.

Benefits:
- Describe fundamental concepts in 3D imaging.
- Develop algorithms for 3D model reconstruction from 2D images.
- Incorporate camera calibration into your reconstructions.
- Classify the limitations of reconstruction techniques.
- Use industry standard tools for developing 3D imaging applications.

Intended Audience: Engineers, researchers, and software developers who develop imaging applications and/or use camera sensors for inspection, control, and analysis. The course assumes basic working knowledge concerning matrices and vectors.

Gady Agam is an associate professor of computer science at the Illinois Institute of Technology. He is the director of the visual computing lab at IIT which focuses on imaging, geometric modeling, and graphics applications. He received his PhD from Ben-Gurion University in 1999.

EI09: Color and Calibration in Mobile Imaging Devices

Instructors: Uwe Artmann, Image Engineering GmbH & Co KG (Germany) and Kevin Matherson, Microsoft Corporation (United States)

10:15 am – 12:15 pm (2 hours)

Course Level: Introductory/Intermediate
Fee: Member fee*: $165 / Non-member fee: $195 / Student fee: $60 *(after January 9, 2017 prices for all courses increase by $50, $25 for students)

When an image is captured using a digital imaging device it needs to be rendered. For consumer cameras this processing is done within the camera and covers various steps like dark current subtraction, flare compensation, shading, color compensation, demosaicing, white balancing, tonal and color correction, sharpening, and compression. Each of these steps have a significant influence on image quality. In order to design and tune cameras, it is important to understand how color camera hardware varies as well as the methods that can be used to calibrate such variations. This course provides the basic methods describing the capture and processing of a color camera image. Participants get to examine the basic color image capture and how calibration can improve images using a typical color imaging pipeline. In the course, participants are shown how raw image data influences color transforms and white balance. The knowledge acquired in understanding the image capture and calibration process can be used to understand tradeoffs in improving overall image quality.

Benefits:
- Understand how hardware choices in compact cameras impact calibrations and the type of calibrations performed and how such choices can impact overall image quality.
- Describe basic image processing steps for compact color cameras.
- Understand calibration methods for mobile camera modules.
- Describe the differences between class calibration and individual module calibration.
- Understand how spectral sensitivities and color matrices are calculated.
- Describe required calibration methods based on the hardware chosen and the image processing used.
- Appreciate artifacts associated with color shading and incorrect calibrations.
- Learn about the impacts of pixel saturation and the importance of controlling it on color.
- Learn about the impact of tone reproduction on perceived color (skin tone, memory colors, etc.)

Intended Audience: People involved in the design and image quality of digital cameras, mobile cameras, and scanners would benefit from participation. Technical staff of manufacturers, managers of digital imaging projects, as well as journalists and students studying image technology are among the intended audience.

Kevin J. Matherson is a director of optical engineering at Microsoft Corporation working on advanced optical technologies for consumer products. Prior to Microsoft, he participated in the design and development of compact cameras at HP and has more than 15 years of experience developing miniature cameras for consumer products. His primary research interests focus on sensor characterization, optical system design and analysis, and the optimization of camera image quality. Matherson holds a masters and PhD in optical sciences from the University of Arizona.

Uwe Artmann studied Photo Technology at the University of Applied Sciences in Cologne following an apprenticeship as a photographer, and finished with the German ‘Diploma Engineer’. He is now CTO at Image Engineering, an independent test lab for imaging devices and manufacturer of all kinds of test equipment for these devices. His special interest is the influence of noise reduction on image quality and MIT measurement in general.

EI10: High-Dynamic-Range Imaging in Cameras, Displays, and Human Vision

Instructors: John McCann, McCann Imaging (United States) and Alessandro Rizzi, Università degli Studi di Milano (Italy)

10:15 am – 12:15 pm (2 hours)

Course Level: To Intermediate
Fee: Member fee*: $165 / Non-member fee: $195 / Student fee: $60 *(after January 9, 2017 prices for all courses increase by $50, $25 for students)

Recent advances in television and displays emphasize HDR technology. High-dynamic range (HDR) imaging records and displays more information than conventional imaging. Nonuniform illumination increases the range of light from a scene. HDR techniques are often associated with recording natural images, such as the Ansel Adams’s Zone system. After a detailed description of the dynamic range problem in image acquisition, this course focuses on standard methods of creating and manipulating HDR images, replacing myths with measurements of scenes, camera images, and visual appearances. The course presents measurements about the limits of accurate camera acquisition (range and color) and the usable range of light for displays presented to human vision. It discusses the principles of tone rendering and the role of HDR spatial comparisons.

Benefits:
- Explore the history of HDR imaging.
- Understand dynamic range and quantization: the ‘salame’ metaphor.
- Compare single and multiple-exposures for scene capture.
- Measuring optical limits in acquisition and visualization.
Instructor: Stephen Viggiano, RIT School of Photographic Arts and Sciences (United States)

• Avoid pitfalls in older analysis methods.
• Recognize the advantages (and disadvantages) of these experiments.
• Understand results of these type experiments presented by others.
• Establish statistical significance between different alternatives.
• Construct an image preference scale from rank-order and graphical scaling experiments.

Benefits:
• Error bars are computed and range tests run so that the stimuli may be compared given for two different types of experiments. A hands-on experience is the focus of the tutorial.
• Rank-order and graphical scaling image preference experiments are conducted and analyzed using ordinary spreadsheet software.
• You learn how to use human observations to assess image quality and get hands-on experience doing it. After an introduction/review of psychometric image preference assessment, complete step-by-step procedures are given for two different types of experiments. A hands-on experience is the focus of the tutorial. Rank-order and graphical scaling image preference experiments are conducted and analyzed using ordinary spreadsheet software.
• Learn to recognize tone-rendering problems and spatial methods.
• Review recent advances in HDR television and cinema.

Intended Audience: Students, color scientists, imaging researchers, medical imaging specialists, software and hardware engineers, photographers, cinematographers, and production specialists interested in using HDR in imaging applications.

NEW for 2017: EI12: Psychophysics Lab: In Depth and Step-by-Step

Instructor: Stephen Viggiano, RIT School of Photographic Arts and Sciences (United States)

10:15 am – 12:15 pm (2 hours)

Course Level: Introductory

Fee: Member fee*: $165 / Non-member fee: $195 / Student fee: $60 *(after January 9, 2017 prices for all courses increase by $50, $25 for students)

Learn how to use human observations to assess image quality and get hands-on experience doing it. After an introduction/review of psychometric image preference assessment, complete step-by-step procedures are given for two different types of experiments. A hands-on experience is the focus of the tutorial. Rank-order and graphical scaling image preference experiments are conducted and analyzed using ordinary spreadsheet software.

Benefits:
• Construct an image preference scale from rank-order and graphical scaling experiments.
• Establish statistical significance between different alternatives.
• Understand results of these type experiments presented by others.
• Recognize the advantages (and disadvantages) of these experiment types over other methods.
• Avoid pitfalls in older analysis methods.

NEW for 2017: EI13: Real-time and Parameter-Free Anomaly Detection from Image Streams

Instructor: Bruno Costa, Ford Motor Company (United States)

1:30 – 3:30 pm (2 hours)

Course Level: Introductory/Intermediate

Fee: Member fee*: $165 / Non-member fee: $195 / Student fee: $60 *(after January 9, 2017 prices for all courses increase by $50, $25 for students)

Anomaly detection plays a very important role in many different areas nowadays. Online and real-time detection of anomalies in data streams is especially important in areas where prompt awareness and action can be crucial, such as surveillance, cyber security, industries, health and, more recently, autonomous vehicles. This short course presents a few recently introduced techniques for anomaly detection in data streams applied to different computer vision scenarios. Such techniques are based on the concepts of typicality and eccentricity of data, unsupervised learning, and on-the-fly non-parametric training.

Benefits:
• Overview and implementation of typicality and eccentricity data analytics,
• Unsupervised learning/clustering of data streams,
• Anomaly detection and foreign object tracking,
• Application to video streams.

Intended Audience: Computer scientists, electrical and computer engineers, and students.

NEW for 2017: EI13: Real-time and Parameter-Free Anomaly Detection from Image Streams

Instructor: Bruno Costa, Ford Motor Company (United States)

1:30 – 3:30 pm (2 hours)

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Anomaly detection plays a very important role in many different areas nowadays. Online and real-time detection of anomalies in data streams is especially important in areas where prompt awareness and action can be crucial, such as surveillance, cyber security, industries, health and, more recently, autonomous vehicles. This short course presents a few recently introduced techniques for anomaly detection in data streams applied to different computer vision scenarios. Such techniques are based on the concepts of typicality and eccentricity of data, unsupervised learning, and on-the-fly non-parametric training.

Benefits:
• Overview and implementation of typicality and eccentricity data analytics,
• Unsupervised learning/clustering of data streams,
• Anomaly detection and foreign object tracking,
• Application to video streams.

Intended Audience: Computer scientists, electrical and computer engineers, and students.
EI14: Perceptual Metrics for Image and Video Quality in a Broader Context: From Perceptual Transparency to Structural Equivalence

Instructors: Sheila Hemami, Draper (United States) and Thrasyvoulos Pappas, Northwestern University (United States)

1:30 – 5:45 pm (4 hours)

Course Level: Intermediate (Prerequisites: Basic understanding of image compression algorithms; background in digital signal processing and basic statistics; frequency-based representations, filtering, distributions.)

Fee: Member fee*: $260 / Non-member fee: $290 / Student fee: $90 *(after January 9, 2017 prices for all courses increase by $50, $25 for students)

The course examines objective criteria for the evaluation of image quality that are based on models of visual perception. The primary emphasis will be on image fidelity, i.e., how close an image is to a given original or reference image, but we will broaden the scope of image fidelity to include structural equivalence. Also discussed is no-reference and limited-reference metrics. An examination of a variety of applications with special emphasis on image and video compression is included. We examine near-threshold perceptual metrics, which explicitly account for human visual system (HVS) sensitivity to noise by estimating thresholds above which the distortion is just noticeable, and suprathreshold metrics, which attempt to quantify visible distortions encountered in high compression applications or when there are losses due to channel conditions. The course also considers metrics for structural equivalence, whereby the original and the distorted image have visible differences but both look natural and are of equally high visual quality. This short course takes a close look at procedures for evaluating the performance of quality metrics, including database design, models for generating realistic distortions for various applications, and subjective procedures for metric development and testing. Throughout the course we discuss both the state of the art and directions for future research.

Benefits:

- Gain a basic understanding of the properties of the human visual system and how current applications (image and video compression, restoration, retrieval, etc.) attempt to exploit these properties.
- Gain an operational understanding of existing perceptually-based and structural similarity metrics, the types of images/artifacts on which they work, and their failure modes.
- Understand current distortion models for different applications and how they can be used to modify or develop new metrics for specific contexts.
- Understand the differences between sub-threshold and suprathreshold artifacts, the HVS responses to these two paradigms, and the differences in measuring that response.
- Understand criteria by which to select and interpret a particular metric for a particular application.
- Understand the capabilities and limitations of full-reference, limited-reference, and no-reference metrics, and why each might be used in a particular application.

Intended Audience: Image and video compression specialists who wish to gain an understanding of how performance can be quantified. Engineers and Scientists who wish to learn about objective image and video quality evaluation. Managers who wish to gain a solid overview of image and video quality evaluation. Students who wish to pursue a career in digital image processing. Intellectual Property and Patent Attorneys who wish to gain a more fundamental understanding of quality metrics and the underlying technologies. Government laboratory personnel who work in imaging.

Thrasyvoulos N. Pappas received SB, SM, and PhD in electrical engineering and computer science from MIT in 1979, 1982, and 1987, respectively. From 1987 until 1999, he was a member of the technical staff at Bell Laboratories, Murray Hill, NJ. He is currently a professor in the department of electrical and computer engineering at Northwestern University, which he joined in 1999. His research interests are in image and video quality and compression, image and video analysis, content-based retrieval, perceptual models for multimedia processing, model-based halftoning, and tactile and multimodal interfaces. Pappas has served as co-chair of the 2005 SPIE/IS&T Electronic Imaging (EI) Symposium, and since 1997 he has been co-chair of the EI Conference on Human Vision and Electronic Imaging. Pappas is a Fellow of IEEE and SPIE. He is currently serving as Vice President-Publications for the Signal Processing Society of IEEE. He has also served as Editor-in-Chief of the IEEE Transactions on Image Processing (2010-12), elected member of the Board of Governors of the Signal Processing Society of IEEE (IEEE TIP 2004-06), chair of the IEEE Image and Multidimensional Signal Processing (IWSIP) Technical Committee, and technical program co-chair of CICIP01 and CIICP09.

Sheila S. Hemami received a BSEE from the University of Michigan (1990), MSEE and PhD from Stanford University (1992 and 1994). She was most recently at Northwestern University as professor and chair of the electrical engineering and computer science department at the College of Engineering, with Hewlett-Packard laboratories in Palo Alto, California in 1994; and with the School of Electrical Engineering at Cornell University from 1995-2013. She is currently Director, Strategic Technical Opportunities, at Draper, Cambridge, MA. Her research interests broadly concern communication of visual information from the perspectives of both signal processing and psychophysics. She was elected a fellow of the IEEE in 2009 for contributions to robust and perceptual image and video communications. Hemami has held various visiting positions, most recently at the University of Nantes, France and at Ecole Polytechnique Fédérale de Lausanne, Switzerland. She has received numerous university and national teaching awards, includingEta Kappa Nu’s C. Holmes MacDonald Award. She was a Distinguished Lecturer for the IEEE Signal Processing Society in 2010-2011, was editor-in-chief for the IEEE Transactions on Multimedia from 2008-2010. She has held various technical leadership positions in the IEEE.
• Review MPEG and JCT-3V activities for 3D video coding.
• Synthesize intermediate views at virtual viewpoints.
• Estimate depth map information from stereoscopic and multi-view.
• Apply image processing techniques for color correction and filtering.
• Analyze the captured data for image rectification and illumination.
• Estimate camera parameters for camera calibration.
• Identify the main components of 3D video processing systems.
• Describe the basic requirements for realistic 3D video services.
• Understand the general trend of 3D video services.

Benefits:
• Design a 3D video system to handle multi-view videos plus depth data.
• Discuss various challenging problems related to 3D video services.

Intended Audience: Scientists, engineers, technicians, or managers who wish to learn more about 3D video and related processing techniques. Undergraduate training in engineering or science is assumed.

Yo-Sung Ho has been developing video processing systems for digital TV and HDTV, first at Philips Labs in New York and later at ETRI in Korea. He is currently a professor at the school of electrical and computer engineering at Gwangju Institute of Science and Technology (GIST) in Korea, and also Director of Realistic Broadcasting Research Center at GIST. He has given several tutorial lectures at various international conferences, including the 3DTV Conference, the IEEE International Conference on Image Processing (ICIP), and the IEEE International Conference on Multimedia & Expo (ICME). He earned his PhD in electrical and computer engineering at the University of California, Santa Barbara. He has been an associate editor of IEEE Transactions on Circuits and Systems for Video Technology (TCSVT).

E116: 3D Video Processing Techniques for Immersive Environments

Instructor: Yo-Sung Ho, Gwangju Institute of Science and Technology (Republic of Korea)

1:30 – 5:45 pm (4 hours)

Course Level: Intermediate

Fee: Member fee*: $260 / Non-member fee: $290 / Student fee: $90
*after January 9, 2017 prices for all courses increase by $50, $25 for students

With the emerging market of 3D imaging products, 3D video has become an active area of research and development in recent years. 3D video is the key to provide more realistic and immersive perceptual experiences than the existing 2D counterpart. There are many applications of 3D video, such as 3D movie and 3DTV, which are considered the main drive of the next-generation technical revolution. Stereoscopic display is the current mainstream technology for 3DTV, while autostereoscopic display is more promising solution that requires more research endeavors to resolve the associated technical difficulties. This short course lecture covers the current state-of-the-art technologies for 3Ds contents generation. After defining the basic requirements for 3D realistic multimedia services, we cover various multi-modal immersive media processing technologies. Also addressed is the depth estimation problem for natural 3D scenes and several challenging issues of 3D video processing, such as camera calibration, image rectification, illumination compensation and color correction. The course discusses JCT-3V activities for 3D video coding, including depth map estimation, prediction structure for multiview video coding, multiview video-plus-depth coding, and intermediate view synthesis for multiview video display applications.

Benefits:
• Understand the general trend of 3D video services.
• Describe the basic requirements for realistic 3D video services.
• Identify the main components of 3D video processing systems.
• Estimate camera parameters for camera calibration.
• Analyze the captured data for image rectification and illumination compensation.
• Apply image processing techniques for color correction and filtering.
• Estimate depth map information from stereoscopic and multi-view images.
• Synthesize intermediate views at virtual viewpoints.
• Review MPEG and JCT-3V activities for 3D video coding.

E117: Perception and Cognition for Imaging

Instructor: Bernice Rogowitz, Visual Perspectives (United States)

1:30 – 5:45 pm (4 hours)

Course Level: Introductory/Intermediate

Fee: Member fee*: $260 / Non-member fee: $290 / Student fee: $90
*after January 9, 2017 prices for all courses increase by $50, $25 for students

Imaging, visualization, and computer graphics provide visual representations of data in order to communicate, provide insight and enhance problem solving. The human observer actively processes these visual representations using perceptual and cognitive mechanisms that have evolved over millions of years. The goal of this tutorial is to provide an introduction to these processing mechanisms, and to show how this knowledge can guide the decisions we make about how to represent data visually, how we visually represent patterns and relationships in data, and how we can use human pattern recognition to extract features in the data.

Benefits:
• Understand basic principles of spatial, temporal, and color processing by the human visual system.
• Explore basic cognitive processes, including visual attention and semantics.
• Develop skills in applying knowledge about human perception and cognition to interactive visualization and computer graphics applications.

Intended Audience: Imaging scientists, engineers, and application developers, and domain experts using imaging systems in their analysis of financial, medical, or other data. Students interested in understanding imaging systems from the perspective of the human user and anyone interested in how the visual world is processed by our eye-brain system.

Bernice Rogowitz is a multidisciplinary scientist, working at the intersection of human perception, imaging, and visualization. She received her BS in experimental psychology from Brandeis University, a PhD in vision science from Columbia University, and was a postdoctoral fellow in the Laboratory for Psychophysics at Harvard University. For many years, she was a scientist and research manager at the IBM T.J. Watson Research Center and is currently active in research and teaching through her consulting company, Visual Perspectives. Her work includes fundamental research in human color and pattern perception, novel perceptual approaches for visual data analysis and image semantics, and human-centric methods to enhance visual problem solving in medical, financial, and scientific applications. As the founder and co-chair of the IS&T Conference on Human
Vision and Electronic Imaging, she is a leader in defining the research agenda for human-computer interaction in imaging, driving technology innovation through research in human perception, cognition, and aesthetics. Rogowitz is a Fellow of IS&T and SPIE, a Senior Member of IEEE, and a 2015 IS&T Senior Member.

EI18: Camera Module Calibration for Mobile Imaging Devices

Instructors: Uwe Artmann, Image Engineering GmbH & Co KG (Germany) and Kevin Matherson, Microsoft Corporation (United States)

1:30 – 5:45 pm (4 hours)

Course Level: Introductory/Intermediate

Fee: Member fee*: $260 / Nonmember fee: $290 / Student fee: $90 *(after January 9, 2017 prices for all courses increase by $50, $25 for students)

Digital and mobile imaging camera and system performance is determined by a combination of sensor characteristics, lens characteristics, and image processing algorithms. Smaller pixels, smaller optics, smaller modules, and lower cost result in more part-to-part variation driving the need for calibration to maintain good image quality. This short course provides an overview of issues associated with compact imaging modules used in mobile and digital imaging. The course covers optics, sensors, actuators, camera modules and the camera calibrations typically performed to mitigate issues associated with production variation of lenses, sensor, and autofocus actuators.

Benefits:
- Describe illumination, photons, sensor, and camera radiometry.
- Select optics and sensor for a given application.
- Understand the optics of compact camera modules used for mobile imaging.
- Understand the difficulties in minimizing sensor and camera modules.
- Assess the need for per unit camera calibrations in compact camera modules.
- Determine camera spectral sensitivities.
- Understand autofocus actuators and why per unit calibrations are required.
- How to perform the various calibrations typically done in compact camera modules (relative illumination, color shading, spectral calibrations, gain, actuator variability, etc.).
- Equipment required for performing calibrations.
- Compare hardware tradeoffs such as temperature variation, its impact on calibration and overall influence on final quality.

Intended Audience: People involved in the design and image quality of digital cameras, mobile cameras, and scanners will benefit from participation. Technical staff of manufacturers, managers of digital imaging projects, as well as journalists and students studying image technology are among the intended audience.

Kevin J. Matherson is a director of optical engineering at Microsoft Corporation working on advanced optical technologies for consumer products. Prior to Microsoft, he participated in the design and development of compact cameras at HP and has more than 15 years of experience developing miniature cameras for consumer products. His primary research interests focus on sensor characterization, optical system design and analysis, and the optimization of camera image quality. Matherson holds a masters and PhD in optical sciences from the University of Arizona.

Uwe Artmann studied Photo Technology at the University of Applied Sciences in Cologne following an apprenticeship as a photographer, and finished with the German ‘Diploma Engineer’. He is now CTO at Image Engineering, an independent test lab for imaging devices and manufacturer of all kinds of test equipment for these devices. His special interest is the influence of noise reduction on image quality and MTF measurement in general.

EI19: OpenVX: A Standard API for Accelerating Computer Vision

Instructors: Radhakrishna Giduthuri, Advanced Micro Devices (United States) and Kari Pulli, Intel Corporation (United States)

1:30 – 5:45 pm (4 hours)

Course Level: Introductory (OpenVX architecture and its relation to other related APIs) to intermediate (the practical programming aspects, requiring familiarity with C++)

Fee: Member fee*: $260 / Non-member fee: $290 / Student fee: $90 *(after January 9, 2017 prices for all courses increase by $50, $25 for students)

OpenVX is a royalty-free open standard API released by the Khronos Group in 2014. OpenVX enables performance and power-optimized computer vision functionality, especially important in embedded and realtime use cases. The course covers both the function-based API and the graph API that enable OpenVX developers to efficiently run computer vision algorithms on heterogeneous computing architectures. A set of example algorithms from computational photography and advanced driver assistance systems are discussed. The course includes hands-on practice session that gets the participants started on solving real computer vision problems using OpenVX.

Benefits: Understanding the architecture of OpenVX computer vision API, its relation to OpenCV, OpenGL, and OpenCL APIs; getting fluent in actually using OpenVX for realtime image processing and computer vision tasks.

Intended Audience: Engineers, researchers, and software developers who develop computer vision and machine learning applications and want to benefit from transparent HW acceleration.

Kari Pulli is Sr. Principal Engineer at Intel. Earlier he was VP of computational imaging at Light. He was also Senior Director of Research at NVIDIA and before that, Nokia Fellow at Nokia Research center; in both places he headed a research team called Mobile Visual Computing. Pulli has a long background in standardization and at Khronos he has contributed to many mobile media standards including OpenVX. He is a frequent author and speaker at venues like CVPR and SIGGRAPH, with h-index of 27. He has a PhD from University of Washington, MBA from University of Oulu, and has taught and worked as a researcher at University of Oulu, Stanford University, and MIT.

Radhakrishna Giduthuri is a design engineer at Advanced Micro Devices (AMD) focusing on development of computer vision toolkit and libraries for heterogeneous compute platforms. He has extensive background with software design and performance tuning for various computer architectures ranging from General Purpose DSPs, Customizable DSPs, Media Processors, Heterogeneous Processors, GPUs, and several CPUs. He is a member of Khronos OpenVX working group representing AMD. In the past he was a member of SMPTE video compression standardizing committee for several years. He is also winner of outstanding leadership and professional services award for IEEE Central Area in 2016.
NEW for 2017 EI20: Computer Vision for Autonomous Driving

Instructor: Rony Ferzli, Intel Corporation (United States)

3:45 – 5:45 pm (2 hours)

Course Level: Introductory to Intermediate

Fee: Member fee*: $165 / Non-member fee: $195 / Student fee: $60 *after January 9, 2017 prices for all courses increase by $50, $25 for students

Computer vision algorithms are the backbone for any autonomous driving system. These algorithms play a key role in the perception and scene understanding enabling vehicles to operate not only under normal conditions, but also to adjust for unusual situations. The goal of the course is to present building blocks or ingredients needed for autonomous vehicles’ scenarios (such as lane departure warning, distance estimation, vehicle detection, traffic light detection, pedestrian detection, tracking, and sign detection) using classical approaches as well as latest research using deep learning. The short course also touches on design choices related to tradeoffs between complexity, performance, and accuracy. In addition, the course focuses on ADAS platforms, SDK tools, and how these can be used to develop and test computer vision algorithms.

Benefits:
• Understand the ADAS challenges.
• Understand ADAS scenarios.
• Describe the latest research in computer vision related to ADAS.
• Identify available platforms and tools to start development.
• Understand the complexity of each scenario and CV algorithm selection process based on a set of criteria (quality, performance, cost, power).

Intended Audience: The short course is intended for engineers, scientists, and students who need to acquire technical knowledge about computer vision algorithms used in Advanced Driver Assistance Systems (ADAS) and available tools used for development.

Rony Ferzli received his BE and ME in electrical engineering from the American University of Beirut, Lebanon, (1999 and 2002, respectively). He received his PhD in electrical engineering from Arizona State University (ASU), Tempe (2007). From 2007 to 2012, he worked in the R&D Unified Communications Group at Microsoft Corp., Redmond, WA, designing next generation video codecs for video conferencing products. Ferzli joined Intel Corporation in 2012 where he is currently a platform architect engineer at the Internet of Things Group (IoTG), researching and enabling computer vision and machine learning algorithms for Intel ADAS platforms. Prior to his current role, he worked on mobile devices SOC media technologies and next generation graphics as well as developing algorithms for HDRVs pre and post processing. He has more than 50 publications and patents in research areas such as image and video processing, DSP architectures and real-time systems, neural networks, and mixed-signal design. He holds several awards such as the Intel Division Award and IEEE SPS 2015 best paper award.

Monday, January 30, 2017

EI22 Introduction to Digital Color Imaging

Instructor: Gaurav Sharma, University of Rochester (United States)

8:30 am – 12:45 pm (4 hours)

Course Level: Introductory

Fee: Member fee*: $260 / Non-member fee: $290 / Student fee: $90 *after January 9, 2017 prices for all courses increase by $50, $25 for students

This short course provides an introduction to color science and digital color imaging systems. Foundational knowledge is introduced first via an overview of the basics of color science and perception, color representation, and the physical mechanisms for displaying and printing colors. Building upon this base, an end-to-end systems view of color imaging is presented that covers color management and color image processing for display, capture, and print. A key objective of the course is to highlight the interactions between the different modules in a color imaging system and to illustrate via examples how color management has played an important role in the development of current digital color imaging devices and algorithms.

Benefits:
• Explain how color is perceived starting from a physical stimulus and proceeding through the successive stages of the visual system by using the concepts of tristimulus values, opponent channel representation, and simultaneous contrast.
• Describe the common representations for color and spatial content in images and their interrelations with the characteristics of the human visual system.
• List basic processing functions in a digital color imaging system and schematically represent a system from input to output for common devices such as a digital cameras, displays, and color printers.
• Describe why color management is required and how it is performed.
• Explain the role of color appearance transforms in image color manipulations for gamut mapping and enhancement.
• Explain how interactions between color and spatial dimensions are commonly utilized in designing color imaging systems and algorithms.
• Cite examples of algorithms and systems that break traditional cost, performance, and functionality tradeoffs through system-wide optimization.

Intended Audience: The short course is intended for engineers, scientists, students, and managers interested in acquiring a broad-system wide view of digital color imaging systems. Prior familiarity with basics of signal and image processing, in particular Fourier representations, is helpful although not essential for an intuitive understanding.

Gaurav Sharma is a professor of electrical and computer engineering and of computer science at the University of Rochester where his research spans signal and image processing, computer vision, color imaging, and bioinformatics. He has extensive experience in developing and applying probabilistic models in these areas. Prior to joining the University of Rochester, he was a principal scientist and project leader at the Xerox Innovation Group. Additionally, he has consulted for several companies on the development of image processing and computer vision algorithms. He holds 51 issued patents and has authored more than a 150 peer-reviewed publications. He is the editor of the Digital Color Imaging Handbook published by CRC Press and served as the Editor-in-Chief for the SPIE/IS&T Journal of Electronic Imaging from 2011 through 2015. Sharma is a fellow of IS&T, IEEE, and SPIE.

EI23: Noise Sources at the Camera Level and the Use of International Standards for its Characterization

Instructors: Uwe Artmann, Image Engineering GmbH & Co KG (Germany) and Kevin Matherson, Microsoft Corporation (United States)

10:30 am – 12:30 pm (2 hours)

Course Level: Introductory to Intermediate

Fee: Member fee*: $165 / Non-member fee: $195 / Student fee: $60 *after January 9, 2017 prices for all courses increase by $50, $25 for students

This short course provides an overview of noise sources associated with “light in to byte out” in digital and mobile imaging cameras. The course discusses common noise sources in imaging devices, the influence of image processing on these noise sources, the use of international
standards for noise characterization, and simple hardware test setups for characterizing noise.

Benefits:
- Become familiar with basic noise source in mobile and digital imaging devices.
- Learn how image processing impacts noise sources in digital imaging devices.
- Make noise measurements based on international standards: EMVA 1288, ISO 14524, ISO 15739, and visual noise measurements.
- Describe simple test setups for measuring noise based on international standards.
- Predict system level camera performance using international standards.

Intended Audience: People involved in the design and image quality of digital cameras, mobile cameras, and scanners would benefit from participation. Technical staff of manufacturers, managers of digital imaging projects, as well as journalists and students studying image technology are among the intended audience.

Kevin J. Matherson is a director of optical engineering at Microsoft Corporation working on advanced optical technologies for consumer products. Prior to Microsoft, he participated in the design and development of compact cameras at HP and has more than 15 years of experience developing miniature cameras for consumer products. His primary research interests focus on sensor characterization, optical system design and analysis, and the optimization of camera image quality. Matherson holds a masters and PhD in optical sciences from the University of Arizona.

Uwe Artmann studied Photo Technology at the University of Applied Sciences in Cologne following an apprenticeship as a photographer, and finished with the German Diplom Engineer. He is now CTO at Image Engineering, an independent test lab for imaging devices and manufacturer of all kinds of test equipment for these devices. His special interest is the influence of noise reduction on image quality and MTF measurement in general.

Tuesday, January 31, 2017

EI24: Joint Design of Optics and Image Processing for Imaging Systems

Instructor: David Stork, Rambus (United States)

8:30 am – 12:45 pm (4 hours)

Course Level: Introductory to Intermediate

Fee: Member fee*: $260 / Non-member fee: $290 / Student fee: $90

*After January 9, 2017, prices for all courses increase by $50, $25 for students

For centuries, optical imaging system design centered on exploiting the laws of the physics of light and materials (glass, plastic, reflective metal,) to form high-quality (sharp, high-contrast, undistorted,) images that "looked good." In the past several decades, the optical images produced by such systems have been ever more commonly sensed by digital detectors and the image imperfections corrected in software. The new era of electro-optical imaging offers a more fundamental revision to this paradigm, however, now the optics and image processing can be designed jointly to optimize an end-to-end digital merit function without regard to the traditional quality of the intermediate optical image. Many principles and guidelines from the optics-only era are counterproductive in the new era of electro-optical imaging and must be replaced by principles grounded on both the physics of photons and the information of bits. This short course describes the theoretical and algorithmic foundations of new methods of jointly designing the optics and image processing of electro-optical imaging systems. The course also focuses on the new concepts and approaches rather than commercial tools.

Benefits:
- Describe the basics of information theory.
- Characterize electro-optical systems using linear systems theory.
- Compute a predicted mean-squared error merit function.
- Characterize the spatial statistics of sources.
- Implement a Wiener filter.
- Implement spatial convolution and digital filtering.
- Make the distinction between traditional optics-only merit functions and end-to-end digital merit functions.
- Perform point-spread function engineering.
- Become aware of the image processing implications of various optical aberrations.
- Describe wavefront coding and cubic phase plates.
- Utilize the power of spherical coding.
- Compare super-resolution algorithms and multi-aperture image synthesizing systems.
- Simulate the manufacturability of jointly designed imaging systems.
- Evaluate new methods of electro-optical compensation.

Intended Audience: Optical designers familiar with system characterization (f#, depth of field, numerical aperture, point spread functions, modulation transfer functions,) and image processing experts familiar with basic operations (convolution, digital sharpening, information theory).

David Stork is Distinguished Research Scientist and Research Director at Rambus Labs and a Fellow of the International Association for Pattern Recognition. He holds 40 US patents and has written nearly 200 technical publications including eight books or proceedings volumes such as Seeing the Light, Pattern Classification (2nd ed.) and HAL's Legacy. He has given more than 230 technical presentations on computer image analysis of art in 19 countries.
General Information

Registration
Onsite Registration and Badge Pick-Up Hours
Sunday 29 January ........................ 7:00 am to 8:00 pm
Monday 30 January ....................... 7:00 am to 5:00 pm
Tuesday 31 January ....................... 8:00 am to 5:00 pm
Wednesday 1 February ................. 8:00 am to 5:00 pm
Thursday 2 February .................... 8:30 am to 5:00 pm

Symposium Registration
Symposium Registration Includes: Admission to all technical sessions, coffee breaks, the Symposium Reception, and support of free access to all the EI proceedings papers on the IS&T Digital Library. Separate registration fees are required for short courses.

Short Course Registration
Courses and workshops are priced separately. Course-only registration includes your selected course(s), course notes, coffee breaks, and admittance to the exhibition. Courses will take place in various meeting rooms at the Hyatt Regency San Francisco Airport. Room assignments are noted on the course admission tickets and distributed with registration materials.

Refund Information
To cover bank charges and processing fees, there is a cancellation fee of $75 until 21 January 2017. After that date, the cancellation fee is 50% of the total plus $75. All requests for refunds must be made in writing. No refunds will be given after 20 February 2017.

Author/Presenter Information
Speaker AV Preparation
Conference Office
Open during Registration Hours
Each conference room has an LCD projector, screen, lapel microphone, and laser pointer. All presenters are encouraged to visit the Speaker AV Prep Room to confirm that their presentation and personal laptop is compatible with the audiovisual equipment supplied in the conference rooms. Speakers who have requested special equipment, prior to the request deadline, are asked to report to the AV Prep Room to confirm their requested equipment is available.

No shared laptops are provided

Policies
Granting Attendee Registration and Admission
IS&T, or their officially designated event management, in their sole discretion, reserves the right to accept or decline an individual’s registration for an event. Further, IS&T, or event management, reserves the right to prohibit entry or remove any individual whether registered or not, be they attendees, exhibitors, representatives, or vendors, who in their sole opinion are not, or whose conduct is not, in keeping with the character and purpose of the event. Without limiting the foregoing, IS&T and event management reserve the right to remove or refuse entry to any attendee, exhibitor, representative, or vendor who has registered or gained access under false pretenses, provided false information, or for any other reason whatsoever that they deem is cause under the circumstances.

IS&T Code of Conduct/Anti-Harassment Policy
The Society for Imaging Science and Technology (IS&T; imaging.org) is dedicated to ensuring a harassment-free environment for everyone, regardless of gender, gender identity/expression, race/ethnicity, sexual orientation, disability, physical appearance,
General Information

As an international, professional organization with community members from across the globe, IS&T is committed to providing a respectful environment where discussions take place and ideas are shared without threat of belittlement, condescension, or harassment in any form. This applies to all interactions with the Society and its programs/events, whether in a formal conference session, in a social setting, or on-line.

Harassment includes offensive verbal comments related to gender, sexual orientation, etc., as well as deliberate intimidation; stalking; harassing photography, recording, or postings; sustained disruption of talks or other events; inappropriate physical contact; and unwelcome sexual attention. Please note that the use of sexual language and/or imagery is never appropriate, including within conference talks, online exchanges, or the awarding of prizes. Participants asked to stop any harassing behavior are expected to comply immediately.

Those participating in IS&T activities who violate these or IS&T’s Publications Policy may be sanctioned or expelled from the conference and/or membership without a refund at the discretion of IS&T. If you are being harassed, notice that someone else is being harassed, or have any other concerns, please contact the IS&T Executive Director or e-mail incident.report@imaging.org immediately. Please note that all reports are kept confidential and only shared with those who “need to know”; retaliation in any form against anyone reporting an incident of harassment, independent of the outcome, will not be tolerated.

Identification

To verify registered participants and provide a measure of security, IS&T will ask attendees to present a government issued Photo ID at registration to collect registration materials. Individuals are not allowed to pick up badges for attendees other than themselves. Further, attendees may not have some other person participate in their place at any conference-related activity. Such other individuals will be required to register on their own behalf to participate.

Capture and Use of a Person’s Image

By registering for an IS&T event, I grant full permission to IS&T to capture, store, use, and/or reproduce my image or likeness by any audio and/or visual recording technique (including electronic/digital photographs or videos), and create derivative works of these images and recordings in any IS&T media now known or later developed, for any legitimate IS&T marketing or promotional purpose. By registering for an IS&T event, I waive any right to inspect or approve the use of the images or recordings or of any written copy. I also waive any right to royalties or other compensation arising from or related to the use of the images, recordings, or materials. By registering, I release, defend, indemnify and hold harmless IS&T from and against any claims, damages or liability arising from or related to the use of the images, recordings, or materials. By registering, I release, defend, indemnify and hold harmless IS&T from and against any claims, damages or liability arising from or related to the use of the images, recordings, or materials, including but not limited to claims of defamation, invasion of privacy, or rights of publicity or copyright infringement, or any misuse, distortion, blurring, alteration, optical illusion or use in composite form that may occur or be produced in taking, processing, reduction or production of the finished product, its publication or distribution.

Payment Method

Registrants for paid elements of the event, who do not provide a method of payment, will not be able to complete their registration. Individuals with incomplete registrations will not be able to attend the conference until payment has been made. IS&T accepts VISA, MasterCard, American Express, Discover, Diner’s Club, checks and wire transfers. Onsite registrations can also pay with Cash.

Audio, Video, Digital Recording Policy

Conferences, courses, and poster sessions: For copyright reasons, recordings of any kind are prohibited without prior written consent of the presenter. Attendees may not capture nor
use the materials presented in any meeting room without written permission. Consent forms are available at Speaker Check-In. Individuals not complying with this policy will be asked to leave a given session and asked to surrender their recording media.

Exhibition Hall: For security and courtesy reasons, recordings of any kind are prohibited unless one has explicit permission from on-site company representatives. Individuals not complying with this policy will be asked to surrender their recording media and to leave the exhibition hall. Your registration signifies your agreement to be photographed or videotaped by IS&T in the course of normal business. Such photos and video may be used in IS&T marketing materials or other IS&T promotional items.

Laser Pointer Safety Information/Policy
IS&T supplies tested and safety-approved laser pointers for all conference meeting rooms. For safety reasons, IS&T requests that presenters use provided laser pointers. Use of a personal laser pointer represents user’s acceptance of liability for use of a non-IS&T-supplied laser pointer. Laser pointers in Class II and IIIa (<5 mW) are eye safe if power output is correct, but output must be verified because manufacturer labeling may not match actual output. Misuse of any laser pointer can lead to eye damage.

Underage Persons on Exhibition Floor Policy
For safety and insurance reasons, no one under the age of 16 will be allowed in the exhibition area during move-in and move-out. During open exhibition hours, only children over the age of 12 accompanied by an adult will be allowed in the exhibition area.

Unauthorized Solicitation Policy
Unauthorized solicitation in the Exhibition Hall is prohibited. Any non-exhibiting manufacturer or supplier observed to be distributing information or soliciting business in the aisles, or in another company’s booth, will be asked to leave immediately.

Unsecured Items Policy
Personal belongings should not be left unattended in meeting rooms or public areas. Unattended items are subject to removal by security. IS&T is not responsible for items left unattended.

Wireless Internet Service Policy
At IS&T events where wireless is included with your registration, IS&T provides wireless access for attendees during the conference and exhibition but cannot guarantee full coverage in all locations, all of the time. Please be respectful of your time and usage so that all attendees are able to access the internet.

Excessive usage (e.g., streaming video, gaming, multiple devices) reduces bandwidth and increases cost for all attendees. No routers may be attached to the network. Properly secure your computer before accessing the public wireless network. Failure to do so may allow unauthorized access to your laptop as well as potentially introduce viruses to your computer and/or presentation. IS&T is not responsible for computer viruses or other computer damage.

Mobile Phones and Related Devices Policy
Mobile phones, tablets, laptops, pagers, and any similar electronic devices should be silenced during conference sessions. Please exit the conference room before answering or beginning a phone conversation.

Smoking
For the health and consideration of all attendees, smoking is not permitted at any event elements, such as but not limited to: plenaries, conferences, workshops, courses, poster sessions, hosted meal functions, receptions, and in the exhibit hall. Most facilities also prohibit smoking in all or specific areas. Attendees should obey any signs preventing or authorizing smoking in specified locations.
Hold Harmless
Attendee agrees to release and hold harmless IS&T from any and all claims, demands, and causes of action arising out of or relating to your participation in the event you are registering to participate in and use of any associated facilities or hotels.

Event Cancellation
If for some unforeseen reason IS&T should have to cancel the event, registration fees processed will be refunded to registrants. Registrants will be responsible for cancellation of travel arrangements or housing reservations and the applicable fees.
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