FINAL PROGRAM

IS&T International Symposium on

Electronic Imaging

SCIENCE AND TECHNOLOGY

14–18 February 2016 • San Francisco, CA, USA

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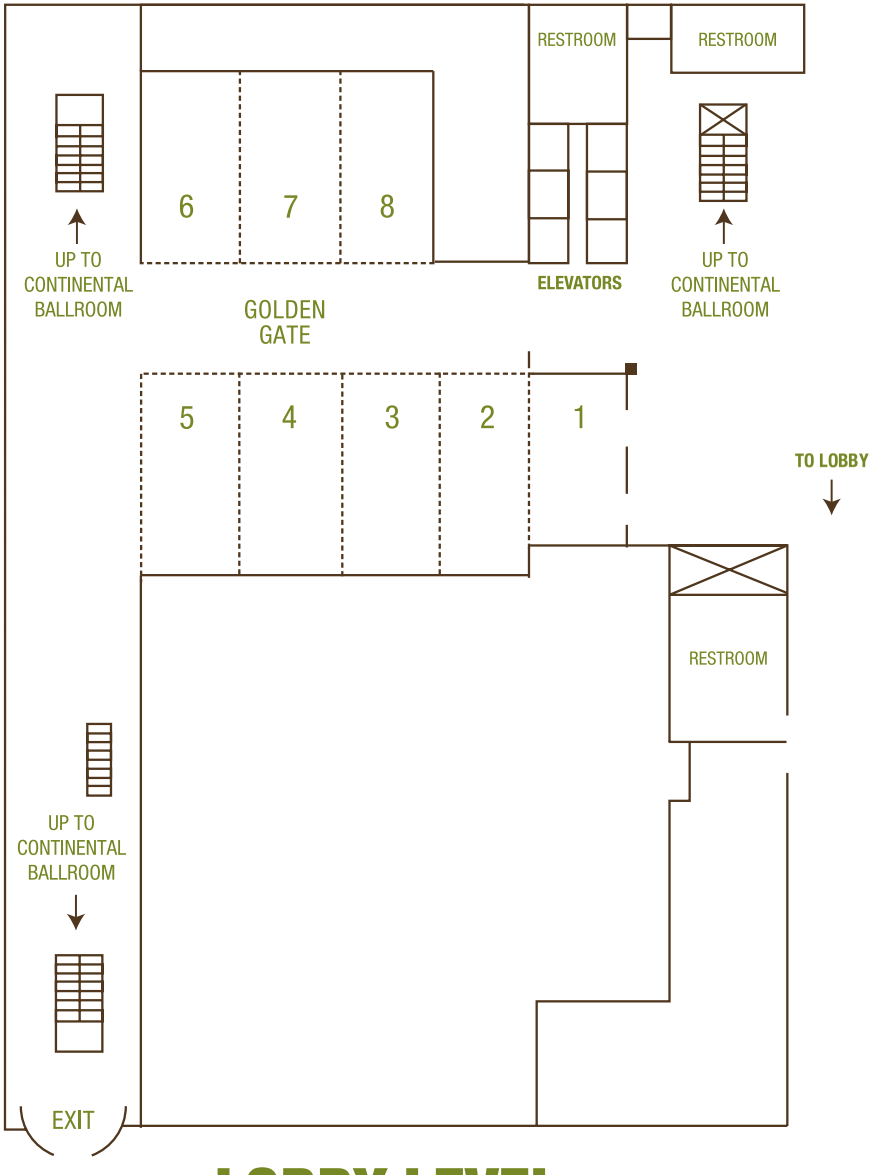
• SHORT COURSES • EXHIBITS • DEMONSTRATION SESSION • PLENARY TALKS • INTERACTIVE PAPER SESSION • SPECIAL EVENTS • TECHNICAL SESSIONS



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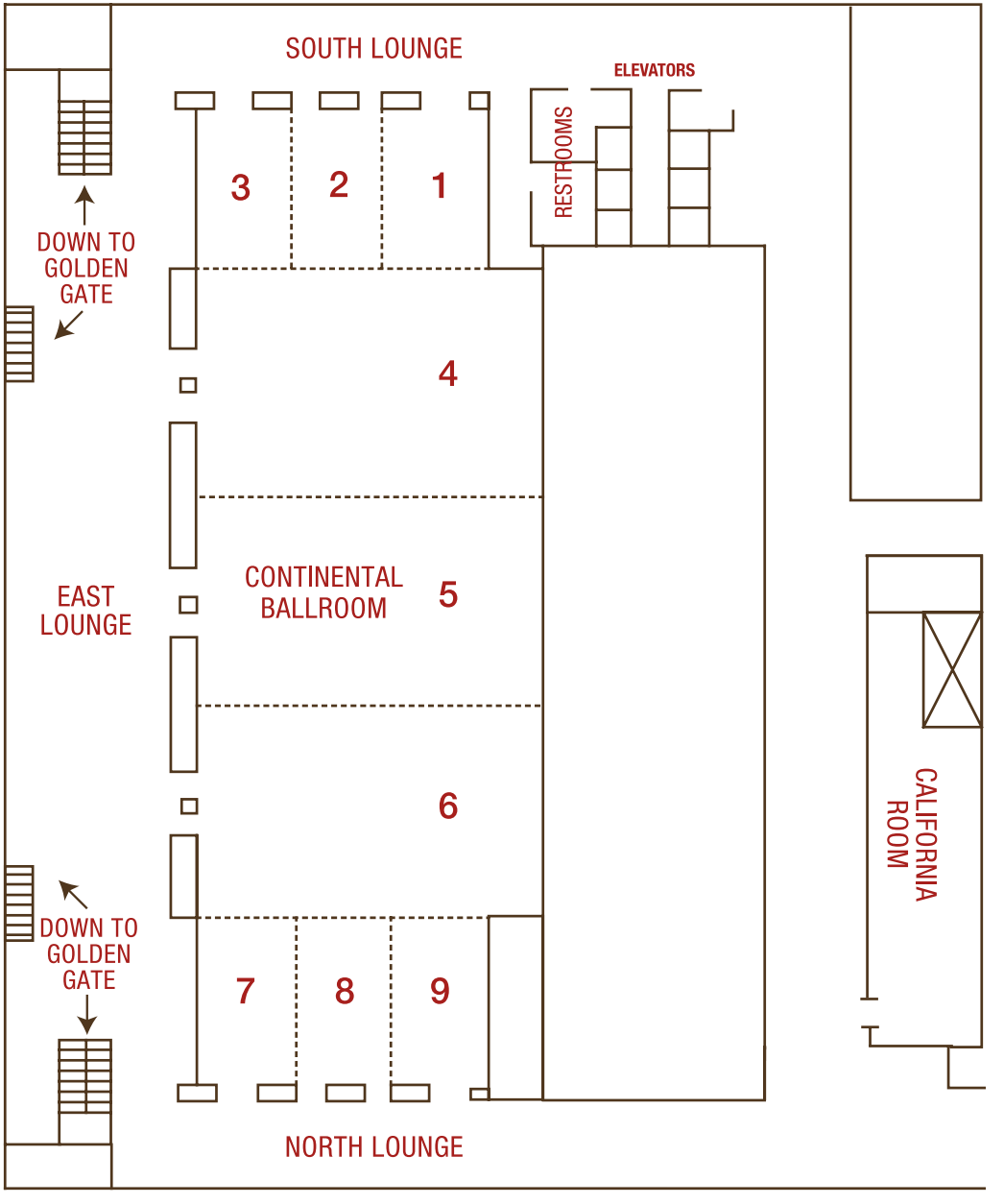

BALLROOM LEVEL

IS&T International Symposium on

Electronic Imaging

SCIENCE AND TECHNOLOGY

14–18 February 2016

Hilton San Francisco, Union Square
San Francisco, California USA

2016 Symposium Chair

Choon-Woo Kim

Inha Univ.
(Republic of Korea)

2016 Symposium Co-Chair

Nitin Sampat

Rochester Institute of Technology (USA)

2016 Short Course Chair

Majid Rabbani

Eastman Kodak Co.
(USA)

2016 Short Course Co-Chair

Mohamed-Chaker Larabi

University of Poitiers
(France)

Welcome

On behalf of IS&T—the Society for Imaging Science and Technology—we would like to welcome you to the 28th 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.

—Choon-Woo Kim and Nitin Sampat, EI2016 Symposium Co-chairs

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UPCOMING IS&T EVENTS

April 19 – 22, 2016; Washington, DC
Archiving 2016

September 12 – 16, 2016; Manchester, UK
Printing for Fabrication
32nd International Conference on Digital Printing Technologies (formerly NIP)

September 15 – 16, 2016; Manchester, UK
Technologies in Digital Photo Fulfillment

November 7 – 11, 2016; San Diego, CA
24th Color and Imaging Conference (CIC24)

Jan. 29 – Feb. 2, 2017; SFO/Burlingame, California
Electronic Imaging 2017

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

Learn more at www.imaging.org/ist/conferences/.
A complete list of imaging-related meetings is at www.imaging.org/ist/conferences/events.cfm

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Plan Now to Participate
Join us for Electronic Imaging 2017
Burlingame, California, 29 January – 2 February, 2017

Photo: Stephen Keith.

EI Symposium Leadership

EI2016 Symposium Committee

Symposium Chair
Choon-Woo Kim, Inha University (Republic of Korea)

Symposium Co-Chair
Nitin Sampat, Rochester Institute of Technology (USA)

Short Course Chair
Majid Rabbani, Eastman Kodak Co. (USA)

Short Course Co-Chair
Mohamed-Chaker Larabi, University of Poitiers (France)

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Philipp Urban, Fraunhofer Institute
Ralf Widenhorn, Portland State Univ.
Thomas Wischgoll, Wright State Univ.
Andrew J. Woods, Curtin Univ.
Dietmar Wueller, Image Engineering GmbH & Co. KG
Song Zhang, Mississippi State Univ.

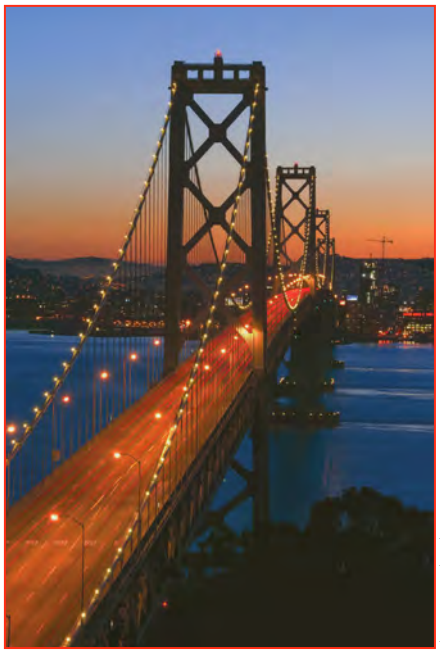

Photo: Can Balcioglu.

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)
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Symposium Overview

Explore the Future in Electronic Imaging

Please join us for the 2016 IS&T International Symposium on Electronic Imaging (EI 2016) at the Hilton San Francisco Union Square in San Francisco, California, 14–18 February 2016.

Imaging is integral to the human experience—from the personal photographs that we take every day to the professional images used in science, communication, security, transportation, education, space exploration, medical imaging, artistic expression, and entertainment. Come to EI 2016, where we discuss, learn about, and share the latest developments from across industry and academia. Meet up with your colleagues, leading researchers, and entrepreneurs from around the world.

On behalf of the Society for Imaging Science and Technology (IS&T), we invite you and your colleagues to join us at the 28th annual EI Symposium. The 2016 event features 20 technical conferences covering all aspects of electronic imaging—from image sensing to display and hardcopy to machine vision in use in transportation systems. Topics include augmented and virtual reality displays and processing; computational and digital photography; human vision, color, perception, and cognition; image and video processing; image and video communication via the web; mobile imaging; imaging sensors; image quality; media security and forensics; and machine learning.

Technical courses taught by experts from academia and industry are offered to augment the main technical program of symposium plenary, conference keynote, and 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.

Photo: Francisco Imai.

Photo: Dietmar Wueller.

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Exhibit Hours
Tuesday: 10AM–7PM
Wednesday: 10AM–4PM

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The Breadth and Synergy of Topics Covered at EI

The wide-ranging technology topics to be presented at EI 2016 are grouped as follows to help attendees get a sense of the breadth of the meeting. Within each of these groups, one or more conferences address various aspects of the assembled topics.

Human Perception and Cognition for Emerging Technologies

e.g., Human visual, auditory and tactile perception and cognition related to electronic imaging algorithms, methods, and applications; Texture and material perception; Image understanding; Task-based visualization; High-level adaptation; Psychophysiological measures of image quality; Cross-sensory perception; Visual aesthetics, art and emotion in electronic media

Image Capture Systems

e.g., Advances in traditional and non-traditional digital cameras and their image processing pipelines; Plenoptic devices; Sensors for low-light imaging; Very high dynamic range sensors and cameras; Hyperspectral sensors and cameras; Wearable multimedia systems; Mobile games; Multimedia data mining; HCI interaction design and techniques

Image Reproduction and Material Appearance

e.g., Effects of extra-spectral attributes; Applications of color hard and soft copy: medical imaging, cartography, fine arts, new communications media, knowledge delivery; Measurement of Bidirectional Reflectance Distribution Functions (BRDF), Bidirectional Texture Functions (BTF), and Bidirectional Surface Scattering Reflectance Distribution Function (BSSRDF); Quality evaluation of 2.5D and 3D soft- and hard-copy reproductions

Document Processing and Media Security

e.g., Document clustering and classification; Query languages and modalities; Pattern discovery, trend mining, topic modeling and analysis; Clustering; Media forensics and authentication; Biometrics and user identification; Physical object identification and interaction

Image and Video Processing, Quality, and Systems

e.g., Electrical resistance and impedance imaging; diffusion optical imaging; imagery-based surveillance and tracking; Readability of electronic paper and mobile displays; Image preference measurement and modeling; Medical and forensic imaging; Genetic and evolutionary computing; Steganography and data hiding; Microarray imaging; Electronic cinema; Multimedia content retrieval; Image and video compression, communications, segmentation and recognition, restoration and enhancement

Virtual and Augmented Reality, 3D, and Stereoscopic Systems

e.g., Virtual reality UI and UX; Virtual and augmented reality in education, learning, gaming, art; 3D shape indexing and retrieval; Scene analysis: from 2D views to 3D reconstruction and interpretation; Stereoscopic image synthesis: 2D to 3D conversion, depth map generation, multi-viewpoint generation; Geometry of 3D perceptual space; 3D measurement, data processing, and recognition

Real-time Image and Video

e.g., Electrical resistance and impedance imaging; Diffusion optical imaging; Imagery-based surveillance and tracking; Machine vision applications for industrial research and development; Tracking and scene analysis for intelligent vehicles; 3D vision: modeling, representation, perception, processing, and recognition; Predictive 3D vision

Web and Mobile Imaging and Visualization

e.g., Image, video, and multimedia analytics: object tracking, face recognition, human detection and tracking; Social networks: use of images and videos in social networks; Video segmentation and tracking algorithms; Bayesian models for tracking and activity monitoring; Social media; Multivariate time series visualization.

New For 2016

Greater access to papers

ALL full papers accepted for presentation at EI will be **available for free download** via the IS&T Digital Library on the IngentaConnect platform.

More joint sessions

EI 2016 highlights cross-disciplinary pursuits with a number of **new Joint Sessions** including 3D Data Hiding; Lightfield and Computational Camera Capture and Processing; Image Restoration and Filtering (deblurring, denoising); Mobile and Digital Camera Image Quality Evaluation; Perceptual Aspects of Materials; Retinex at 50; and Virtual Reality and Stereo Display Experiences. See individual conferences for listing of planned joint sessions.

More plenary talks

Three plenary talks by leaders in the field are scheduled for the week to help you broaden your knowledge of the expansive electronic imaging field. See page 7 for details.

Photo: Stephan Keith

Plenary Speakers

Illuminating a Bright Future for Medicine

Monday, February 15, 2016
2:00 – 3:00 PM
Continental Ballroom 5

Audrey (Ellerbee) Bowden (Stanford University)

Cancer. Infertility. Hearing loss. Each of these phrases can bring a ray of darkness into an otherwise happy life. The Stanford Biomedical Optics group, led by Professor Audrey Bowden, aims to develop and deploy novel optical technologies to solve interdisciplinary challenges in the clinical and basic sciences. In short, we use light to image life—and in so doing, illuminate new paths to better disease diagnosis, management and treatment. In this talk, I will discuss our recent efforts to design, fabricate and/or construct new hardware, software and systems-level biomedical optics tools to attack problems in skin cancer, bladder cancer, hearing loss and infertility. Our efforts span development of new fabrication techniques for 3D tissue-mimicking phantoms, new strategies for creating large mosaics and 3D models of biomedical data, machine-learning classifiers for automated detection of disease, novel system advances for multiplexed optical coherence tomography and low-cost technologies for point-of-care diagnostics.

Audrey K (Ellerbee) Bowden, PhD is an Assistant Professor of Electrica l Engineering at Stanford University. She received her BSE in Electrical Engineering from Princeton University, her PhD in Biomedical Engineering from Duke University and completed her postdoctoral training in Chemistry and Chemical Biology at Harvard University. During her career, Dr. Bowden spent a short time as an International Fellow at Ngee Ann Polytechnic in Singapore and as a Legislative Assistant in the United States Senate through the AAAS Science and Technology Policy Fellows Program sponsored by the OSA and SPIE. She is a member of the OSA and SPIE and is the recipient of numerous awards, including the Air Force Young Investigator Award, the NSF Career Award and the Hellman Faculty Scholars Award. Dr. Bowden currently serves on the OSA Public Policy Committee.

Dr. Bowden directs the Stanford Biomedical Optics group, whose mission is to develop and deploy novel tools for optical imaging at the microscale and nanoscale. Their applications of interest span clinical and basic science domains. The group also has a particular interest in the development of low-cost, portable technologies suited for use in poorly resourced environments. Building on their expertise and experience with interferometry, they aim to create innovative technologies that serve as integral complements to the toolkits of biologists and clinicians, as well as use their own technologies to study various cellular phenomena relevant to disease.

Pushing Computational Photography Deeper into Imaging System Design

Tuesday, February 16, 2016
2:00 – 3:00 PM
Continental Ballroom 5

Ren Ng (University of California, Berkeley)

Computational photography is pushing sophisticated computational thinking deeper into the imaging pipeline. For example, light field cameras record higher-dimensional data than conventional cameras, and enable new functionality, like depth inference, refocusing and correcting lens aberrations in post-processing. In addition to new capabilities, the architecture of computational imaging systems motivate deep changes in the design of the core subsystems: optics, sensors and processors.

Ren Ng is a faculty member in EECS at the University of California, Berkeley. His research interests are in imaging, graphics and applied mathematics, focusing on the theory and engineering of computational imaging systems. Dr. Ng was previously Founder and CEO of Lytro, Inc, and led the company to commercialize his Ph.D. research and bring consumer light field cameras to market. Ren completed his Ph.D. in computer science at Stanford University, which received the ACM Doctoral Dissertation Award and Stanford's Arthur Samuel Award. Ren has received the HIPA Photographic Research Award, PMDA Technical Achievement Award, R.I.T.'s Imaging Hall of Fame, the Selwyn Award from the Royal Photographic Society, MIT Tech Review's TR35 and Entrepreneur of the Year, Fast Company's 100 Most Creative People in Business, and Silicon Valley Journal's 40 under 40.

Intel® RealSense Technology: Adding Human-Like Sensing and Interactions to Computing Devices

Wednesday, February 17, 2016
2:00 – 3:00 PM
Continental Ballroom 5

Achin Bhowmik (Intel Corporation)

The world of intelligent and interactive technologies and applications is undergoing a revolutionary transformation. With rapid advances in natural sensing and perceptual computing technologies, we are endowing the devices and systems with the abilities to "see", "understand", and "interact" with us and the physical world. This keynote will present and demonstrate Intel® RealSense™ Technology, which is enabling a new class of interactive and immersive applications based on embedded real-time 3D visual sensing; spanning from PCs, to mobile computing devices, to intelligent autonomous machines, robotics and internet-of-things, blurring the border between the real and the virtual words.

Achin Bhowmik is vice president and general manager of the Perceptual Computing Group at Intel Corporation. He leads the development and deployment of interactive technologies and products based on natural sensing, intuitive interfaces, immersive applications and experiences, branded as Intel® RealSense™ Technology. Previously, he served as chief of staff for the Personal Computing Group, Intel's largest business unit. Earlier, he led the development of advanced video and display processing technologies for Intel's computing products. His prior work includes microdisplay technologies and electro-optical devices.

As an adjunct and guest professor, Dr. Bhowmik has advised graduate research and taught advanced sensing and human-computer interactions, computer vision and display technologies at the University of California, Berkeley, Stanford University, Liquid Crystal Institute of the Kent State University, Kyung Hee University, Seoul, and the Indian Institute of Technology, Gandhinagar. He has over 150 publications, including two books titled "Interactive Displays: Natural Human-Interface Technologies" and "Mobile Displays: Technology & Applications", and 28 granted patents.

Dr. Bhowmik is on the executive committee of the Society for Information Display (SID), and serves as the vice president of SID Americas. He is a senior member of the IEEE. He is on the board of directors for OpenCV, the organization behind the open source computer vision library.

Special Events

Women in Electronic Imaging Lunch

Monday, 15 February

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

All-Conference Welcome Reception

Continental Ballroom Foyer

Monday, 15 February, 5:00 to 6:00 PM

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

3D Theater

Continental Ballroom 5

Monday, 15 February, 6:00 to 7:30 PM

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

The 3D Theater Session at 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 at 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.

Symposium Demonstration Session

Continental Ballroom Foyer

Tuesday, 16 February, 5:30 to 7:00 PM

The highly-successful, interactive, hands-on demonstration of hardware, software, display, and research products are related to all the topics covered by the Electronic Imaging Symposium. This annual demonstration, which traditionally has showcased the largest and most diverse collection of stereoscopic research and products in one location, represents a unique networking opportunity, a time when attendees can see the latest research in action, compare commercial products, ask questions of technically knowledgeable demonstrators, and even make purchasing decisions about a range of electronic imaging products.

Industry Exhibition

Continental Ballroom Foyer

Tuesday, 16 February, 10:00 AM to 7:00 PM

Wednesday, 17 February, 10:00 AM to 4:00 PM

EI's annual industry exhibit provides a unique opportunity to meet company representatives working 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

Continental Ballroom 6

Interactive Paper Session:
Wednesday, 17 February, 5:30 to 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 Monday.

Authors are asked to set up their poster papers starting at 10:00 am on Monday. Pushpins are provided; other supplies can be obtained at the Registration Desk. Authors must remove poster papers 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 Paper Session.

Short Course Daily Schedule

See page 84 for course descriptions.

Sunday February 14						
8:00–10:00	**EI01** Burns/Williams - "Introduction to Image Quality Testing: Targets, Software and Standards"	**EI02** Matherson/ Artmann - "Color and Calibration in Mobile Imaging Devices"		**EI03** Ptucha/ Gray - "Fundamentals of Deep Learning"	**EI04** Ho - "3D Video Processing Techniques for Realistic Contents Generation"	**EI05** Rabbani - "Advanced Image Enhancement and Deblurring"
10:15–12:15	**EI06** Darmont - "Introduction to the EMVA1288 Standard"	**EI07** Rizzi/ McCann - "HDR Imaging in Cameras, Displays and Human Vision"	**EI08** Matherson/ Artmann - "Concepts, Procedures and Practical Aspects of Measuring Resolution in Mobile and Compact Imaging Devices and the Impact of Image Processing"			
1:30–5:30	**EI09** Matherson/ Artmann - "Hardware and Its Calibration in Mobile Imaging Devices"	**EI10** Sharma - "Introduction to Digital Color Imaging"		**EI11** Pulli/ Gitudhuri - "OpenVX: A Framework for Accelerating Computer Vision"	**EI12** Agam - "3D imaging"	**EI13** Darmont - "Introduction to CMOS Image Sensor Technology"
Monday February 15						
8:30–10:30	**EI14** Matherson/ Artmann - "Noise Sources at the Camera Level and the Use of International Standards for Its Characterization"	**EI15** Stork - "Joint Design of Optics and Image Processing for Imaging Systems"				
8:30–12:30						
Tuesday February 16						
8:30–12:30	**EI16** Hemami/ Pappas - "Perceptual Metrics for Image and Video Quality in a Broader Context: From Perceptual Transparency to Structural Equivalence"	**EI17** Rabbani - "Understanding and Interpreting Images"				

Keynote and Invited Talks

Monday, February 15, 2016

Measuring, Modeling, and Reproducing Material Appearance 2016

8:50 – 9:50 am
Continental Ballroom 2

MMRMA-354

Computational imaging for inverse scattering, *Ioannis Gkioulekas[1], Kavita Bala[2], Frédo Durand[3], Anat Levin[4], Shuang Zhao[5], and Todd Zickler[1]; [1]Harvard University (USA), [2]Cornell University (USA), [3]Massachusetts Institute of Technology (USA), [4]The Weizmann Institute of Science (Israel), and [5]University of California, Irvine (USA)*

Stereoscopic Displays and Applications XXVII

3:50 – 4:50 pm
Continental Ballroom 5

SDA-432

Two shipwrecks, 2500 metres underwater, six 3D cameras – let the survey begin, *Andrew Woods[1], Andrew Hutchison[1], Joshua Hollick[1], and Tim Eastwood[2]; [1]Curtin University and [2]Western Australian Museum (Australia)*

Imaging and Multimedia Analytics in a Web and Mobile World 2016

10:30 – 11:30 am
Golden Gate 8

IMAWM-458

Browsing heterogeneous multimedia social networks contents on mobile devices, *Chang Wen Chen, State University of New York at Buffalo (USA)*

Tuesday, February 16, 2016

Media Watermarking, Security, and Forensics 2016

3:30 – 4:30 pm
Continental Ballroom 3

MWSF-081

Security, privacy, and regulatory challenges of unmanned aerial vehicle integration, *Evan Carr, AppFolio Inc. (USA)*

Computational Imaging XIV

8:50 – 9:50 am
Golden Gate 1

COIMG-147

Indoor and outdoor image based localization for mobile devices, *Avideh Zakhor, University of California, Berkeley (USA)*

Image Quality and System Performance XIII

8:50 – 9:40 am
Golden Gate 5

IQSP-205

Objective image quality assessment: Facing the real-world challenges, *Zhou Wang, University of Waterloo (Canada)*

Image Quality and System Performance XIII

10:40 – 11:20 am
Continental Ballroom 2

MMRMA-368

Refractive object reconstruction using computational imaging, *Gordon Wetzstein, Stanford University (USA)*

Stereoscopic Displays and Applications XXVII

3:30 – 4:30 pm
Continental Ballroom 5

SDA-443

3-D movie rarities, *Robert Furmanek and Greg Kintz, 3-D Film Archive (USA)*

Imaging and Multimedia Analytics in a Web and Mobile World 2016

10:30 – 11:10 am
Golden Gate 8

IMAWM-467

Deep 3D shape representation, *Yi Fang, New York University Abu Dhabi (USA)*

Visualization and Data Analysis 2016

10:40 – 11:40 am
Golden Gate 3

VDA-479

Visualization for the masses, redux, *Alex Pang, University of California at Santa Cruz (USA)*

Wednesday, February 17, 2016

Human Vision and Electronic Imaging (HVEI) 2016

8:50 – 9:50 am
Continental Ballroom 4

HVEI-091

Towards a rudimentary neural model of multisensory integration in human neocortex, *John Foxe[1] and Sophie Molholm[2]; [1]University of Rochester Medical Center and [2]Albert Einstein College of Medicine (USA)*

Digital Photography and Mobile Imaging XII

9:30 – 10:10 am
Golden Gate 6/7

DPMI-250

Photo editing on mobile devices, *Sylvain Paris, Adobe (USA)*

Intelligent Robots and Computer Vision XXXIII: Algorithms and Techniques

9:10 – 9:50 am
Golden Gate 8

ROBVIS-390

The 23rd Annual Intelligent Ground Vehicle Competition: Building engineering students into robotists, *Bernard Theisen, US Army TARDEC (USA)*

Thursday, February 18, 2016

Document Recognition and Retrieval XXIII

8:40 – 10:20 am
Continental Ballroom 2

DRR-059

OCR at Google: Books and Beyond, *Yasuhisa Fujii, Dmitriy Genzel, Otavio Good, Patrick Hurst, Yuanpeng Li, Ashok Popat, and Ray Smith, Google Inc. (USA)*

Human Vision and Electronic Imaging (HVEI) 2016

8:50 – 9:40 am
Continental Ballroom 4

HVEI-130

Optimizing for visual cognition in high performance scientific computing, *Colin Ware, University of New Hampshire (USA)*

Human Vision and Electronic Imaging (HVEI) 2016

1:50 – 2:40 pm
Continental Ballroom 4

HVEI-137

Lessons learned from the colorization and 3D conversion of feature films and how they can be applied to the emerging mediums of virtual and augmented reality: A creative, consumer and neuroscience perspective, *Barry Sandrew, Augmented Vision Works (USA)*

Color Imaging XXI: Displaying, Processing, Hardcopy, and Applications

2:00 – 2:30 pm
Continental Ballroom 1

COLOR-345

Vision security – the role of imaging, *Marius Pedersen and Jon Yngve Hardeberg, Gjøvik University College (Norway)*

Joint Sessions

Monday, February 15, 2016

DPMI/IQSP: Mobile and Digital Camera Image Quality Evaluation

Session Chair: Joyce Farrell, Stanford University (United States)

10:40 am – 12:30 pm

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

Conference Opening Remarks
Image stabilization performance – existing standards and the challenges for mobile imaging, *Uwe Artmann and Philipp Feldker, Image Engineering GmbH & Co KG (Germany)*

Image flare measurement according to ISO 18844, *Dietmar Wueller, Image Engineering GmbH & Co. KG (Germany)*

MTF measurements of wide field of view cameras, *Boyd Fowler, Vlad Cardei, and Sam Kavusi, Google (United States)*

Method for quantifying image sensor susceptibility to chromatic flare artifacts, *Orit Skorka, Dave Jasinski, Radu Ispasoiu, and Vladi Koborov, ON Semiconductor (USA)*

"Which factor is more important in obtaining good capture characterization, and, consequently, render higher color accuracy: the characterization of the camera's sensor, or the characterization of illuminant?", *Nitin Sampat and Stephen Viggiano, Rochester Institute of Technology (United States)*

DPMI/IQSP: Image Capture I

Session Chair: Dietmar Wueller, Image Engineering (Germany)

3:30 – 5:00 pm

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

Adaptive geometric calibration correction for camera array, *Florian Ciurea, Dan Lelescu, and Priyam Chatterjee, Pelican Imaging (United States)*

A filter design approach for consistent image quality, *Ahmed Eid, Michael Phelps, and Brian Cooper, Lexmark International (United States)*

Linearization and normalization in spatial frequency response measurement, *Uwe Artmann, Image Engineering GmbH & Co KG (Germany)*

Optimized tone curve for in-camera image processing, *Praveen Cyriac, David Kane, and Marcelo Bertalmío, Universitat Pompeu Fabra (Spain)*

Tuesday, February 16, 2016

Color/HVEI: Retinex at 50: History

Session Chair: Marcelo Bertalmío, Universitat Pompeu Fabra (Spain)

8:50 – 10:10 am

This session is jointly sponsored by: Color Imaging XXI: Displaying, Processing, Hardcopy, and Applications, and Human Vision and Electronic Imaging (HVEI) 2016.

Retinexes algorithms: many spatial processes used to solve many different problems (invited), *John McCann, McCann Imaging (United States)*

Designator Retinex, Milano Retinex and the locality issue (invited), *Alessandro Rizzi, Università degli Studi di Milano (Italy)*

DPMI/IPAS: Image Filtering and Denoising

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

8:50 – 10:10 am

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

Intelligent image filtering using multilayer neural network with multi-valued neurons, *Igor Aizenberg, Texas A&M University-Texarkana (United States)*

Robust extensions to guided image filtering, *Oleg Michailovich, University of Waterloo (Canada)*

Local denoising applied to RAW images may outperform non-local patch-based methods applied to the camera output, *Gabriela Ghimpeteanu[1], Thomas Batard[1], Tamara Seybold[2], and Marcelo Bertalmío[1]; [1]University Pompeu Fabra (Spain) and [2]ARRI Arnold & Richter Cine Technik GmbH & Co. Betriebs KG (Germany)*

Use of flawed and ideal image pairs to drive filter creation by genetic programming, *Subash Sridhar, Henry Dietz, and Paul Eberhart, University of Kentucky (United States)*

COLOR/HVEI: Retinex at 50: Spatial Algorithms

Session Chair: John McCann, McCann Imaging (United States)

10:50 am – 12:30 pm

This session is jointly sponsored by: Color Imaging XXI: Displaying, Processing, Hardcopy, and Applications, and Human Vision and Electronic Imaging (HVEI) 2016.

The Oriented Difference of Gaussians model of brightness perception (invited), *Mark McCourt and Barbara Blakeslee, North Dakota State University (United States)*

A center-surround framework for spatial image processing, *Vassilios Vonikakis, Advanced Digital Sciences Center (ADSC) (Singapore)*

Retinex-like computations in human lightness perception and their possible realization in visual cortex (invited), *Michael Rudd, University of Washington (United States)*

The role of lightness perception in determining the perceived contrast of real world scenes (invited), *David Kane and Marcelo Bertalmío, Univ. Pompeu Fabra (Spain)*

Processing astro photographs using Retinex based methods (invited), *Daniele Marini, Alessandro Rizzi, and Cristian Bonanomi, Università degli Studi di Milano (Italy)*

DPMI/IPAS: Color Filter Array Interpolation and Superresolution

Session Chairs: Atanas Gotchev, Tampere University of Technology (Finland) and Ajit S. Bopardikar, Samsung R&D Institute India-Bangalore (India)

10:50 am – 12:30 pm

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

Optimal transparent wavelength and arrangement for multispectral filter array, *Yudai Yanagi[1], Kazuma Shinoda[1], Madoka Hasegawa[1], Shigeo Kato[1], Masahiro Ishikawa[2], Hideki Komagata[2], and Naoki Kobayashi[2]; [1]Utsunomiya Univ. and [2]Saitama Medical Univ. (Japan)*

Multi-spectrum to RGB with direct structure-tensor reconstruction, *Takashi Shibata[1,2], Masayuki Tanaka[1], and Masatoshi Okutomi[1]; [1]Tokyo Institute of Technology and [2]NEC corporation (Japan)*

Edge-directional interpolation algorithm using structure tensor, *Andrey Nasonov[1], Andrey Krylov[1], Xenya Petrova[2], and Michael Rychagov[2]; [1]Lomonosov Moscow State University and [2]Samsung R&D Institute Rus (Russian Federation)*

Fast edge-directed single-image super-resolution, *Mushfiqur Rouf[1], Dikpal Reddy[2], Kari Pulli[2], and Rabab Ward[3]; [1]University of British Columbia (Canada) and [2]Light co (United States)*

Light-weight single image super-resolution via pattern-wise regression function, *Kohei Kurihara[1], Yoshitaka Toyoda[1], Shotaro Moriya[2], Daisuke Suzuki[1], Takeo Fujita[1], Narihiro Matoba[1], Jay Thornton[3], and Fatih Porikli[4]; [1]Mitsubishi Electric Corporation (Japan), [3]Mitsubishi Electric Research Laboratories (MERL) (USA), and [4]Australian National University (Australia)*

Wednesday, February 17, 2016

HVEI/IQSP: Keynote: Perception and Quality

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

8:50 – 9:40 am

This session is jointly sponsored by: Image Quality and System Performance XIII, and Human Vision and Electronic Imaging (HVEI) 2016.

Up Periscope! Designing a new perceptual metric for imaging system performance, *Andrew Watson, NASA Ames Research Center (United States)*

3DIPM/SDA: Stereoscopic Image Processing and Depth Mapping

Session Chairs: William Puech, University of Montpellier (France) and Michael Weissman, TrueVision Systems (United States)

10:50 am – 12:30 pm

This session is jointly sponsored by: Stereoscopic Displays and Applications XXVII and 3D Image Processing, Measurement (3DIPM), and Applications 2016.

Geometrically constrained sub-pixel disparity estimation from stereo images of the retinal fundus, *Mohamad Kharboutly, Carlos Vazquez, Stéphane Coulombe, and Jacques De Guise, école de technologie supérieure (Canada)*

3D autostereoscopic display image generation using direct light field rendering, *Young Ju Jeong and Hyunsung Chang, Samsung Advanced Institute of Technology (South Korea)*

A new hole filling method based on 3D geometric transformation for synthesized image, *Hak Gu Kim and Yong Man Ro, Korea Advanced Institute of Science and Technology (South Korea)*

Blue noise sampling of surfaces from stereoscopic images, *Frederic Payan, Jean-Luc Peyrot, and Marc Antonini, Laboratory I3S, University Nice - Sophia Antipolis and CNRS (France) - UMR 7271 (France)*

3D image warping based on linear disparity mapping, *Riddhi Ray Chaudhuri and Prabir Kumar Biswas, Indian Institute of Technology (India)*

DPMI/IPAS/VIPC: Blur Removal and Synthesis

Session Chair: Radka Tezaur, Nikon Research Corporation of America (United States)

10:50 am – 12:30 pm

This session is jointly sponsored by: Digital Photography and Mobile Imaging XII, Image Processing: Algorithms and Systems XIV, and Visual Information Processing and Communication VII.

Multi-image sparse motion-invariant photography, *Bart Kofoed[1,2], Peter de With[1], and Eric Janssen[2]; [1]Eindhoven Univ. of Technology and [2]Prodrive Technologies (Netherlands)*

Virtual DSLR: high quality dynamic depth-of-field synthesis on mobile platforms, *Yang Yang[1], Haiting Lin[1], Zhan Yu[2], Sylvain Paris[2], and Jingyi Yu[1]; [1]University of Delaware and [2]Adobe (United States)*

Robust blur estimation for blind image deblurring, *Jan Kotera[1,2] and Filip Šroubek[1]; [1]UTIA and [2]Charles University (Czech Republic)*

Motion deblurring for depth-varying scenes, *Ruiwen Zhen and Robert Stevenson, Univ. of Notre Dame (United States)*

ERVR/SDA: Virtual Reality and 3D

Session Chairs: Margaret Dolinsky, Indiana University (United States) and Chris Ward, Lightspeed Design, Inc. (United States)

3:30 – 5:30 pm

This session is jointly sponsored by: Stereoscopic Displays and Applications XXVII, and The Engineering Reality of Virtual Reality 2016.

LEIA 3D: holographic reality, *David Fattal, LEIA Inc. (United States)*

Effect of inter-lens distance on fusional limit in stereoscopic vision using a simple smartphone head-mounted display, *Hiroyuki Morikawa[1,2], Yoshihiro Banchi[2], Shota Tsukada[2], Yusuke Hasegawa[2], Suguru Takahashi[2], Kaiji Ohta[3], and Takashi Kawai[2]; [1]Aoyama Gakuin University, [2]Waseda Univiersity, and [3]International Christian University (Japan)*

Investigating intermittent stereoscopy: its effects on perception and visual fatigue, *Ari Bouaniche and Laure Leroy, Université Paris 8 (France)*

Stereoscopy-based procedural generation of virtual environments, *Manlio Scalabrin, Laura Anna Ripamonti, Dario Maggiorini, and Davide Gadia, University of Milan (Italy)*

Beyond fun and games: VR as a tool of the trade, *Carolina Cruz-Neira and Dirk Reiners, University of Arkansas (USA)*

SD&A Conference Closing Remarks

Thursday, February 18, 2016

3DIPM/IPAS: 3D Scene Sensing and Object Recording

Session Chair: Robert Sitnik, Warsaw University of Technology (Poland)

10:40 am – 12:10 pm

This session is jointly sponsored by: 3D Image Processing, Measurement (3DIPM), and Applications 2016, and Image Processing: Algorithms and Systems XIV.

Joint Session Introduction

Shadow detection on 3D point cloud, *Shuyang Sheng and B. Keith Jenkins, Univ. of Southern California (United States)*

Im2Fit: fast 3D model fitting and anthropometrics using single consumer depth camera and synthetic data, *Qiaosong Wang[1], Vignesh Jagadeesh[2], Bryan Ressler[3], and Robinson Piramuthu[3]; [1]University of Delaware, [2]Apple Inc., and [3]eBay Inc. (United States)*

Human detection from still depth images, *Gulsum Can and Helin Dutagaci, Eskisehir Osmangazi University (Turkey)*

Tracking the guitarist's fingers as well as recognizing pressed chords from a video sequence, *Zhao Wang and Jun Ohya, Waseda Univ. (Japan)*

3DIPM/IMSE: Image Sensors and Systems for 3D Imaging

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

1:50 – 3:20 pm

This session is jointly sponsored by: Image Sensors and Imaging Systems 2016, and 3D Image Processing, Measurement (3DIPM), and Applications 2016.

Joint conference introduction

A time-of-flight CMOS range image sensor using 4-tap output pixels with lateral-electric-field control, *Taichi Kasugai[1], Sang-Man Han[1], Hanh Trang[1], Taishi Takasawa[1], Satoshi Aoyama[2], Keita Yasutomi[1], Keiichiro Kagawa[1], and Shoji Kawahito[1]; [1]Shizuoka Univ. and [2]Brookman Technology (Japan)*

Design, implementation and evaluation of a TOF range image sensor using multi-tap lock-in pixels with cascaded charge draining and modulating gates, *Trang Nguyen[1], Taichi Kasugai[1], Keigo Isobe[2], Sang-Man Han[1], Taishi Takasawa[1], De Xing Lioe[1], Keita Yasutomi[1], Keiichiro Kagawa[1], and Shoji Kawahito[1]; [1]Shizuoka Univ. and [2]Brookman Technology (Japan)*

Markerless motion capture with multi-view structured light, *Ricardo Garcia and Avideh Zakhor, Univ. of California, Berkeley (United States)*

Towards automated, high resolution 3D scanning of large surfaces for cultural heritage documentation, *Robert Sitnik[1], Eryk Bunsch[2], Grzegorz Maczkowski[1], Wojciech Zaluski[1], Krzysztof Lech[1], Jakub Michonski[1], and Jakub Krzeslowski[1]; [1]Warsaw University of Technology and [2]Museum of King Jan III's Palace at Wilanów (Poland)*

Human Vision and Electronic Imaging (HVEI) 2016

Conference grouping: Human Perception and Cognition for Emerging Technologies
Conferences in this grouping discuss human visual, auditory and tactile perception, and cognition related to electronic imaging algorithms, methods, and applications; texture and material perception; image understanding; task-based visualization; other topics. Special topics this year include: high-level adaptation, psychophysiological measures of image quality, cross-sensory perception, and visual aesthetics, art and emotion in electronic media.

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/Poster Award

Joint Sessions: **Perception and Quality** with the Image Quality and System Performance Conference and **Retinex at 50** with the Color Imaging: Displaying, Processing, Hardcopy, and Applications Conference.

Events: Monday evening HVEI Banquet and Talk; Museum Field Trip; End-of-Day Discussions; and Panel Discussions.

Photo: Stephan Keith.

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

Program Committee: **Albert J. Ahumada,** NASA Ames Research Ctr. (USA); **Jan P. Allebach,** Purdue Univ. (USA); **Erhardt Barth,** Univ. zu Lübeck (Germany); **Walter R. Bender,** Sugar Labs (USA); **Michael H. Brill,** Datacolor (USA); **Kjell Brunnstrom,** ACREO (Sweden); **Damon M. Chandler,** Oklahoma State Univ. (USA); **John C. Dalton,** Synthetik Software (USA); **Scott J. Daly,** Dolby Labs., Inc. (USA); **Ulrich Engelke,** Commonwealth Scientific and Industrial Research Organisation (Australia); **Elena A. Fedorovskaya,** Rochester Institute of Technology (USA); **James A. Ferwerda**, Rochester Institute of Technology (USA); **Jennifer L. Gille,** Qualcomm Technologies Inc. (USA); **Sergio R. Goma,** Qualcomm Technologies Inc. (USA); **Sheila S. Hemami,** Northeastern Univ. (USA); **Hari Kalva,** Florida Atlantic Univ. (USA); **Stanley A. Klein,** Univ. of California, Berkeley (USA); **Patrick Le Callet,** Univ. de Nantes (France); **Lora T. Likova,** The Smith-Kettlewell Eye Research Institute (USA); **Monica Lopez-Gonzalez,** La Petite Noiseuse Productions (USA); **John J. McCann,** McCann Imaging (USA); **Mark E. McCourt,** North Dakota State Univ. (USA); **Jeffrey B. Mulligan,** NASA Ames Research Ctr. (USA); **Karol Myszkowski,** Max-Planck-Institut für Informatik (Germany); **Adar Pelah,** The Univ. of York (UK); **Eliezer Peli,** Schepens Eye Research Institute (USA); **Judith A. Redi,** Technische Univ. Delft (the Netherlands); **Hawley K. Rising,** Consultant (USA); **Sabine Süsstrunk,** École Polytechnique Fédérale de Lausanne (Switzerland); **Christopher W. Tyler,** The Smith-Kettlewell Eye Research Institute (USA); **Andrew B. Watson,** NASA Ames Research Ctr. (USA); and **Michael A. Webster,** Univ. of Nevada, Reno (USA)

Human Vision and Electronic Imaging (HVEI) 2016

Monday, February 15, 2016

Welcome and Keynote Session 1:
The Neuroscience of Multisensory Processing
Session Chairs: Bernice Rogowitz, Visual Perspectives (USA); Thrasyvoulos Pappas, Northwestern University (USA); and Huib de Ridder, Delft University of Technology (Netherlands)
8:50 – 9:50 am
Continental Ballroom 4
HVEI Conference Welcome

HVEI-091
Towards a rudimentary neural model of multisensory integration in human neocortex, *John Foxe[1] and Sophie Molholm[2]; [1]University of Rochester Medical Center and [2]Albert Einstein College of Medicine (USA)*

Multisensory Interactions

Session Chairs: Mark McCourt, North Dakota State University (USA) and Lora Likova, Smith-Kettlewell Eye Research Institute (USA)

9:50 – 10:20 am
Continental Ballroom 4

9:50 HVEI-092
Multisensory development and plasticity: From neurons to the clinic (Invited), *Mark Wallace, Vanderbilt University (USA)*

10:20 – 10:50 am Coffee Break

Multisensory Interactions (continued)

Session Chairs: Mark McCourt, North Dakota State University (USA) and Lora Likova, Smith-Kettlewell Eye Research Institute (USA)

10:50 – 12:30 am
Continental Ballroom 4

10:50 HVEI-093
Psychophysical investigations into Ramachandran's mirror and visual feedback for phantom limb pain: Video-based variants for unilateral and bilateral amputees, and temporal dynamics of paresthesias (Invited), *David Peterzell, John F. Kennedy University (USA)*

11:10 HVEI-094
Language processing in congenitally blind people (Invited), *Krish Sathian[1,2], Valeria Occelli[1], Simon Lacey[1], and Randall Stilla[1]; [1]Emory University and [2]Atlanta VAMC (USA)*

11:30 HVEI-095
High-order multisensory mechanisms: Insights from Braille writing and reading (Invited), *Lora Likova, Christopher Tyler, Kristyo Mineff, Laura Caciamani, and Spero Nicholas, Smith-Kettlewell Eye Research Institute (USA)*

11:50 HVEI-096
Blind individuals represent the auditory space in egocentric rather than allocentric reference frame (Invited), *Tiziana Vercillo[1] and Monica Gori[2]; [1]University of Nevada, Reno (USA) and [2]Fondazione Istituto Italiano di Tecnologia (Italy)*

12:10 HVEI-097
Individual differences in multisensory integration and timing (Invited), *Elliot Freeman and Alberta Ipser, City University London (United Kingdom)*

12:30 – 2:00 pm Lunch Break

EI 2016 Opening Plenary and Symposium Awards
Session Chair: Choon-Woo Kim (Inha University)
2:00 – 3:00 PM
Continental Ballroom 5

Illuminating a bright future for medicine, *Audrey K. Bowden, Stanford University (USA)*

3:00 – 3:30 pm Coffee Break

Multisensory Interactions (continued)

Session Chairs: Mark McCourt, North Dakota State University (USA) and Lora Likova, Smith-Kettlewell Eye Research Institute (USA)

3:30 – 4:30 pm
Continental Ballroom 4

3:30 HVEI-098
Beyond the predominance of the visual empire: A functional model on haptics & more (Invited), *Claus-Christian Carbon[1,2,3]; [1]University of Bamberg, [2]Forschungsgruppe EPAEG, and [3]Bamberg Graduate School of Affective and Cognitive Sciences (Germany)*

3:50 HVEI-099
Visual-tactile integration during active touch (Invited), *Cintia Martins and Qi Wang, Columbia University (USA)*

4:10 HVEI-100
Evaluating the effectiveness of auditory and tactile surface graphs for the visually impaired, *James Ferwerda[1], Vladimir Bulatov[2], and John Gardner[2]; [1]Rochester Institute of Technology and [2]ViewPlus Technologies (USA)*

HVEI Monday Author Discussion Session
Moderators: Bernice Rogowitz, Visual Perspectives (USA); Thrasyvoulos Pappas, Northwestern University (USA); and Huib de Ridder, Delft University of Technology (Netherlands)
4:30 – 5:30 pm
Continental Ballroom 4

5:00 – 6:00 pm EI 2016 Symposium Reception

HVEI Banquet
Conference Chairs: Bernice Rogowitz, Visual Perspectives (USA); Thrasyvoulos Pappas, Northwestern University (USA); and Huib de Ridder, Delft University of Technology (Netherlands)
7:30 – 10:30 pm
TBA at Registration

HVEI-101
Bach to the blues: Color, music, emotion, and synesthesia, *Stephen Palmer, University of California (USA)*

Tuesday, February 16, 2016

COLOR/HVEI: RETINEX at 50: History Joint Session

Session Chair: Marcelo Bertalmio, Universitat Pompeu Fabra (Spain)

8:50 – 10:10 am
Continental Ballroom 4

This session is jointly sponsored by: Color Imaging XXI: Displaying, Processing, Hardcopy, and Applications, and Human Vision and Electronic Imaging (HVEI) 2016.

8:50 RETINEX-017
Retinexes algorithms: Many spatial processes used to solve many different problems (Invited), *John McCann, McCann Imaging (USA)*

9:30 RETINEX-018
Designator Retinex, Milano Retinex and the locality issue (Invited), *Alessandro Rizzi, Università degli Studi di Milano (Italy)*

10:10 – 10:50 am Coffee Break

COLOR/HVEI: RETINEX at 50: Spatial Algorithms Joint Session

Session Chair: John McCann, McCann Imaging (USA)

10:50 am – 12:30 pm
Continental Ballroom 4

This session is jointly sponsored by: Color Imaging XXI: Displaying, Processing, Hardcopy, and Applications, and Human Vision and Electronic Imaging (HVEI) 2016.

10:50 RETINEX-019
The oriented difference of Gaussians model of brightness perception (Invited), *Mark McCourt and Barbara Blakeslee, North Dakota State University (USA)*

11:10 RETINEX-020
A center-surround framework for spatial image processing, *Vassilios Vonikakis, Advanced Digital Sciences Center (ADSC) (Singapore)*

11:30 RETINEX-021
Retinex-like computations in human lightness perception and their possible realization in visual cortex (Invited), *Michael Rudd, University of Washington (USA)*

11:50 RETINEX-022
The role of lightness perception in determining the perceived contrast of real world scenes (Invited), *David Kane and Marcelo Bertalmio, Universitat Pompeu Fabra (Spain)*

12:10 RETINEX-023
Processing astro photographs using Retinex based methods (Invited), *Daniele Marini, Alessandro Rizzi, and Cristian Bonanomi, Università degli Studi di Milano (Italy)*

12:30 – 2:00 pm Lunch Break

EI 2016 Tuesday Plenary and Symposium Awards
Session Chair: Nitin Sampat (Rochester Institute of Technology)
2:00 – 3:00 PM
Continental Ballroom 5

Pushing computational photography deeper into imaging system design, *Ren Ng, University of California, Berkeley (USA)*

3:00 – 3:30 pm Coffee Break

Image Quality from Threshold to Experience

Session Chairs: Thrasyvoulos Pappas, Northwestern University (USA) and Huib de Ridder, Delft University of Technology (Netherlands)

3:30 – 6:10 pm
Continental Ballroom 4

3:30 HVEI-102
The pyramid of visibility, *Andrew Watson and Albert Ahumada, NASA Ames Research Ctr. (USA)*

3:50 HVEI-103
Perceptual image quality assessment using a normalized Laplacian pyramid, *Valero Laparra[1,2], Johannes Ballé[2,3], Alexander Berardino[2], and Eero Simoncelli[2,3]; [1]Universitat de Valencia (Spain), [2]New York University (USA), and [3]Howard Hughes Medical Institute (USA)*

4:10 HVEI-104
A method for rapid measurement of contrast sensitivity on mobile touch-screens, *Jeffrey Mulligan, NASA Ames Research Ctr. (USA)*

4:30 HVEI-105
Subjective analysis and objective characterization of adaptive bitrate videos, *Jacob Søgaard[1], Samira Tavakoli[2], Kjell Brunnstrom[3,4], and Narciso Garcia[2]; [1]Technical University of Denmark (Denmark), [2]Universidad Politécnica de Madrid (Spain), [3]Acreo Swedish ICT, and [4]Mid Sweden University (Sweden)*

4:50 HVEI-106
Assessing visibility of individual transmission errors in networked video, *Jari Korhonen and Claire Mantel, Technical University of Denmark (Denmark)*

5:10 HVEI-107
Visual saliency in HEVC video stream, *Marwa Ammar[1], Mihai Mitrea[1], Ismail Boujelben[1], and Patrick Le Callet[2]; [1]Telecom Sud Paris and [2]Polytech Nantes/Université de Nantes (France)*

5:30 HVEI-108
Perceptual flicker visibility prediction model, *Lark Kwon Choi and Alan Bovik, The University of Texas at Austin (USA)*

5:50 HVEI-109
Does visual quality depend on semantics? A study on the relationship between impairment annoyance and image semantics at early attentive stages, *Judith Redi, Ernestasia Siahaan, and Alan Hanjalic, Technische Universiteit Delft (Netherlands)*

EI 2016 Symposium Demonstration Session and Exhibit Hall Happy Hour
5:30 – 7:00 PM
Continental Ballroom Foyer

HVEI Tuesday Author Discussion Session
Moderators: Bernice Rogowitz, Visual Perspectives (USA); Thrasyvoulos Pappas, Northwestern University (USA); and Huib de Ridder, Delft University of Technology (Netherlands)
6:10 – 7:10 pm
Continental Ballroom 4

Wednesday, February 17, 2016

IQSP/HVEI: Keynote: Perception and Quality Joint Session

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

8:50 – 9:40 am
Continental Ballroom 4

This session is jointly sponsored by: Image Quality and System Performance XIII, and Human Vision and Electronic Imaging (HVEI) 2016.

8:50 IQSP-029
Up Periscope! Designing a new perceptual metric for imaging system performance, *Andrew Watson, NASA Ames Research Center (USA)*

Perceptual Image Analysis

Session Chair: Bernice Rogowitz, Visual Perspectives (USA)

9:40 – 10:20 am
Continental Ballroom 4

9:40 HVEI-110
Hierarchical Manifold Sensing with foveation and adaptive partitioning of the dataset (JIST-first), *Irina Burciu, Thomas Martinetz, and Erhardt Barth, University of Lübeck (Germany)*

10:00 HVEI-111
Comparing object recognition from binary and bipolar edge features, *Jae-Hyun Jung[1], Tian Pu[1,2], and Eliezer Peli[1]; [1]Schepens Eye Research Institute/Mass. Eye and Ear, Harvard Medical School (USA) and [2]University of Electronic Science and Technology of China (China)*

10:20 – 10:50 am Coffee Break

Individual Differences in Perceptual Judgments

Session Chairs: Michael Webster, University of Nevada, Reno (USA) and David Peterzell, John F. Kennedy University (USA)

10:50 am – 12:40 pm
Continental Ballroom 4

10:50 HVEI-112
Discovering sensory processes using individual differences: A review and factor analytic manifesto (Invited), *David Peterzell, John F. Kennedy University (USA)*

11:10 HVEI-113
Individual differences in perceptual preferences: The role of "good fit" (Invited), *Stephen Palmer[1], Karen Schloss[2], and William Griscom[3]; [1]University of California, Berkeley, [2]Brown University, and [3]Microsoft Corporation (USA)*

11:40 HVEI-114
Individual differences in color naming (Invited), *Delwin Lindsey and Angela Brown, Ohio State University (USA)*

12:00 HVEI-115
Using individual differences to better determine normative responses from crowdsourced transcription tasks: An application to the R. E. MacLaury Color Categorization Archive (Invited), *Kimberly Jameson, Prutha Deshpande, Sean Tauber, Stephanie Chang, Nathanial Benjamin, Yang Jiao, and Sergio Gago, University of California, Irvine (USA)*

12:20 HVEI-116
Individual differences in lifetime face exposure predict behavioral and neural responses to faces (Invited), *Benjamin Balas and Corey Grant, North Dakota State University (USA)*

12:40 – 2:00 pm Lunch Break

EI 2016 Wednesday Plenary and Symposium Awards
Session Chair: Choon-Woo Kim (Inha University)
2:00 – 3:00 PM
Continental Ballroom 5

Intel® RealSense Technology: Adding human-like sensing and interactions to computing devices, *Achin Bhowmik, Intel Corporation (USA)*

3:00 – 3:20 pm Coffee Break

Human Vision and Electronic Imaging (HVEI) 2016 Interactive Papers Oral Previews

Session Chair: Jeffrey Mulligan, NASA Ames Research Ctr. (USA)

3:20 – 3:30 pm
Continental Ballroom 4

In this session interactive poster authors will each provide a brief oral preview of their poster presentation, which will be presented fully in the Human Vision and Electronic Imaging (HVEI) 2016 Interactive Papers Session at 5:30 pm on Wednesday.

3:20 HVEI-117
Role of spatio-temporal distortions in the visual periphery in disrupting natural attention deployment, *Yashas Rai K, Marcus Barkowsky, and Patrick Le Callet, University of Nantes (France)*

3:21 HVEI-118
Reducing inattentional blindness using subliminal cues in visual performance tasks, *Deepti Pappusetty and Hari Kalva, Florida Atlantic University (USA)*

3:22 HVEI-119
Evaluation of aesthetic appeal with regard of user's knowledge, *Pierre Lebreton[1], Alexander Raake[1], and Marcus Barkowsky[2]; [1]Technische Universität Ilmenau (Germany) and [2]Université de Nantes (France)*

3:23 HVEI-120
Visually-based sensations: From perception to the 'wow factor', *Floris van Nes, Eindhoven University. of Technology; TU/e (Netherlands)*

3:24 HVEI-121
Image segmentation using fuzzy spatial-taxon cut: comparison of two different stage one perception based input models of color (Bayesian classifier and fuzzy constraint), *Lauren Barghout, University of California, Berkeley (USA)*

3:25 HVEI-122
Positive and negative polarity contrast sensitivity measuring app, *Alex Hwang[1,2,3] and Eliezer Peli[1,2,3]; [1]Schepens Eye Research Institute, [2]Massachusetts Eye and Eye, and [3]Harvard University (USA)*

3:26 HVEI-123
Are lab-based audiovisual quality tests reflecting what users experience at home?, *Miguel Rios Quintero[1] and Alexander Raake[1,2]; [1]Technical Universität Berlin and [2]Technische Universität Ilmenau (Germany)*

3:27 HVEI-124
Image quality of experience: A subjective test targeting the consumer's experience, *Michele Saad[1], Margaret Pinson[2], David Nicholas[1], Niels Van Kets[3], Glenn Van Wallendael[3], Ramesh Jaladi[1], and Philip Corriveau[1]; [1]Intel Corporation (USA), [2]NTIA's Institute for Telecommunication Sciences (USA), and [3]Ghent University-iMinds (Belgium)*

Psychophysiological Measures for Visual Quality

Session Chairs: Kjell Brunnstrom, Acreo Swedish ICT AB (Sweden) and Sebastian Arndt, Technische Universität Berlin (Germany)

3:30 – 5:10 pm
Continental Ballroom 4

3:30 HVEI-125
Review on using physiology in quality of experience (Invited), *Sebastian Arndt[1], Kjell Brunnstrom[2], Eva Cheng[3], Ulrich Engelke[4], Sebastian Möller[1], and Jan-Niklas Antons[1]; [1]Technische Universität Berlin (Germany), [2]Acreo (Sweden), [3]RMIT University, and [4]CSIRO (Australia)*

3:50 HVEI-126
Physiological capture of augmented viewing states: Objective impact measures of high-dynamic range and wide-color gamut viewing experiences (Invited), *Dan Darcy, Evan Gitterman, Alex Brandmeyer, and Poppy Crum, Dolby Laboratories, Inc. (USA)*

4:10 HVEI-127
Using eye tracking metrics and visual saliency maps to assess image utility (Invited), *Laura Matzen, Michael Haass, Jonathan Tran, and Laura McNamara, Sandia National Laboratories (USA)*

4:30 HVEI-128
Towards prediction of sense of presence in immersive audiovisual communications (Invited), *Anne-Flore Perrin, Martin Rerabek, and Touradj Ebrahimi, EPFL (Switzerland)*

4:50 HVEI-129
Emotion recognition by physiological signals (Invited), *Naeem Ramzan, Sebastian Palke, Thomas Cuntz, Ryan Gibson, and Abbes Amira, University of West of Scotland (United Kingdom)*

HVEI Wednesday Author Discussion Session
Moderators: Bernice Rogowitz, Visual Perspectives (USA); Thrasyvoulos Pappas, Northwestern University (USA); and Huib de Ridder, Delft University of Technology (Netherlands)
5:10 – 5:40 pm
Continental Ballroom 4

EI 2016 Symposium Interactive Papers Session
5:30 – 7:00 PM
Continental Ballroom 6

Human Vision and Electronic Imaging (HVEI) 2016 Interactive Papers Session

5:30 – 7:00 pm
Continental Ballroom 6

The HVEI interactive papers will be presented in the EI 2016 Symposium Interactive Papers Session.

Thursday, February 18, 2016

Keynote Session II: Visual Cognition
Session Chairs: Bernice Rogowitz, Visual Perspectives (USA); Thrasyvoulos Pappas, Northwestern University (USA); and Huib de Ridder, Delft University of Technology (Netherlands)
8:50 – 9:40 am
Continental Ballroom 4

8:50 HVEI-130
Optimizing for visual cognition in high performance scientific computing, *Colin Ware, University of New Hampshire (USA)*

Perceptual Coding for Visualization

Session Chair: Ulrich Engelke, CSIRO (Australia)

9:40 – 10:30 am
Continental Ballroom 4

9:40 HVEI-131
From vision science to data science: Applying perception to problems in big data (Invited), *Remco Chang, Tufts University (USA)*

10:10 HVEI-132
A grounded theory study on the language of data visualization principles and guidelines, *Eser Kandogan[1] and Hanseung Lee[2]; [1]IBM Research and [2]Google (USA)*

10:30 – 11:00 am Coffee Break

Perceptual Coding for Visualization (continued)

Session Chair: Ulrich Engelke, CSIRO (Australia)

11:00 am – 12:20 pm
Continental Ballroom 4

11:00 HVEI-133
Why we use bad color maps and what you can do about it (Invited), *Kenneth Moreland, Sandia National Laboratories (USA)*

11:20 HVEI-134
SwordPlots: Exploring neuron behavior within dynamic communities of brain networks (JIST-first), *Chihua Ma[1], Angus Forbes[1], Daniel Llano[2], Tanya Berger-Wolf[1], and Robert Kenyon[1]; [1]University of Illinois at Chicago and [2]University of Illinois at Urbana-Champaign (USA)*

11:40 HVEI-135
Color visualization of the phase component of complex signals, *Alfredo Restrepo, Universidad de los Andes (Colombia)*

12:00 HVEI-136
Visual performance in multidimensional data characterisation with scatterplots and parallel coordinates (Invited), *Ulrich Engelke, Jenny Vuong, and Julian Heinrich, CSIRO (Australia)*

12:20 – 1:50 pm Lunch Break

Keynote Session III: Perception and Aesthetics in Emerging Media
Session Chairs: Bernice Rogowitz, Visual Perspectives (USA); Thrasyvoulos Pappas, Northwestern University (USA); and Huib de Ridder, Delft University of Technology (Netherlands)

1:50 – 2:40 pm
Continental Ballroom 4

1:50 HVEI-137
Lessons learned from the colorization and 3D conversion of feature films and how they can be applied to the emerging mediums of virtual and augmented reality: A creative, consumer and neuroscience perspective, *Barry Sandrew, Augmented Vision Works (USA)*

Art, Aesthetics, and Perception

Session Chairs: Monica Lopez-Gonzalez, La Petite Noiseuse Productions (USA) and Elena Fedorovskaya, Rochester Institute of Technology (USA)

2:40 – 3:40 pm
Continental Ballroom 4

2:40 HVEI-138
Peripheral color vision and motion processing, *Christopher Tyler[1,2]; [1]Smith-Kettlewell Eye Research Institute (USA) and [2]City University (United Kingdom)*

3:00 HVEI-139
Experiencing the interestingness concept within and between pictures, *Christel Chamaret, Claire-Hélène Demarty, Vincent Demoulin, and Gwenaelle Marquant, Technicolor (France)*

3:20 HVEI-140
Enhancing visualization with expressive motion, *Matthew Lockyer[1], Lyn Bartram[1], Thecla Schiphorst[1], and Karen Studd[2]; [1]Simon Fraser University (Canada) and [2]GMU School of Dance (USA)*

3:40 – 4:00 pm Coffee Break

Art, Aesthetics and Perception (continued)

Session Chairs: Monica Lopez-Gonzalez, La Petite Noiseuse Productions (USA) and Elena Fedorovskaya, Rochester Institute of Technology (USA)

4:00 – 6:00 pm
Continental Ballroom 4

4:00 HVEI-141
Color systems are categories that carry meaning in visualizations: A conceptual metaphor theory approach (Invited), *Jack Ox[1,2]; [1]University of Texas, Dallas and [2]University of New Mexico (USA)*

4:20 HVEI-142
Towards a computational account of art cognition: Unifying perception, visual art, and music through Bayesian inference (Invited), *Jorge Menendez, University College London (United Kingdom)*

4:40 HVEI-143
Minds in the spotlight: Using live performance art to uncover creative thinking processes (Invited), *Monica Lopez-Gonzalez, La Petite Noiseuse Productions (USA)*

5:00 HVEI-144
Swapping swatches: Adapting to and from an artist's palette (Invited), *Katie Tregillus and Michael Webster, University of Nevada Reno (USA)*

5:20 HVEI-145
Art, interpersonal comparisons of color experience, and potential human tetrachromacy (Invited), *Kimberly Jameson[1], Keith Goldfarb[2], and Vladimir Bochko[3]; [1]University of California, Irvine (USA), [2]Blackthorn Media LLC (USA), and [3]University of Vaasa (Finland)*

5:40 HVEI-146
Painting like old masters, creative algorithms for 2.5D reproduction (Invited), *Carinna Parraman, University of the West of England (United Kingdom)*

HVEI Thursday Author Discussion and Reception

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

6:00 – 7:00 pm
Continental Ballroom 4

Digital Photography and Mobile Imaging XII

Conference grouping: Image Capture Systems

Conferences in this grouping discuss advances in traditional and non-traditional digital cameras and their image processing pipelines; plenoptic devices; sensors for low-light imaging; very high dynamic range sensors and cameras; hyperspectral sensors and cameras; wearable multimedia systems; mobile games; multimedia data mining; and HCI design and techniques, among other topics.

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 have 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.

The conference includes panel discussions and joint sessions with other Electronic Imaging conferences with overlapping interests.

Awards: Best Paper and Best Student Paper

Joint Sessions: **Blur Removal and Synthesis** with the Image Processing: Algorithms and Systems and the Visual Information Processing and Communication (VIPC) Conferences; **Color Filter Array Interpolation and Superresolution** with the Image Processing: Algorithms and Systems Conference; **Image Capture I** with the Image Quality and System Performance Conference; **Image Filtering and Denoising** with the Image Quality and System Performance Conference; Image Processing: Algorithms and Systems Conference; and **Mobile and Digital Camera Image Quality Evaluation** with the Image Quality and System Performance Conference.

Conference Chairs: **Jackson Roland,** Imatest LLC (USA); **Radka Tezaur,** Nikon Research Corp. of America (USA); and **Dietmar Wueller,** Image Engineering GmbH & Co. KG (Germany)

Program Committee: **Sebastiano Battiato,** Univ. degli Studi di Catania (Italy); **Kathrin Berkner,** Ricoh Innovations, Inc. (USA); **Ajit S. Bopardikar,** Samsung R&D Institute India Bangalore Pvt. Ltd. (India); **Peter B. Catrysse,** Stanford Univ. (USA); **Henry G. Dietz,** Univ. of Kentucky (USA); **Giovanni Farinella,** Univ. degli Studi di Catania (Italy); **Joyce E. Farrell,** Stanford Univ. (USA); **Robert D. Fiete,** Exelis (USA); **Boyd A. Fowler,** Google (USA); **Sergio R. Goma,** Qualcomm Technologies Inc. (USA); **Mirko Guarnera,** STMicroelectronics R&D Shenzhen Co. Ltd. (China); **Bahadir K. Gunturk,** Istanbul Medipol Univ. (Turkey); **Zhen He,** Intel Corp. (USA); **Paul M. Hubel,** Apple Inc. (USA); **Francisco H. Imai,** Canon USA, Inc. (USA); **Pramati Kalwad,** National Institute of Technology Karnataka, Surathkal (India); **Michael A. Kriss,** MAK Consultants (USA); **Jiangtao Kuang,** OmniVision Technologies, Inc. (USA); **Andrew Lumsdaine,** Indiana Univ. (USA); **Kevin J. Matherson,** Microsoft Corp. (USA); **Jon S. McElvain,** Dolby Labs., Inc. (USA); **Lingfei Meng,** Ricoh Innovations, Inc. (USA); **David Morgan-Mar,** Canon Information Systems Research Australia (Australia); **Bo Mu,** BAE Systems (USA); **Kari A. Pulli,** Light (USA); **John R. Reinert-Nash,** Lifetouch, Inc. (USA); **Nitin Sampat,** Rochester Institute of Technology (USA); **Sabine Süsstrunk,** École Polytechnique Fédérale de Lausanne (Switzerland); **Touraj Tajbakhsh,** Apple Inc. (USA); **Ashok Veeraraghavan,** Rice Univ. (USA); **Thomas Vogelsang,** Rambus Inc. (USA); **Michael Wang,** Intel Corp. (USA); and **Zhan Yu,** Univ. of Delaware (USA)

Conference Sponsors

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Digital Photography and Mobile Imaging XII

Monday, February 15, 2016

DPMI/IQSP: Mobile and Digital Camera Image Quality Evaluation Joint Session

Session Chairs: Joyce Farrell, Stanford University (USA) and Elaine Jin, Intel Corporation (USA)

10:40 am – 12:30 pm
Golden Gate 6/7

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

10:40
Conference Opening Remarks

10:50 DPMI-004
Image stabilization performance – existing standards and the challenges for mobile imaging, *Uwe Artmann and Philipp Feldker, Image Engineering GmbH & Co. KG (Germany)*

11:10 DPMI-005
Image flare measurement according to ISO 18844, *Dietmar Wueller, Image Engineering GmbH & Co. KG (Germany)*

11:30 DPMI-006
MTF measurements of wide field of view cameras, *Boyd Fowler, Vlad Cardei, and Sam Kavusi, Google Inc. (USA)*

11:50 DPMI-007
Method for quantifying image sensor susceptibility to chromatic flare artifacts, *Orit Skorka, Dave Jasinski, Radu Ispasoiu, and Vladi Koborov, ON Semiconductor (USA)*

12:10 DPMI-008
Which factor is more important in obtaining good capture characterization, and, consequently, render higher color accuracy: The characterization of the camera's sensor, or the characterization of illuminant?, *Nitin Sampat and Stephen Viggiano, Rochester Institute of Technology (USA)*

12:30 – 2:00 pm Lunch Break

EI 2016 Opening Plenary and Symposium Awards
Session Chair: Choon-Woo Kim (Inha University)
2:00 – 3:00 PM
Continental Ballroom 5

Illuminating a bright future for medicine, *Audrey K. Bowden, Stanford University (USA)*

3:00 – 3:30 pm Coffee Break

DPMI/IQSP: Image Capture I Joint Session

Session Chairs: Susan Farnand, Rochester Institute of Technology (USA) and Dietmar Wueller, Image Engineering GmbH & Co. KG (Germany)

3:30 – 5:00 pm
Golden Gate 6/7

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

3:30 IQSP-009
Adaptive geometric calibration correction for camera array, *Florian Ciurea, Dan Lelescu, and Priyam Chatterjee, Pelican Imaging (USA)*

4:00 IQSP-010
A filter design approach for consistent image quality, *Ahmed Eid, Michael Phelps, and Brian Cooper, Lexmark International (USA)*

4:20 IQSP-011
Linearization and normalization in spatial frequency response measurement, *Uwe Artmann, Image Engineering GmbH & Co. KG (Germany)*

4:40 IQSP-012
Optimized tone curve for in-camera image processing, *Praveen Cyriac, David Kane, and Marcelo Bertalmio, Universitat Pompeu Fabra (Spain)*

5:00 – 6:00 pm EI 2016 Symposium Reception

Tuesday, February 16, 2016

DPMI/IPAS: Image Filtering and Denoising Joint Session

Session Chairs: Karen Egiazarian, Tampere University of Technology (Finland) and Zhen He, Intel Corporation (USA)

8:50 – 10:10 am
Golden Gate 6/7

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

8:50 IPAS-013
Intelligent image filtering using multilayer neural network with multi-valued neurons, *Igor Aizenberg, Texas A&M University-Texarkana (USA)*

9:10 IPAS-014
Robust extensions to guided image filtering, *Oleg Michailovich, University of Waterloo (Canada)*

9:30 DPMI-015
Local denoising applied to RAW images may outperform non-local patch-based methods applied to the camera output, *Gabriela Ghimpeteanu[1], Thomas Batard[1], Tamara Seybold[2], and Marcelo Bertalmio[1]; [1]University Pompeu Fabra (Spain) and [2]ARRI Arnold & Richter Cine Technik GmbH & Co. Betriebs KG (Germany)*

9:50 DPMI-016
Use of flawed and ideal image pairs to drive filter creation by genetic programming, *Subash Sridhar, Henry Dietz, and Paul Eberhart, University of Kentucky (USA)*

10:10 – 10:50 am Coffee Break

DPMI/IPAS: Color Filter Array Interpolation and Superresolution Joint Session

Session Chairs: Ajit Bopardikar, Samsung R&D Institute India - Bangalore (India) and Atanas Gotchev, Tampere University of Technology (Finland)

10:50 am – 12:30 pm
Golden Gate 6/7

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

10:50 IPAS-024
Optimal transparent wavelength and arrangement for multispectral filter array, *Yudai Yanagi[1], Kazuma Shinoda[1], Madoka Hasegawa[1], Shigeo Kato[1], Masahiro Ishikawa[2], Hideki Komagata[2], and Naoki Kobayashi[2]; [1]Utsunomiya University and [2]Saitama Medical University (Japan)*

11:10 DPMI-025
Multi-spectrum to RGB with direct structure-tensor reconstruction, *Takashi Shibata[1,2], Masayuki Tanaka[1], and Masatoshi Okutomi[1]; [1]Tokyo Institute of Technology and [2]NEC Corporation (Japan)*

11:30 IPAS-026
Edge-directional interpolation algorithm using structure tensor, *Andrey Nasonov[1], Andrey Krylov[1], Xenya Petrova[2], and Michael Rychagov[2]; [1]Lomonosov Moscow State University and [2]Samsung R&D Institute Rus (Russian Federation)*

11:50 IPAS-027
Fast edge-directed single-image super-resolution, *Mushfiqur Rouf[1], Dikpal Reddy[2], Kari Pulli[2], and Rabab Ward[3]; [1]University of British Columbia (Canada) and [2]Light Co (USA)*

12:10 DPMI-028
Light-weight single image super-resolution via pattern-wise regression function, *Kohei Kurihara[1], Yoshitaka Toyoda[1], Shotaro Moriya[2], Daisuke Suzuki[1], Takeo Fujita[1], Narihiro Matoba[1], Jay Thornton[3], and Fatih Porikli[4]; [1]Mitsubishi Electric Corporation (Japan), [3]Mitsubishi Electric Research Laboratories (MERL) (USA), and [4]Australian National University (Australia)*

12:30 – 2:00 pm Lunch Break

EI 2016 Tuesday Plenary and Symposium Awards
Session Chair: Nitin Sampat (Rochester Institute of Technology)
2:00 – 3:00 PM
Continental Ballroom 5

Pushing computational photography deeper into imaging system design, *Ren Ng, University of California, Berkeley (USA)*

3:00 – 3:30 pm Coffee Break

High Dynamic Range Imaging

Session Chair: Thomas Vogelsang, Rambus Inc. (USA)

3:30 – 4:30 pm
Golden Gate 6/7

3:30 DPMI-245
High quality video in high dynamic range scenes from interlaced dual-ISO footage, *Raquel Gil Rodríguez and Marcelo Bertalmio, Universitat Pompeu Fabra (Spain)*

3:50 DPMI-246
FPGA-based implementation of estimating saturated pixel values in RAW image, *Jun Fu, Yungang Wu, Xuanqin Mou, Wenbo Ji, and Ping Wang, Institute of Image Processing and Pattern Recognition, Xi'an Jiaotong University (China)*

4:10 DPMI-247
Novel approach to detect HDR scenes and determine suitable frames for image fusion, *Sphurti Bhoskar and Ramakrishna Kakarala, Nanyang Technological University (Singapore)*

Image Signal Processing Pipeline

Session Chair: Jon McElvain, Dolby Laboratories (USA)

4:30 – 5:10 pm
Golden Gate 6/7

4:30 DPMI-248
Local linear approximation for camera image processing pipelines, *Haomiao Jiang, Qiyuan Tian, Joyce Farrell, and Brian Wandell, Stanford University (USA)*

4:50 DPMI-249
A novel adaptive shading correction algorithm for camera systems, *Varuna De Silva and Daniel Larkin, Apical Ltd (United Kingdom)*

EI 2016 Symposium Demonstration Session and Exhibit Hall Happy Hour
5:30 – 7:00 PM
Continental Ballroom Foyer

Wednesday, February 17, 2016

DPMI XII Keynote
Session Chair: Francisco Imai, Canon U.S.A. Inc. (USA)
9:30 – 10:10 am
Golden Gate 6/7

DPMI-250
Photo editing on mobile devices, *Sylvain Paris, Adobe (USA)*

10:10 – 10:50 am Coffee Break

DPMI/IPAS/VIPC: Blur Removal and Synthesis Joint Session

Session Chair: Radka Tezaur, Nikon Research Corp. of America (USA)

10:50 am – 12:10 pm
Golden Gate 6/7

This session is jointly sponsored by: Digital Photography and Mobile Imaging XII, Image Processing: Algorithms and Systems XIV, and Visual Information Processing and Communication VII.

10:50 DPMI-030
Multi-image sparse motion-invariant photography, *Bart Kofoed[1,2], Peter de With[1], and Eric Janssen[2]; [1]Eindhoven University of Technology and [2]Prodrive Technologies (Netherlands)*

11:10 DPMI-031
Virtual DSLR: High quality dynamic depth-of-field synthesis on mobile platforms, *Yang Yang[1], Haiting Lin[1], Zhan Yu[2], Sylvain Paris[2], and Jingyi Yu[1]; [1]University of Delaware and [2]Adobe (USA)*

11:30 DPMI-032
Robust blur estimation for blind image deblurring, *Jan Kotera[1,2] and Filip Šroubek[1]; [1]UTIA and [2]Charles University (Czech Republic)*

11:50 VIPC-033
Motion deblurring for depth-varying scenes, *Ruiwen Zhen and Robert Stevenson, University of Notre Dame (USA)*

12:10 – 2:00 pm Lunch Break

EI 2016 Wednesday Plenary and Symposium Awards
Session Chair: Choon-Woo Kim (Inha University)
2:00 – 3:00 PM
Continental Ballroom 5

Intel® RealSense Technology: Adding human-like sensing and interactions to computing devices, *Achin Bhowmik, Intel Corporation (USA)*

3:00 – 3:30 pm Coffee Break

Optics and Optical Modeling

Session Chair: Michael Kriss, MAK Consultants (USA)

3:30 – 4:10 pm
Golden Gate 6/7

3:30 DPMI-251
Gapless dual-layered diffractive optical element and optical design of imaging lens that incorporates it, *Hiroto Yasui, Canon Inc. (Japan)*

3:50 DPMI-252
A three parameter underwater image formation model, *Henryk Blasinski and Joyce Farrell, Stanford University (USA)*

Digital Photography and Mobile Imaging XII Interactive Papers Oral Previews

Session Chair: Kevin Matherson, Microsoft Corporation (USA)

4:10 – 4:50 pm
Golden Gate 6/7

In this session interactive poster authors will each provide a brief oral preview of their poster presentation, which will be presented fully in the Digital Photography and Mobile Imaging XII Interactive Papers Session at 5:30 pm on Wednesday.

4:10 DPMI-253
Focus assist for 4K camera, *Seiichi Gohshi, Kogakuin University (Japan)*

4:15 DPMI-254
Using disparity information for stereo autofocus in 3-D photography, *Shao-Kang Huang, Cheng-Chieh Yang, Kuang-Tsu Shih, and Homer Chen, National Taiwan University (Taiwan)*

4:20 DPMI-255
Fast JPEG rate control, *Sergey Zavalishin, Valery Anisimovskiy, and Ilya Kurilin, Samsung R&D Institute Russia (Russian Federation)*

4:25 DPMI-256
Single-sensor RGB and NIR image acquisition: Toward optimal performance by taking account of CFA pattern, demosaicking, and color correction, *Hayato Teranaka, Yusuke Monno, Masayuki Tanaka, and Masatoshi Okutomi, Tokyo Institute of Technology (Japan)*

4:30 DPMI-257
A reduced-reference image quality assessment model based on joint-distribution of neighboring LOG signals, *Congmin Chen and Xuanqin Mou, Institute of Image Processing & Pattern Recognition (China)*

4:35 DPMI-258
Several parameters that affect the spatial frequency response of camera phones to the dead leaves target, *Nitin Suresh[1,2] and Quanzeng Wang[1]; [1]US FDA and [2]University of Maryland (USA)*

4:40 DPMI-259
Scene appearance change as framerate approaches infinity, *Henry Dietz, Zachary Snyder, John Fike, and Pablo Quevedo, University of Kentucky (USA)*

4:45
DPMI Conference Closing Remarks

EI 2016 Symposium Interactive Papers Session
5:30 – 7:00 PM
Continental Ballroom 6

Digital Photography and Mobile Imaging XII Interactive Papers Session

5:30 – 7:00 pm
Continental Ballroom 6

The DPMI interactive papers will be presented in the EI 2016 Symposium Interactive Papers Session.

Image Sensors and Imaging Systems 2016

Conference grouping: Image Capture Systems
Conferences in this grouping discuss advances in traditional and non-traditional digital cameras and their image processing pipelines; plenoptic devices; sensors for low-light imaging; very high dynamic range sensors and cameras; hyperspectral sensors and cameras; wearable multimedia systems; mobile games; multimedia data mining; and HCI design and techniques, among other topics.

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 the discussion a set of high level invited talks is followed by a panel discussion. To encourage young talent, a best student paper contest is organized.

Awards: Best Paper Award, Best Student Paper Award

Joint Sessions: Image Sensors and Systems for 3D Imaging with the 3D Image Processing, Measurement and Applications Conference.

Conference Chairs: **Ralf Widenhorn,** Portland State Univ. (USA); **Antoine Dupret,** Commissariat à l'Énergie Atomique (France); and **Arnaud Darmont,** APHESA SPRL (Belguim)

Program Committee: **Morley M. Blouke,** Portland State Univ. (retired) (USA); **Erik Bodegom,** Portland State Univ. (USA); **Calvin Chao,** TSMC (Taiwan); **Glenn H. Chapman,** Simon Fraser Univ. (Canada); **James A. DiBella,** ON Semiconductor (USA); **Boyd A. Fowler,** Google (USA); **Bumsuk Kim,** Samsung Electronics Co., Ltd (Republic of Korea); **Rihito Kuroda,** Tohoku Univ. (Japan); **Kevin J. Matherson,** Microsoft Corp. (USA); **Alice L. Reinheimer,** e2v (USA); **Gilles Sicard,** Commissariat à l'Énergie Atomique (France); **Nobukazu Teranishi,** Univ. of Hyogo (Japan); **Jean-Michel Tualle,** Univ. Paris 13 (France); **Gordon Wan,** Google Inc. (USA); and **Xinyang Wang,** GPIXEL (China)

Conference Sponsors

OmniVision

Image Sensors and Imaging Systems 2016

Wednesday, February 17, 2016

Image Sensors and Algorithms for High Dynamic Range

Session Chair: Arnaud Darmont, APHESA SPRL (Belgium)

8:40 – 10:20 am
Golden Gate 4

8:40
Conference Remarks

8:50 IMSE-260
A high dynamic range linear vision sensor with event asynchronous and frame-based synchronous operation, *Juan A. Leñero-Bardallo, Ricardo Carmona-Galán, and Angel Rodríguez-Vázquez, Universidad de Sevilla (Spain)*

9:10 IMSE-261
A dual-core highly programmable 120dB image sensor, *Benoit Dupont, Pyxalis (France)*

9:30 IMSE-262
Analog current mode implementation of global and local tone mapping algorithm for wide dynamic range image display, *Peng Chen, Kartikeya Murari, and Orly Yadid-Pecht, Univ. of Calgary (Canada)*

9:50 IMSE-263
Novel real-time tone mapping operator for noisy logarithmic CMOS image sensors (JIST-first), *Jing Li, Orit Skorka, Kamal Ranaweera, and Dileepan Joseph, University of Alberta (Canada)*

10:10
High dynamic range challenges

Short presentation by Arnaud Darmont

10:20 – 10:50 am Coffee Break

Novel Image Sensors and Image Sensor Technologies

Session Chair: Antoine Dupret, CEA (France)

10:50 am – 12:40 pm
Golden Gate 4

10:50 IMSE-264
Image sensor with organic photoconductive films by stacking the red/green and blue components, *Tomomi Takagi[1], Toshikatu Sakai[1], Kazunori Miyakawa[1], and Mamoru Furuta[2]; [1]NHK Science & Technology Research Laboratories and [2]Kochi University of Technology (Japan)*

11:10 IMSE-265
High-sensitivity CMOS image sensor overlaid with Ga_2O_3/CIGS heterojunction photodiode, *Kazunori Miyakawa[1], Shigeyuki Imura[1], Hiroshi Ohtake[1], Misao Kubota[1], Kenji Kikuchi[2], Tokio Nakada[3], Toru Okino[4], Yutaka Hirose[4], Yoshihisa Kato[4], and Nobukazu Teranishi[5,6]; [1]NHK Science and Technology Research Laboratories, [2]NHK Sapporo Station, [3]Tokyo University of Science, [4]Panasonic Corporation, [5]University of Hyogo, and [6]Shizuoka University (Japan)*

11:30 IMSE-266
Sub-micron pixel CMOS image sensor with new color filter patterns, *Biay-Cheng Hseih[1], Sergio Goma[1], Hasib Siddiqui[1], Kalin Atanassov[1], Jiafu Luo[1], RJ Lin[2], Hy Cheng[2], Kuoyu Chou[2], JJ Sze[2], and Calvin Chao[2]; [1]Qualcomm Technologies Inc. (USA) and [2]TSMC (Taiwan)*

11:50 IMSE-267
A CMOS image sensor with variable frame rate for low-power operation, *Byoung-Soo Choi, Sung-Hyun Jo, Myunghan Bae, Sang-Hwan Kim, and Jang-Kyoo Shin, Kyungpook National University (South Korea)*

12:10 IMSE-268
ADC techniques for optimized conversion time in CMOS image sensors, *Cedric Pastorelli[1] and Pascal Mellot[2]; [1]ANRT and [2]STMicroelectronics (France)*

12:30
Best paper/best student paper

Presentation and awards for the best paper/best student paper and sponsor presentation

12:40 – 2:00 pm Lunch Break

EI 2016 Wednesday Plenary and Symposium Awards
Session Chair: Choon-Woo Kim (Inha University)
2:00 – 3:00 PM
Continental Ballroom 5

Intel® RealSense Technology: Adding human-like sensing and interactions to computing devices, *Achin Bhowmik, Intel Corporation (USA)*

3:00 – 3:30 pm Coffee Break

Cameras and Systems

Session Chair: Boyd Fowler, OmniVision Technologies (USA)

3:30 – 5:30 pm
Golden Gate 4

3:30 IMSE-269
Miniature lensless computational infrared imager, *Evan Erickson, Mark Kellam, Patrick Gill, James Tringali, and David Stork, Rambus (USA)*

3:50 IMSE-270
Focal-plane scale space generation with a 6T pixel architecture, *Fernanda Oliveira[1], José Gabriel Gomes[1], Ricardo Carmona-Galán[2], Jorge Fernández-Berni[2], and Angel Rodríguez-Vázquez[2]; [1]Universidade Federal do Rio de Janeiro (Brazil) and [2]Instituto de Microelectrónica de Sevilla (Spain)*

4:10 IMSE-271
Development of an 8K full-resolution single-chip image acquisition system, *Tomohiro Nakamura, Ryohei Funatsu, Takahiro Yamasaki, Kazuya Kitamura, and Hiroshi Shimamoto, Japan Broadcasting Corporation (NHK) (Japan)*

4:30 IMSE-272
Smart digital camera based on spatial pre-processing filtering and spike generation, *Michel Paindavoine, Univ Bourgogne Franche-Comte (France)*

4:50 IMSE-273
Estimation and correction of geometric distortion in pushbroom hyperspectral system for imaging art paintings, *Sony George and Jon Yngve Hardeberg, Gjøvik University College (Norway)*

5:10
Preview of posters and Thursday sessions

EI 2016 Symposium Interactive Papers Session
5:30 – 7:00 PM
Continental Ballroom 6

Image Sensors and Imaging Systems 2016 Interactive Papers Session

5:30 – 7:00 pm
Continental Ballroom 6

The following works will be presented at the EI 2016 Symposium Interactive Papers Session.

IMSE-274
EMVA1288 3.1rc2 and research on version 3.2 and next, *Arnaud Darmont and Adrien Lombet, APHESA SPRL (Belgium)*

IMSE-275
Software environment for holistic Vision-System-on-Chip programming, *Peter Reichel, Jens Döge, Christoph Hoppe, Nico Peter, Andreas Reichel, and Peter Schneider, Fraunhofer Institute for Integrated Circuits (IIS) (Germany)*

Thursday, February 18, 2016

Algorithms for Image Sensors and Camera Systems

Session Chair: Alice Reinheimer, e2v (USA)

8:50 – 10:10 am
Golden Gate 4

8:50 IMSE-276
FPGA implementation of gamma correction using a piecewise linear approach for a small size endoscopic camera, *Sheikh Shanawaz Mostafa[1], L. Natércia Sousa[1], Nuno Fábio Ferreira[1], Ricardo M. Sousa[2], João Santos[2], Martin Waeny[2], and Fernando Morgado-Dias[1,3]; [1] Madeira Interactive Technologies Institute, [2]AWAIBA, and [3]University of Madeira (Portugal)*

9:10 IMSE-277
Non-negative Matrix Completion for the enhancement of Snapshot Mosaic Multispectral Imagery, *Grigorios Tsagkatakis[1], Murali Jayapala[2], Bert Geelen[2], and Panagiotis Tsakalides[1]; [1]FORTH (Greece) and [2]IMEC (Belgium)*

9:30 IMSE-278
Trade-off between the number of bits per pixel and motion detection quality for ultra-low power imaging applications, *Camille Dupoiron, Arnaud Verdant, and Gilles Sicard, CEA LETI (France)*

9:50 IMSE-279
Development of an 8K UHDTV demosaicing processor using adaptive interpolation based on local edge magnitude, *Noriyuki Shirai and Yukihiro Nishida, NHK Science and Technology Research Laboratories (Japan)*

10:10 – 10:50 am Coffee Break

Noise, Defects and Characterization

Session Chair: Ralf Widenhorn, Portland State University (USA)

10:50 am – 12:10 pm
Golden Gate 4

10:50 IMSE-280
Characterization of VNIR hyperspectral sensors with monolithically integrated optical filters, *Prashant Agrawal[1], Klaas Tack[1], Bert Geelen[1], Bart Masschelein[1], Pablo Mateo Aranda Moran[2], Andy Lambrechts[1], and Murali Jayapala[1]; [1]Imec and [2]TMC (Belgium)*

11:10 IMSE-281
A 1.12-um pixel CMOS image sensor survey, *Clemenz Portmann, Lele Wang, Guofeng Liu, Ousmane Diop, and Boyd Fowler, Google Inc. (USA)*

11:30 IMSE-282
A comparative noise analysis and measurement for n-type and p-type pixels with CMS technique, *Xiaoliang Ge[1], Bastien Mamdy[2,3], and Albert Theuwissen[1,4]; [1]Technische Universiteit Delft (Netherlands), [2]STMicroelectronics (France), [3]Universite Claude Bernard Lyon 1 (France), and [4]Harvest Imaging (Belgium)*

11:50 IMSE-283
Increases in hot pixel development rates for small digital pixel sizes, *Glenn Chapman[1], Rahul Thomas[1], Rohan Thomas[1], Klinsmann Meneses[1], Tony Yang[1], Israel Koren[2], and Zahava Koren[2]; [1]Simon Fraser University (Canada) and [2]University of Massachusetts Amherst (USA)*

12:10 – 1:50 pm Lunch Break

3DIPM/IMSE: Image Sensors and Systems for 3D Imaging Joint Session

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

1:50 – 3:20 pm
Golden Gate 6/7

This session is jointly sponsored by: Image Sensors and Imaging Systems 2016, and 3D Image Processing, Measurement (3DIPM), and Applications 2016.

1:50
Joint conference introduction

2:00 IMSE-048
A time-of-flight CMOS range image sensor using 4-tap output pixels with lateral-electric-field control, *Taichi Kasugai[1], Sang-Man Han[1], Hanh Trang[1], Taishi Takasawa[1], Satoshi Aoyama[2], Keita Yasutomi[1], Keiichiro Kagawa[1], and Shoji Kawahito[1]; [1]Shizuoka University and [2]Brookman Technology (Japan)*

2:20 IMSE-049
Design, implementation and evaluation of a TOF range image sensor using multi-tap lock-in pixels with cascaded charge draining and modulating gates, *Trang Nguyen[1], Taichi Kasugai[1], Keigo Isobe[2], Sang-Man Han[1], Taishi Takasawa[1], De Xlng Lioe[1], Keita Yasutomi[1], Keiichiro Kagawa[1], and Shoji Kawahito[1]; [1]Shizuoka University and [2]Brookman Technology (Japan)*

2:40 3DIPM-050
Markerless motion capture with multi-view structured light, *Ricardo Garcia and Avideh Zakhor, University of California, Berkeley (USA)*

3:00 3DIPM-051
Towards automated, high resolution 3D scanning of large surfaces for cultural heritage documentation, *Robert Sitnik[1], Eryk Bunsch[2], Grzegorz Maczkowski[1], Wojciech Zaluski[1], Krzysztof Lech[1], Jakub Michonski[1], and Jakub Krzeslowski[1]; [1]Warsaw University of Technology and [2]Museum of King Jan III's Palace at Wilanów (Poland)*

MOBMU

Mobile Devices and Multimedia: Enabling Technologies, Algorithms, and Applications 2016

Conference grouping: Image Capture Systems

Conferences in this grouping discuss advances in traditional and non-traditional digital cameras and their image processing pipelines; plenoptic devices; sensors for low-light imaging; very high dynamic range sensors and cameras; hyperspectral sensors and cameras; wearable multimedia systems; mobile games; multimedia data mining; and HCI design and techniques, among other topics.

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. Work-in progress papers, as well as updates on previously reported systems, are included.

Awards: Best Paper and Best-Student Paper for outstanding papers

Photo: Stephan Keith.

Conference Chairs: **Reiner Creutzburg,** Fachhochschule Brandenburg (Germany), and **David Akopian,** The Univ. of Texas at San Antonio (USA)

Program Committee: **John Adcock,** FX Palo Alto Lab. (USA); **Sos S. Agaian,** The Univ. of Texas at San Antonio (USA); **Faouzi Alaya Cheikh,** Gjøvik Univ. College (Norway); **Noboru Babaguchi,** Osaka Univ. (Japan); **Nina T. Bhatti,** Hewlett-Packard Labs. (USA); **Chang Wen Chen,** Univ. at Buffalo (USA); **C. L. Philip Chen,** Univ. of Macau (China); **David E. Cook,** Consultant (Namibia); **Matthew L. Cooper,** FX Palo Alto Lab. (USA); **Kenneth J. Crisler,** Motorola, Inc. (USA); **Francesco G. B. De Natale,** Univ. degli Studi di Trento (Italy); **Alberto Del Bimbo,** Univ. degli Studi di Firenze (Italy); **Stefan Edlich,** Technische Fachhochschule Berlin (Germany); **Atanas P. Gotchev,** Tampere Univ. of Technology (Finland); **Alan Hanjalic,** Technische Univ. Delft (the Netherlands); **Alexander G. Hauptmann,** Carnegie Mellon Univ. (USA); **Winston H. Hsu,** National Taiwan Univ. (Taiwan); **Gang Hua,** Stevens Institute of Technology (USA); **Catalin Lacatus,** Qualcomm Technologies, Inc. (USA); **Xin Li,** West Virginia Univ. (USA); **Qian Lin,** Hewlett-Packard Labs. (USA); **Gabriel G. Marcu,** Apple Inc. (USA); **Vasileios Mezaris,** Informatics and Telematics Institute (Greece); **Chong-Wah Ngo,** City Univ. of Hong Kong (Hong Kong, China); **Sethuraman Panchanathan,** Arizona State Univ. (USA); **Kari A. Pulli,** Light (USA); **Yong Rui,** Microsoft Corp. (China); **Olli Silvén,** Univ. of Oulu (Finland); **John R. Smith,** IBM Thomas J. Watson Research Ctr. (USA); **Hari Sundaram,** Arizona State Univ. (USA); **Jarmo Henrik Takala,** Tampere Univ. of Technology (Finland); **Marius Tico,** Nokia Research Ctr. (Finland); **Meng Wang,** National Univ. of Singapore (Singapore); **Rong Yan,** Facebook Inc. (USA); and **Jun Yang,** Facebook Inc. (USA)

Mobile Devices and Multimedia: Enabling Technologies, Algorithms, and Applications 2016

Wednesday, February 17, 2016

Mobile Devices and Multimedia: Enabling Technologies, Algorithms, and Applications 2016 Interactive Papers Session

5:30 – 7:00 pm
Continental Ballroom 6

The following works will be presented at the EI 2016 Symposium Interactive Papers Session.

MOBMU-284
Concept for software-based configuration of the organizational and technical security of a company of any size, *Thomas Möller[1], Knut Bellin[2], and Reiner Creutzburg[2]; [1]Assecor GmbH (Germany) and [2]Brandenburg University of Applied Sciences*

MOBMU-285
Semi-automatic generation of multilingual lecture notes - Wikipedia books for algorithms and data structure courses in various languages, *Reiner Creutzburg, Brandenburg University of Applied Sciences (Germany)*

MOBMU-286
RED color spaces demystified - reverse engineering of RED gamma and RED color by spectral analysis of Xrite color charts and RED Scarlet-X Camera recordings, *Eberhard Hasche, Thomas Schrader, Patrick Ingwer, Martin Haferanke, and Reiner Creutzburg, Brandenburg University of Applied Sciences (Germany)*

MOBMU-287
Algorithm of out-of-band radiation reduction, *Valentin Fedosov[1], Roman Rubtsov[1], Viacheslav Voronin[2], Andrey Legin[1], and Anna Lomakina[1]; [1]Southern Federal University and [2]Don State Technical University (Russian Federation)*

MOBMU-288
Advanced features for messaging solutions for mobile health promotion research, *David Akopian, Jafet Morales, Rodrigo Escobar, Suraj Sankarawarrier, and Kavya Choppa, University of Texas at San Antonio (USA)*

MOBMU-289
Digital inpainting with applications to forensic image and video processing, *Viacheslav Voronin[1], Vladimir Marchuk[1], and Reiner Creutzburg[2]; [1]Don State Technical University (Russian Federation) and [2]Fachhochschule Brandenburg (Germany)*

MOBMU-290
Energy efficient algorithm for lookup-tables on mobile devices, *Sergey Makov, Vladimir Frantc, Viacheslav Voronin, Vladimir Marchuk, and Evgeny Semenishchev, Don State Technical University (Russian Federation)*

EI 2016 Symposium Interactive Papers Session
5:30 – 7:00 PM
Continental Ballroom 6

Thursday, February 18, 2016

Emerging Mobile Applications

Conference Chairs: David Akopian, The University of Texas at San Antonio (USA) and Reiner Creutzburg, Fachhochschulel Brandenburg - Brandenburg University of Applied Sciences (Germany)

8:50 – 10:10 am
Golden Gate 5

8:50 MOBMU-291
Contactless palm landmark detection and localization on mobile devices, *Yaqi Wang, Liangrui Peng, Shengjin Wang, and Xiaoqing Ding, Tsinghua University (China)*

9:10 MOBMU-292
RECfusion: Automatic scene clustering and tracking in videos from multiple sources, *Filippo Milotta[1], Sebastiano Battiato[1], Filippo Stanco[1], Valeria D'Amico[2], Giovanni Torrisi[2], and Luca Addesso[2]; [1]University of Catania and [2]Telecom Italia - Joint Open Lab - WAVE (Italy)*

9:30 MOBMU-293
Improving the RDP based applications by using HTML5 content representation, *Rama Rao Ganji[1], Mihai Mitrea[1], Dancho Panovski[1], and Bojan Joveski[2]; [1]Telecom-SudPars; Institut Mines-Telecom (France) and [2]Ustartapp*

9:50 MOBMU-294
Automated segmentation of ophthalmological OCT images, *Friedrich Müller and Reiner Creutzburg, Brandenburg University of Applied Sciences (Germany)*

10:10 – 10:50 am Coffee Break

Mobile Applications for Broader Impact and Infrastructure

Conference Chairs: David Akopian, The University of Texas at San Antonio (USA) and Reiner Creutzburg, Fachhochschulel Brandenburg - Brandenburg University of Applied Sciences (Germany)

10:50 am – 12:30 pm
Golden Gate 5

10:50 MOBMU-295
3D reconstruction of buildings and / or landscapes - evaluation of quality parameters and optimization of mission planning using RPAS, *Stefan Schön, Patrick Ingwer, Arno Fischer, Steffen Doerner, Martin Schafföner, Eberhard Hasche, Sören Hirsch, and Reiner Creutzburg, Brandenburg University of Applied Sciences (Germany)*

11:10 MOBMU-296
Point cloud supported survey of building structures for structural engineering and inspection, *Patrick Ingwer[1], Jenny Knackmuss[1], Stefan Maack[2], and Reiner Creutzburg[1]; [1]Brandenburg University of Applied Sciences and [2]Bundesanstalt für Materialprüfung (Germany)*

11:30 MOBMU-297
Supplementation of LiDAR scans with Structure from Motion (SfM) data, *Fabian Gassen and Reiner Creutzburg, Brandenburg University of Applied Sciences (Germany)*

11:50 MOBMU-298
Digital photonic measurements for high tech strategy 2020, *Paul-Gerald Dittrich and Dietrich Hofmann, Technologie- und Innovationspark Jena GmbH (Germany)*

12:10 MOBMU-299
Turbo fusion of LPQ and HOG feature sets for indoor positioning using smartphone camera, *Jichao Jiao, Zhongliang Deng, Jun Mo, and Cheng Li, Beijing University of Posts and Telecommunications (China)*

12:30 – 2:00 pm Lunch Break

Mobile Platforms and Algorithms

Conference Chairs: David Akopian, The University of Texas at San Antonio (USA) and Reiner Creutzburg, Fachhochschulel Brandenburg - Brandenburg University of Applied Sciences (Germany)

2:00 – 3:20 pm
Golden Gate 5

2:00 MOBMU-300
Musical instruments simulation on mobile platform, *Xunyu Pan[1], Jacob Wilson[1], Megan Balukoff[1], Anyi Liu[2], and Wenjuan Xu[1]; [1]Frostburg State University and [2]Indiana University–Purdue University Fort Wayne (USA)*

2:20 MOBMU-301
Handle large-scale digital investigations with certain commercial forensic software tools on different forensic workstations, *Knut Bellin, Thomas Höne, and Reiner Creutzburg, Brandenburg University of Applied Sciences (Germany)*

2:40 MOBMU-302
Hierarchical text/non-text segmentation for document pages, *Canhui Xu[1], Cao Shi[1], Zhi Tang[2], and Xiaoqing Lu[2]; [1]Qingdao University of Science & Technology and [2]Institute of Computer Science and Technology, Peking University (China)*

3:00 MOBMU-303
Conception, implementation and test of a university course evaluation software including an app - Open university evaluation, - *Sebastian Müller, Max Gregor, Raoul van Rüschen, Rico Wildenhein, Martin Kindsmüller, and Reiner Creutzburg, Brandenburg University of Applied Sciences (Germany)*

Color Imaging XXI: Displaying, Processing, Hardcopy, and Applications

Conference grouping: Image Reproduction and Material Appearance

Conferences in this grouping discuss the effects of extra-spectral attributes; applications of color hard and soft copy: medical imaging, cartography, fine arts, new communications media, knowledge delivery; measurement of Bidirectional Reflectance Distribution Functions (BRDF), Bidirectional Texture Functions (BTF), and Bidirectional Surface Scattering Reflectance Distribution Function (BSSRDF); and quality evaluation of 2.5D and 3D soft- and hard-copy reproductions, among other topics.

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 hardcopy devices, but to an even larger extent to soft-copy displays. Adaptive gamut and tone mapping, dynamic contrast, adaptive power usage, and color management continue to support the unprecedented development of the display hardware spreading from mobile displays to large size screens.

This conference provides an opportunity to learn about the most recent developments in color imaging technologies and applications. Focus of the conference is on 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 software, media, and systems. Special attention is given to applications and requirements created by new disciplines.

The Special Session entitled "The Dark Side of Color" groups challenging questions, open issues, alternative views, paradigm shifts, bottom up experimentation, re-addressing the current state of the color science, technology, and applications.

Joint Sessions: **Retinex at 50** with the Human Vision and Electronic Imaging (HVEI) Conference

Conference Chairs: **Reiner Eschbach,** Monroe Community College (USA); **Gabriel G. Marcu,** Apple Inc. (USA); and **Alessandro Rizzi,** Univ. degli Studi di Milano (Italy)

Program Committee: **Jan P. Allebach,** Purdue Univ. (USA); **Vien Cheung,** Univ. of Leeds (UK); **Scott J. Daly,** Dolby Labs., Inc. (USA); **Phil J. Green,** Gjøvik Univ. College (Norway); **Roger D. Hersch,** École Polytechnique Fédérale de Lausanne (Switzerland); **Choon-Woo Kim,** Inha Univ. (Republic of Korea); **Michael A. Kriss,** MAK Consultants (USA); **Fritz Lebowsky,** STMicroelectronics (France); **Nathan Moroney,** Hewlett-Packard Labs. (USA); **Carinna E. Parraman,** Univ. of the West of England (UK); **Marius Pedersen,** Gjøvik Univ. College (Norway); **Shoji Tominaga,** Chiba Univ. (Japan); and **Stephen Westland,** Univ. of Leeds (UK)

Photo: San Francisco Travel Association–Scott Chernis.

Color Imaging XXI: Displaying, Processing, Hardcopy, and Applications

Monday, February 15, 2016

Display

Session Chair: Reiner Eschbach, Monroe Community College (USA)

9:10 – 10:10 am
Continental Ballroom 1

9:10 COLOR-304
Multiprimary display color calibration: A variational framework for robustness to device variation, *Carlos Rodriguez-Pardo and Gaurav Sharma, University of Rochester (USA)*

9:30 COLOR-305
High resolution LED display using a new rendering method with color sub-pixel architecture, *Dae-Sik Kim, Samsung Electronics Co., Ltd. (South Korea)*

9:50 COLOR-306
Modeling of luminance transition curve for transparent displays, *Hyeok Jun Kwon, Chang-Mo Yang, Min-Cheol Kim, and Choon-Woo Kim, Inha University (South Korea)*

10:10 – 10:50 am Coffee Break

Display & Halftone

Session Chair: Gabriel Marcu (USA)

10:50 am – 12:30 pm
Continental Ballroom 1

10:50 COLOR-307
Developing calibrating curves for trilinear interpolation model during display characterization (JIST-first), *Bangyong Sun[1,2], Jon Yngve Hardeberg[2], and Congjun Cao[1]; [1]Xi'an University of Technology (China) and [2]Gjøvik University College (Norway)*

11:10 COLOR-308
The preferred display color temperature (Non-transparent vs. Transparent display), *Hyeyoung Ha[1], Sooyeon Lee[1], Youngshin Kwak[1], Hyosun Kim[2], Young-jun Seo[2], and Byung-choon Yang[1]; [1]UNIST (South Korea) and [2]Samsung Display Co.,Ltd.*

11:30 COLOR-309
Extended corrected-moments illumination estimation, *Xiaochuan Chen[1], Mark Drew[1], Ze-Nian Li[1], and Graham Finlayson[2]; [1]Simon Fraser University (Canada) and [2]The University of East Anglia (United Kingdom)*

11:50 COLOR-310
Quad-interleaved block-level Parallel Direct Binary Search, *Xujie Zhang[1] and Jan Allebach[2]; [1]Qualcomm Company and [2]Purdue University (USA)*

12:10 COLOR-311
HVS-based model for superposition of two color halftones, *Altyngul Jumabayeva[1], Tal Frank[2], Robert Ulichney3, and Jan Allebach[1]; [1]Purdue University (USA), [2]Hewlett-Packard Indigo Division (Israel), and [3]Hewlett-Packard Laboratories USA (USA)*

12:30 – 2:00 pm Lunch Break

EI 2016 Opening Plenary and Symposium Awards
Session Chair: Choon-Woo Kim (Inha University)
2:00 – 3:00 PM
Continental Ballroom 5

Illuminating a bright future for medicine, *Audrey K. Bowden, Stanford University (USA)*

3:00 – 3:30 pm Coffee Break

Cameras

Session Chair: Fritz Lebowsky, STMicroelectronics (France)

3:30 – 4:50 pm
Continental Ballroom 1

3:30 COLOR-312
Demosaicking algorithms for different RGBW color filter arrays, *Mina Rafinazari and Eric Dubois, University of Ottawa (Canada)*

3:50 COLOR-313
Optimizing color accuracy of a filter-based multispectral camera via iccMAX framework for digital achieves, *Wei-Chun Hung and Pei-Li Sun, National Taiwan University of Science and Technology (Taiwan)*

4:10 COLOR-314
A learning-based approach to image demosaicking with spatial autocorrelation analysis, *Min-Kook Choi, Chan Joo, Hyun-Gyu Lee, and Sang-Chul Lee, Inha University (South Korea)*

4:30 COLOR-315
On the selection of patches for color camera calibration, *Margarita Khokhlova and Jon Yngve Hardeberg, Gjøvik University College (Norway)*

5:00 – 6:00 pm EI 2016 Symposium Reception

Tuesday, February 16, 2016

COLOR/HVEI: Retinex at 50: History Joint Session

Session Chair: Marcelo Bertalmio, Universitat Pompeu Fabra (Spain)

8:50 – 10:10 am
Continental Ballroom 4

This session is jointly sponsored by: Color Imaging XXI: Displaying, Processing, Hardcopy, and Applications, and Human Vision and Electronic Imaging (HVEI) 2016.

8:50 RETINEX-017
Retinexes algorithms: Many spatial processes used to solve many different problems (Invited), *John McCann, McCann Imaging (USA)*

9:30 RETINEX-018
Designator Retinex, Milano Retinex and the locality issue (Invited), *Alessandro Rizzi, Università degli Studi di Milano (Italy)*

10:10 – 10:50 am Coffee Break

COLOR/HVEI: Retinex at 50: Spatial Algorithms Joint Session

Session Chair: John McCann, McCann Imaging (USA)

10:50 am – 12:30 pm
Continental Ballroom 4

This session is jointly sponsored by: Color Imaging XXI: Displaying, Processing, Hardcopy, and Applications, and Human Vision and Electronic Imaging (HVEI) 2016.

10:50 RETINEX-019
The oriented difference of Gaussians model of brightness perception (Invited), *Mark McCourt and Barbara Blakeslee, North Dakota State University (USA)*

11:10 RETINEX-020
A center-surround framework for spatial image processing, *Vassilios Vonikakis, Advanced Digital Sciences Center (ADSC) (Singapore)*

11:30 RETINEX-021
Retinex-like computations in human lightness perception and their possible realization in visual cortex (Invited), *Michael Rudd, University of Washington (USA)*

11:50 RETINEX-022
The role of lightness perception in determining the perceived contrast of real world scenes (Invited), *David Kane and Marcelo Bertalmio, Universitat Pompeu Fabra (Spain)*

12:10 RETINEX-023
Processing astro photographs using Retinex based methods (Invited), *Daniele Marini, Alessandro Rizzi, and Cristian Bonanomi, Università degli Studi di Milano (Italy)*

12:30 – 2:00 pm Lunch Break

EI 2016 Tuesday Plenary and Symposium Awards
Session Chair: Nitin Sampat (Rochester Institute of Technology)
2:00 – 3:00 PM
Continental Ballroom 5

Pushing computational photography deeper into imaging system design, *Ren Ng, University of California, Berkeley (USA)*

3:00 – 3:30 pm Coffee Break

RETINEX at 50: Image Processing

Session Chair: Alessandro Rizzi, Università degli Studi di Milano (Italy)

3:30 – 5:30 pm
Continental Ballroom 1

3:30 RETINEX-316
Connections between Retinex, neural models and variational methods (Invited), *Marcelo Bertalmio, Universitat Pompeu Fabra (Spain)*

4:10 RETINEX-317
Image processing applications through a variational perceptually-based color correction related to Retinex (Invited), *Javier Vazquez-Corral[1], Syed Waqas Zamir[1], Adrian Galdran[2], David Pardo[3], and Marcelo Bertalmio[1]; [1]Universitat Pompeu Fabra, [2]Tecnalia, and [3]EHU/UPV and Ikerbasque (Spain)*

4:30 RETINEX-318
A generalized white-patch model for fast color cast detection in natural images (Invited), *José Luis Lisani[1], Ana Belen Petro[1], Edoardo Provenzi[2], and Catalina Sbert[1]; [1]Universitat des Illes Balears (Spain) and [2]Université Paris Descartes (France)*

4:50 RETINEX-319
Statistical aspects of space sampling in Retinex models (Invited), *Gabriele Gianini, Universitá degli Studi di Milano (Italy)*

5:10
RETINEX Discussion

EI 2016 Symposium Demonstration Session and Exhibit Hall Happy Hour
5:30 – 7:00 PM
Continental Ballroom Foyer

Wednesday, February 17, 2016

Color Management

Session Chair: Phil Green, Gjøvik University College (Norway)

8:50 – 10:10 am
Continental Ballroom 1

8:50 COLOR-320
Estimation of color matching function for tiled LCDs based on genetic algorithm, *Yohan Park[1], Chang-Mo Yang[1], Choon-Woo Kim[1], Hosup Lee[2], and Dae-Sik Kim[2]; [1]Inha University and [2]Samsung Electronics. (South Korea)*

9:10 COLOR-321
The spatial gamut mapping based on guided filter, *Ming Zhu[1,2], Jon Yngve Hardeberg[2], Na Wang[1], and Bangyong Sun[2]; [1]Henan Institute of Engineering (China) and [2]Gjøvik University College (Norway)*

9:30 COLOR-322
Can the problems of CIECAM02 be overcome without losing predicting accuracy?, *Zhifeng Wang[1], Zhiqiang Li[2], Ming Luo[3], Xuedong Zhang[4], and Changjun Li[5]; [1]University of Science and Technology Liaoning (China) and [3]University of Leeds (United Kingdom)*

9:50 COLOR-323
A color retargeting approach for mesopic vision: simulation and compensation (JIST-first), *Mehdi Rezagholizadeh[1], Tara Akhavan[2], Afsoon Soudi[3], Hannes Kaufmann[2], and James Clark[4]; [1]McGill University (Canada), [2]Vienna University of Technology (Austria), and [3]TandemLaunch Inc. (Canada)*

10:10 – 10:40 am Coffee Break

Color Deficiency

Session Chair: Alessandro Rizzi, Università degli Studi di Milano (Italy)

10:40 am – 12:40 pm
Continental Ballroom 1

10:40 COLOR-324
Using a data-bearing frame to capture an extended target, *Robert Ulichney, Matthew Gaubatz, Chun-Jung Tai, Stephen Pollard, Melanie Gottwals, and Ingeborg Tastl, Hewlett-Packard, Inc (USA)*

11:00 COLOR-325
A new approach to image enhancement for the visually impaired, *Xiaohong Gao[1] and Monica Loomes[2]; [1]Middlesex University and [2]Hertfordshire County Council (United Kingdom)*

11:20 COLOR-326
Quality of color coding in maps for color deficient observers, *Anne Kristin Kvitle, Marius Pedersen, and Peter Nüssbaum, Gjøvik University College (Norway)*

11:40 COLOR-327
Image quality assessment comparison between local and whole color rendering on large displays, *YoonJung Kim, Daeun Park, and YungKyung Park, Ewha Womans University (South Korea)*

12:00 COLOR-328
Colour vision deficiency transforms using ICC profiles, *Phil Green and Peter Nussbaum, Gjøvik University College (Norway)*

12:20 COLOR-329
Color appearance simulations using spectral estimation theory, *Haomiao Jiang, Trisha Lian, Brian Wandell, and Joyce Farrell, Stanford University (USA)*

12:40 – 2:00 pm Lunch Break

EI 2016 Wednesday Plenary and Symposium Awards
Session Chair: Choon-Woo Kim (Inha University)
2:00 – 3:00 PM
Continental Ballroom 5

Intel® RealSense Technology: Adding human-like sensing and interactions to computing devices, *Achin Bhowmik, Intel Corporation (USA)*

3:00 – 3:30 pm Coffee Break

The Dark Side of Color
Session Chair: Reiner Eschbach, Monroe Community College (USA)
3:30 – 5:30 pm
Continental Ballroom 1

3:30 COLOR-330
How red is cadmium red?, *Carinna Parraman[1] and Judith Mottram[2]; [1]University of the West of England and [2]Royal College of Art (United Kingdom)*

3:50 COLOR-331
Contentious and discrete spectral power distributions: Which is a better white light source?, *Po-Chieh Hung, Konica Minolta, Inc. (Japan)*

4:10 COLOR-332
Color management breaks good anaglyph 3D images – is there a solution?, *Andrew Woods, Curtin University (Australia)*

4:30 COLOR-333
New dimension of color perception: From artistic expression to scientific analysis, *Larissa Noury[2] and Christine Fernandez Maloigne[1,3,4]; [1]XLIM, [2]Couleur-Espace-Culture, [3]University of Poitiers, and [4]CNRS (France)*

4:50 COLOR-334
The murkiness of image quality assessment, *Marius Pedersen, Gjøvik University College (Norway)*

5:10 COLOR-335
For each country, a color of lipstick, *Christine Fernandez Maloigne[1,2,3]; [1]University of Poitiers, [2]XLIM lab, and [3]CNRS (France)*

Color Imaging XXI: Displaying, Processing, Hardcopy, and Applications Interactive Papers Session

5:30 – 7:00 pm
Continental Ballroom 6

The following works will be presented at the EI 2016 Symposium Interactive Papers Session.

COLOR-336
Color vision testing using the Oculus Rift, *Trisha Lian, Haomiao Jiang, and Joyce Farrell, Stanford University (USA)*

EI 2016 Symposium Interactive Papers Session
5:30 – 7:00 PM
Continental Ballroom 6

Thursday, February 18, 2016

Color in Medical Applications

Session Chair: Daniele Marini, Università degli Studi di Milano (Italy)

9:10 – 10:10 am
Continental Ballroom 1

9:10 COLOR-337
Optical imaging techniques for non-contact measurements of vital functions and diagnosis of malignant tissues in medicine, *Rudolf Verdaasdonk, John Klaessens, and Albert Veen, VU University Medical Center (Netherlands)*

9:30 COLOR-338
Characterisation of skin spectra in a Caucasian and Oriental sample, *Kaida Xiao[3,2], Mengmeng Wang[1], Ming Luo[1], Changjun Li[3], and Sophie Wuerger[2]; [1]University of Leeds, [2]University of Liverpool (United Kingdom), and [3]University of Science and Technology Liaoning (China)*

9:50 COLOR-339
Current problems and perspectives on colour in medical imaging, *William Revie[1] and Phil Green[2]; [1]FFEI (United Kingdom) and [2]Gjøvik University College (Norway)*

10:10 – 10:50 am Coffee Break

Printing

Session Chair: Carinna Parraman, University of the West of England (United Kingdom)

10:50 am – 12:30 pm
Continental Ballroom 1

10:50 COLOR-340
Dynamic print stream classification and optimal JPEG compression, *Cheng Lu[1], Mark Shaw[2], Randy Guay[2], David Day[2], and Jan Allebach[1]; [1]Purdue University and [2]Hewlett Packard (USA)*

11:10 COLOR-341
Toner usage prediction, *Mengqi Gao[2], Yanling Ju[1], Terry Nelson[3], Theresa Prenn[3], and Jan Allebach[1]; [2]Purdue University and [3]Hewlett-Parkard Co. (USA)*

11:30 COLOR-342
Color uniformity improvement for an inkjet color 3D printing system, *Pei-Li Sun and Yuping Sie, National Taiwan University of Science and Technology (Taiwan)*

11:50 COLOR-343
Vector driven 2.5D printing with non-photorealistic rendering, *Paul O'Dowd, Carinna Parraman, and Mikaela Harding, University of the West of England (United Kingdom)*

12:10 COLOR-344
2.5D printing: The evolution of the water lily, *Carinna Parraman, Paul O'Dowd, and Mikaela Harding, University of the West of England (United Kingdom)*

12:30 – 2:00 pm Lunch Break

Invited Talk: Vision Security - The Role of Imaging
Session Chair: Alessandro Rizzi, Università degli Studi di Milano (Italy)
2:00 – 2:30 pm
Continental Ballroom 1

COLOR-345
Vision security – the role of imaging, *Marius Pedersen and Jon Yngve Hardeberg, Gjøvik University College (Norway)*

Vision & Image Processing

Session Chair: Marius Pedersen, Gjøvik University College (Norway)

2:30 – 5:10 pm
Continental Ballroom 1

2:30 COLOR-346
Psychophysical study of color verbalization using fuzzy logic, *Corey Abshire[1], Jan Allebach[2], and Dmitri Gusev[3]; [1]Indiana University and [2]Purdue University (USA)*

2:50 COLOR-347
Lightness perception for different size displays under various surround conditions, *YungKyung Park[1], Hyosun Kim[2], Young-jun Seo[2], and YoonJung Kim[1]; [1]Ewha Womans University and [2]Samsung Display Co. Ltd. (South Korea)*

3:10 COLOR-348
Enhancement of perceived sharpness by chroma contrast, *YungKyung Park and YoonJung Kim, Ewha Womans University (South Korea)*

3:30 COLOR-349
Choice of distance metrics for RGB color image analysis, *Amadou Tidjani Sanda Mahama[1], Augustin Dossa[1], and Pierre Gouton[2]; [1]Institut de Mathématiques et de Sciences Physiques (Benin) and [2]Université de Bourgogne (France)*

3:50 COLOR-350
Digital image segmentation for object-oriented halftoning, *Zuguang Xiao[1], Mengqi Gao[1], Brent Bradburn[2], and Jan Allebach[1]; [1]Purdue University and [2]Hewlett-Packard (USA)*

4:10 COLOR-351
How suitable is structure tensor analysis for real-time color image compression in context of high quality display devices, *Fritz Lebowsky and Mariano Bona, STMicroelectronics (France)*

4:30 COLOR-352
Preserving color fidelity in real-time color image compression using a ranking naturalness criterion, *Marina Nicolas and Fritz Lebowsky, STMicroelectronics (France)*

4:50 COLOR-353
Multiscale approach for dehazing using the STRESS framework (JIST-first), *Vincent Jacob Whannou de Dravo and Jon Yngve Hardeberg; The Norwegian Colour and Visual Computing Laboratory, Gjøvik University College (Norway)*

Measuring, Modeling, and Reproducing Material Appearance 2016

Conference grouping: Image Reproduction and Material Appearance

Conferences in this grouping discuss the effects of extra-spectral attributes; applications of color hard and soft copy: medical imaging, cartography, fine arts, new communications media, knowledge delivery; measurement of Bidirectional Reflectance Distribution Functions (BRDF), Bidirectional Texture Functions (BTF), and Bidirectional Surface Scattering Reflectance Distribution Function (BSSRDF); and quality evaluation of 2.5D and 3D soft- and hard-copy reproductions, among other topics.

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.

Awards: Best Student Paper Award

Photo: Dietmar Wueller.

Conference Chairs: **Francisco H. Imai,** Canon U.S.A., Inc. (USA); **Maria V. Ortiz-Segovia,** Océ Print Logic Technologies (France); and **Philipp Urban,** Fraunhofer-Institut für Graphische Datenverarbeitung (Germany);

Program Committee: **Jan P. Allebach,** Purdue Univ. (USA); **Susan P. Farnand,** Rochester Institute of Technology (USA); **Roland Fleming,** Justus-Liebig-Universität Giessen (Germany); **Jon Yngve Hardeberg,** Gjøvik Univ. College (Norway); **Mathieu Hebert,** Université Jean Monnet de Saint Etienne (France); **Matthias B. Hullin,** Univ. Bonn (Germany); **Susanne Klein,** Hewlett-Packard (UK); **Gary Meyer,** Univ. of Minnesota (USA); **Gael Obein,** Conservatoire National des Arts et Metiers (France); **Holly Rushmeier,** Yale Univ. (USA); **Sabine Süsstrunk,** École Polytechnique Fédérale de Lausanne (Switzerland); **Ingeborg Tastl,** Hewlett-Packard Labs. (USA); **Shoji Tominaga,** Chiba University (Japan); and **Greg Ward,** Dolby Labs., Inc. (USA)

Conference Sponsor

Canon

Measuring, Modeling, and Reproducing Material Appearance 2016

Monday, February 15, 2016

Keynote: Computational Imaging for Inverse Scattering
Session Chair: Philipp Urban, Fraunhofer IGD (Germany)
8:50 – 9:50 am
Continental Ballroom 2

MMRMA-354
Computational imaging for inverse scattering, *Ioannis Gkioulekas[1], Kavita Bala[2], Frédo Durand[3], Anat Levin[4], Shuang Zhao[5], and Todd Zickler[1]; [1]Harvard University (USA), [2]Cornell University (USA), [3]Massachusetts Institute of Technology (USA), [4]The Weizmann Institute of Science (Israel), and [5]University of California, Irvine (USA)*

Measuring

Session Chair: Maria Ortiz Segovia, Océ - Canon Group (France)

9:50 – 10:10 am
Continental Ballroom 2

MMRMA-355
Trichromatic reflectance capture using a tunable light source: Setup, characterization and reflectance estimation, *Tejas Tanksale and Philipp Urban, Fraunhofer IGD (Germany)*

10:10 – 10:50 am Coffee Break

Measuring (continued)

Session Chair: Greg Ward, Dolby Laboratories (USA)

10:50 am – 12:30 pm
Continental Ballroom 2

10:50 MMRMA-356
BRDF interpolation using anisotropic stencils, *Radomir Vavra and Jiri Filip, Inst. of Information Theory and Automation of the CAS (Czech Republic)*

11:10 MMRMA-357
3D scanner characterisation for open design, *Fabrizio Valpreda[1] and Paola Iacomussi[2]; [1]Politecnico di Torino and [2]INRIM (Italy)*

11:30 MMRMA-358
Learning optimal incident illumination using spectral BRDF images for material classification (JIST-first), *Sandra Skaff, Siu-Kei Tin, and Manuel Martinello, Canon USA (USA)*

11:50 MMRMA-359
Multispectral BRDF measurements on anisotropic surfaces: Application to structured metallic surfaces and the aspect simulation of OLED displays, *Pierre Boher, Thierry Leroux, Thibault Bignon, and Véronique Collomb-Patton, ELDIM (France)*

12:10 MMRMA-360
Image based reflectance measurement based on camera spectral sensitivities, *Aditya Sole[1], Ivar Farup[1], and Shoji Tominaga[2]; [1]Gjøvik University College (Norway) and [2]Graduate School of Advanced Integration Science, Chiba University (Japan)*

12:30 – 2:00 pm Lunch Break

EI 2016 Opening Plenary and Symposium Awards
Session Chair: Choon-Woo Kim (Inha University)
2:00 – 3:00 PM
Continental Ballroom 5

Illuminating a bright future for medicine, *Audrey K. Bowden, Stanford University (USA)*

3:00 – 3:30 pm Coffee Break

Reproducing

Session Chair: Ingeborg Tastl, Hewlett-Packard Laboratories (USA)

3:30 – 4:30 pm
Continental Ballroom 2

3:30 MMRMA-361
Relating optical and geometric surface characteristics for gloss management in printing applications (JIST-first), *Teun Baar[1,2], Hans Brettel[1], and Maria Ortiz Segovia[2]; [1]Institut Mines - Télécom and [2]OCE Print Logic Technologies (France)*

3:50 MMRMA-362
An exploration of 2.5D printing as tactile pictures, *Carinna Parraman[1] and Maria Ortiz Segovia[2]; [1]University of the West of England (United Kingdom) and [2]Océ Print Logic Technologies SA (France)*

4:10 MMRMA-363
Interrelation between gloss and texture perception of 2.5D-printed surfaces, *Teun Baar[1,2], Sepideh Samadzadegan[3], Philipp Urban[4], and Maria Ortiz Segovia[2]; [1]Institut Mines-Télécom; Télécom ParisTech (France), [2]Océ Print Logic Technologies (France), [3]Technische Universität Darmstadt (Germany), and [4]Fraunhofer IGD (Germany)*

5:00 – 6:00 pm EI 2016 Symposium Reception

Tuesday, February 16, 2016

Perception in MMRMA

Session Chairs: Mathieu Hebert, Université Jean Monnet de Saint Etienne (France) and Sabine Süsstrunk, EPFL-IC-IVRL (Switzerland)

8:50 – 10:20 am
Continental Ballroom 2

8:50 MMRMA-364
Modeling and estimation for surface-spectral reflectance of watercolor paintings, *Shoji Tominaga and Takahiko Horiuchi, Chiba University (Japan)*

9:10 MMRMA-365
Brightness and sparkle appearance of goniochromatic samples, *Paola Iacomussi, Michela Radis, and Giuseppe Rossi, INRIM (Italy)*

9:30 MMRMA-366
Perceptual dependencies between texture and color in fabric appearance, *Takafumi Katsunuma, Keita Hirai, and Takahiko Horiuchi, Chiba University (Japan)*

9:50 MMRMA-367
Effects of mesoscale surface structure on perceived brightness, *Michael Ludwig and Gary Meyer, University of Minnesota (USA)*

10:20 – 10:40 am Coffee Break

Invited Speaker: Refractive Object Reconstruction using Computational Imaging
Session Chair: Francisco Imai, Canon U.S.A. Inc. (USA)
10:40 – 11:20 am
Continental Ballroom 2

MMRMA-368
Refractive object reconstruction using computational imaging, *Gordon Wetzstein, Stanford University (USA)*

Modeling

Session Chair: Susan Farnand, Rochester Institute of Technology (USA)

11:20 am – 12:30 pm
Continental Ballroom 2

11:20 MMRMA-369
Assessing the capacity of a two-flux model to predict the spectral reflectance of stratified coloring coatings, *Mathieu Hebert[1,2], Serge Mazauric[1], and Lionel Simonot[3]; [1]Université Jean Monnet, [2]Institut d'Optique Graduate School, and [3]Université de Poitiers (France)*

11:40 MMRMA-370
Fitting analytical BRDF models to low-resolution measurements of light scattered from relief printing samples, *Ni Yan[1], Teun Baar[2], Maria Ortiz Segovia[2], and Jan Allebach[1]; [1]Purdue University (USA) and [2]Océ Print Logic Technologies (France)*

12:00 MMRMA-371
Testing spatial patterns for acquiring shape and subsurface scattering properties, *Yitzchak Lockerman, Samuel Brenner, Joseph Lanzone, Alexander Doronin, and Holly Rushmeier, Yale Univ (USA)*

12:30 – 2:00 pm Lunch Break

EI 2016 Tuesday Plenary and Symposium Awards
Session Chair: Nitin Sampat (Rochester Institute of Technology)
2:00 – 3:00 PM
Continental Ballroom 5

Pushing computational photography deeper into imaging system design, *Ren Ng, University of California, Berkeley (USA)*

3:00 – 3:30 pm Coffee Break

EI 2016 Symposium Demonstration Session and Exhibit Hall Happy Hour
5:30 – 7:00 PM
Continental Ballroom Foyer

Document Recognition and Retrieval (DRR) XXIII

Conference grouping: Document Processing and Media Security

Conferences in this grouping discuss document clustering and classification, query languages and modalities, pattern discovery, trend mining, topic modeling and analysis, clustering, media forensics and authentication, biometrics and user identification, and physical object identification and interaction, among other topics.

Conference overview

Document Recognition and Retrieval (DRR) is one of the leading international conferences devoted to current research in document analysis, recognition, and retrieval. Papers are presented in oral and poster sessions at the conference, along with invited talks by leading researchers. Papers are indexed by DBLP. At the conference a Best Student Paper Award is presented.

Awards: Best Student Paper Award

Photo: Francisco Imai.

Conference Chairs: **Bart Lamiroy,** Univ. de Lorraine (France), and **Sameer Antani,** National Library of Medicine (USA)

Program Committee: **Gady Agam,** Illinois Institute of Technology (USA); **Elisa H. Barney Smith,** Boise State Univ. (USA); **William A. Barrett,** Brigham Young Univ. (USA); **Bertrand Coüasnon,** Institut National des Sciences Appliquées de Rennes (France); **Xiaoqing Ding,** Tsinghua Univ. (China); **Ergina Kavallieratou,** Univ. of the Aegean (Greece); **Laurence Likforman-Sulem,** Telecom ParisTech (France); **Xiaofan Lin,** A9.com, Inc. (USA); **Daniel P. Lopresti,** Lehigh Univ. (USA); **Umapada Pal,** Indian Statistical Institute (India); **Eric K. Ringger,** Brigham Young Univ. (USA); **Sargur N. Srihari,** Univ. at Buffalo (USA); **Kazem Taghva,** Univ. of Nevada, Las Vegas (USA); **George R. Thoma,** National Library of Medicine (USA); **Christian Viard-Gaudin,** Univ. de Nantes (France); **Pingping Xiu,** Salesforce.com, Inc. (USA); **Richard Zanibbi,** Rochester Institute of Technology (USA); and **Jie Zou,** National Library of Medicine (USA)

Document Recognition and Retrieval (DRR) XXIII

Wednesday, February 17, 2016

Recognition and Classification

11:00 am – 12:30 pm
Continental Ballroom 2

11:00 DRR-052
Training a calligraphy style classifier on a non-representative training set, *George Nagy[1] and Xiafen Zhang[2]; [1]Rensselaer Polytechnic Institute (USA) and [2]Shanghai Maritime University (China)*

11:30 DRR-053
Human-directed optical music recognition, *Liang Chen and Christopher Raphael, Indiana University Bloomington (USA)*

12:00 DRR-054
Arrowhead detection in biomedical images, *K.C. Santosh[1], Naved Alam[2], Pratim Partha Roy[2], Sameer Antani[1], George Thoma[1], and Laurent Wendling[3]; [1]US National Library of Medicine (USA), [2]IIT Roorkie (India), and [3]Paris V University (France)*

12:30 – 2:00 pm Lunch Break

EI 2016 Wednesday Plenary and Symposium Awards
Session Chair: Choon-Woo Kim (Inha University)
2:00 – 3:00 PM
Continental Ballroom 5

Intel® RealSense Technology: Adding human-like sensing and interactions to computing devices, *Achin Bhowmik, Intel Corporation (USA)*

3:00 – 3:30 pm Coffee Break

Writer and Language Identification – Handwriting

3:30 – 5:30 pm
Continental Ballroom 2

3:30 DRR-055
Simple and fast geometrical descriptors for writer identification, *Angelika Garz[1], Marcel Würsch[1], Andreas Fischer[1,2], and Rolf Ingold[1]; [1]University of Fribourg and [2]University of Applied Sciences and Arts Western Switzerland (Switzerland)*

4:00 DRR-056
Cuckoos among your data: A quality control method to retrieve mislabeled writer identities from handwriting datasets, *Vlad Atanasiu, University of Fribourg (Switzerland)*

4:30 DRR-057
Intelligent pen: A least cost search approach to stroke extraction in historical documents, *Kevin Bauer and William Barrett, Brigham Young University (USA)*

5:00 DRR-058
Language identification in document images (JIST-first), *Philippine Barlas, David Hébert, Clément Chatelain, Sébastien Adam, and Thierry Paquet, LITIS (France)*

EI 2016 Symposium Interactive Papers Session
5:30 – 7:00 PM
Continental Ballroom 6

Thursday, February 18, 2016

DRR Keynote
Session Chairs: Sameer Antani, National Library of Medicine (USA) and Bart Lamiroy, Université de Lorraine (France)
8:40 – 10:20 am
Continental Ballroom 2
DRR Opening Remarks

DRR-059
OCR at Google: Books and Beyond, *Yasuhisa Fujii, Dmitriy Genzel, Otavio Good, Patrick Hurst, Yuanpeng Li, Ashok Popat, and Ray Smith, Google Inc. (USA)*

10:20 – 11:00 am Coffee Break

OCR and Text Recognition

11:00 am – 12:30 pm
Continental Ballroom 2

11:00 DRR-060
Improving a deep convolutional neural network architecture for character recognition, *Bogdan-Ionut Cirstea and Laurence Likforman, Telecom ParisTech / Institut Mines-Telecom (France)*

11:30 DRR-061
Integrating text recognition for overlapping text detection in maps, *Narges Honarvar Nazari, Tianxiang Tan, and Yao-Yi Chiang, University of Southern California (USA)*

12:00 DRR-062
Automatic transcription of historical newsprint by leveraging the Kaldi speech recognition toolkit, *Patrick Schone, Alan Cannaday, Seth Stewart, Rachael Day, and Jeremy Schone, Family Search (USA)*

12:30 – 2:00 pm Lunch Break

DRR Panel Discussion
Panel Moderators: Sameer Antani, National Library of Medicine (USA) and Bart Lamiroy, Université de Lorraine (France)
2:00 – 3:00 pm
Continental Ballroom 2

3:00 – 3:30 pm Coffee Break

Text Analysis

3:30 – 5:00 pm
Continental Ballroom 2

3:30 DRR-063
Recognizing predatory chat documents using semi-supervised anomaly detection, *Mohammadreza Ebrahimi, Ching Suen, Olga Ormandjieva, and Adam Krzyzak, Concordia University (Canada)*

4:00 DRR-064
Information extraction from resume documents in PDF format, *Jiaze Chen, Liangcai Gao, and Zhi Tang, Peking University (China)*

4:30 DRR-065
Revisiting known-item retrieval in degraded document collections, *Jason Soo and Ophir Frieder, Georgetown University (USA)*

Media Watermarking, Security, and Forensics 2016

Conference grouping: Document Processing and Media Security

Conferences in this grouping discuss document clustering and classification, query languages and modalities, pattern discovery, trend mining, topic modeling and analysis, clustering, media forensics and authentication, biometrics and user identification, and physical object identification and interaction, among other topics.

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.

Awards: Best Paper

Photo: Diana Gonzalez.

Conference Chairs: **Adnan M. Alattar,** Digimarc Corp. (USA), and **Nasir D. Memon,** Polytechnic Institute of New York Univ. (USA)

Program Committee: **Mauro Barni,** Univ. degli Studi di Siena (Italy); **Sebastiano Battiato,** Univ. degli Studi di Catania (Italy); **Jeffrey A. Bloom,** Sirius XM Satellite Radio (USA); **Marc Chaumont,** Lab. d'Informatique de Robotique et de Microelectronique de Montpellier (France); **Scott A. Craver,** Binghampton Univ. (USA); **Edward J. Delp,** Purdue Univ. (USA); **Jana Dittmann,** Otto-von-Guericke-Univ. Magdeburg (Germany); **Gwenaël Doërr,** Technicolor S.A. (France); **Tomas Filler,** Digimarc Corp. (USA); **Jessica Fridrich,** Binghamton Univ. (USA); **Anthony T. S. Ho,** Univ. of Surrey (UK); **Jiwu Huang,** Sun Yat-Sen Univ. (China); **Ton Kalker,** DTS, Inc. (USA); **Andrew D. Ker,** Univ. of Oxford (UK); **Matthias Kirchner,** Binghamton University (USA); **Alex C. Kot,** Nanyang Technological Univ. (Singapore); **Chang-Tsun Li,** The Univ. of Warwick (UK); **Pierre Moulin,** Univ. of Illinois at Urbana-Champaign (USA); **Regunathan Radhakrishnan,** Pivotal Systems (USA); **Husrev Taha Sencar,** TOBB Univ. of Economics and Technology (Turkey); **Gaurav Sharma,** Univ. of Rochester (USA); **Yun Qing Shi,** New Jersey Institute of Technology (USA); **Ashwin Swaminathan,** Qualcomm Technologies Inc. (USA); **Claus Vielhauer,** Fachhochschule Brandenburg (Germany); **Svyatoslav V. Voloshynovskiy,** Univ. de Genève (Switzerland); and **Chang Dong Yoo,** Korea Advanced Institute of Science and Technology (KAIST) (Republic of Korea)

Media Watermarking, Security, and Forensics 2016

Monday, February 15, 2016

Forensics

Session Chair: Sebastiano Battiato, University of Catania (Italy)

8:50 – 10:10 am
Continental Ballroom 3

8:50
MWSF Conference Opening Remarks

8:55 MWSF-066
Ambiguity attack on the integrity of a genuine picture by producing another picture immune to generic digital forensic test, *Jun Yu[1], Enping Li[2], and Scott Craver[3]; [1]Marvell Semiconductors, Inc., [2]Eastern Kentucky University, and [3]Binghamton University (USA)*

9:20 MWSF-067
Compression forensics beyond the first significant digit, *Sujoy Chakraborty and Matthias Kirchner, Binghamton University (USA)*

9:45 MWSF-068
Detecting copy-move forgeries in scanned text documents, *Svetlana Abramova and Rainer Böhme, Universität Innsbruck (Austria)*

10:10 – 10:30 am Coffee Break

Watermarking

Session Chair: Gaurav Sharma, University of Rochester (USA)

10:30 am – 12:10 pm
Continental Ballroom 3

10:30 MWSF-069
Improvement of trade-off between compression tolerance and perceptibility of video watermark for broadcasting, *Keizo Kato, Kensuke Kuraki, and Ryuta Tanaka, Fujitsu Laboratories Ltd. (Japan)*

10:55 MWSF-070
Optically written watermarking technology using temporally and spatially luminance-modulated light, *Kohei Ohshita, Piyarat Silapasuphakornwong, Hiroshi Unno, and Kazutake Uehira, Kanagawa Institute of Technology (Japan)*

11:20 MWSF-071
Maximal stable extremal regions for robust video watermarking, *Waldemar Berchtold, Marcel Schaefer, and Martin Steinebach, Fraunhofer SIT (Germany)*

11:45 MWSF-072
Telltale watermarks for counting JPEG compressions, *Matthias Carnein[1], Pascal Schöttle[2], and Rainer Böhme[2]; [1]University of Münster (Germany) and [2]Universität Innsbruck (Austria)*

12:10 – 2:00 pm Lunch Break

EI 2016 Opening Plenary and Symposium Awards
Session Chair: Choon-Woo Kim (Inha University)
2:00 – 3:00 PM
Continental Ballroom 5

Illuminating a bright future for medicine, *Audrey K. Bowden, Stanford University (USA)*

3:00 – 3:30 pm Coffee Break

Identification

Session Chair: Adnan Alattar, Digimarc Corporation (USA)

3:30 – 4:00 pm
Continental Ballroom 3

3:30 MWSF-073
Attacks on speaker identification systems constrained to speech-to-text decoding, *Alireza Farrokh Baroughi[1], Daniel Douglas[2], and Scott Craver[1]; [1]Binghamton University and [2]Temple University (USA)*

5:00 – 6:00 pm EI 2016 Symposium Reception

Tuesday, February 16, 2016

Steganography

Session Chair: Jessica Fridrich, SUNY Binghamton (USA)

8:50 – 10:10 am
Continental Ballroom 3

8:50
Opening Remarks

8:55 MWSF-074
Detection and embedding strategies for linguistic steganography, *Alex Wilson and Andrew Ker, University of Oxford (United Kingdom)*

9:20 MWSF-075
Separating steganographic images by embedding key, *Tu-Thach Quach, University of New Mexico (USA)*

9:45 MWSF-076
Toss that BOSSbase, Alice!, *Vahid Sedighianaraki[1], Jessica Fridrich[1], and Remi Cogranne[2]; [1]Binghamton University (USA) and [2]Université de Technologie Troyes (France)*

10:10 – 10:30 am Coffee Break

Steganalysis

Session Chair: Vojtech Holub, Digimarc Corporation ()

10:30 am – 12:10 pm
Continental Ballroom 3

10:30 MWSF-077
Accelerating the DCTR features extraction for JPEG steganalysis based on CUDA, *Chao Xia, Qingxiao Guan, Xianfeng Zhao, and Yong Deng, Chinese Academy of Sciences (China)*

10:55 MWSF-078
Deep learning is a good steganalysis tool when embedding key is reused for different images, even if there is a cover source-mismatch, *Lionel Pibre, Jérôme Pasquet, Dino Ienco, and Marc Chaumont, LIRMM (France)*

11:20 MWSF-079
Detecting messages hidden in favicons, *Tomas Pevny[1], Martin Kopp[3], Jakub Kroustek[4], and Andrew Ker[2]; [1]Czech Technical University in Prague (Czech Republic), [2]University of Oxford (United Kingdom), [3]Cisco Systems, Inc. (Czech Republic), and [4]AVG Technologies (Czech Republic)*

11:45 MWSF-080
Improving selection-channel-aware steganalysis features, *Tomas Denemark and Jessica Fridrich, Binghamton University (USA)*

12:10 – 2:00 pm Lunch Break

EI 2016 Tuesday Plenary and Symposium Awards
Session Chair: Nitin Sampat (Rochester Institute of Technology)
2:00 – 3:00 PM
Continental Ballroom 5

Pushing computational photography deeper into imaging system design, *Ren Ng, University of California, Berkeley (USA)*

3:00 – 3:30 pm Coffee Break

Keynote: Security, Privacy, and Regulatory Challenges of Unmanned Aerial Vehicle Integration
Session Chair: Nasir Memon, New York University (USA)
3:30 – 4:30 pm
Continental Ballroom 3

MWSF-081
Security, privacy, and regulatory challenges of unmanned aerial vehicle integration, *Evan Carr, AppFolio Inc. (USA)*

EI 2016 Symposium Demonstration Session and Exhibit Hall Happy Hour
5:30 – 7:00 PM
Continental Ballroom Foyer

Wednesday, February 17, 2016

Banknote Security

Session Chair: Scott Craver, Binghamton University (USA)

8:50 – 10:10 am
Continental Ballroom 3

8:50 MWSF-082
Banknote crease detection and banknote fitness classification, *Reinhold Huber-Mörk, Johannes Ruisz, and Svorad Štolc, Austrian Institute of Technology (Austria)*

9:15 MWSF-083
Forensic authentication of banknotes on mobile phones, *Thomas Dewaele, Maurits Diephuis, Slava Voloshynovskiy, and Taras Holotyak, Université de Genève (Switzerland)*

9:40 MWSF-084
Security evaluation based on the analytic hierarchy process for first-line anti-counterfeit elements, *Manabu Yamakoshi, Junichi Tanaka, and Hiroshi Iwasaki, National Printing Bureau of Japan (Japan)*

10:10 – 10:30 am Coffee Break

Fingerprinting

Session Chair: Matthias Kirchner, Binghamton University (USA)

10:30 am – 12:10 pm
Continental Ballroom 3

10:30 MWSF-085
A novel attack model for collusion secure fingerprinting codes, *Marcel Schaefer[1], Waldemar Berchtold[1], Teetje Stark[3], Nils Reimers[2], and Martin Steinebach[1]; [1]Fraunhofer SIT, [2]Technische Universität Darmstadt, and [3]Freie Universität Berlin (Germany)*

10:55 MWSF-086
Effect of compression on sensor-fingerprint based camera identification, *Miroslav Goljan[1], Jessica Fridrich[1], Mo Chen[1], and Pedro Comesaña[2]; [1]SUNY Binghamton (USA) and [2]University of Vigo (Spain)*

11:20 MWSF-087
Patch-based desynchronization of digital camera sensor fingerprints, *John Entrieri and Matthias Kirchner, Binghamton University (USA)*

11:45 MWSF-088
Robust smartphone fingerprint by mixing device sensors features for mobile strong authentication, *Irene Amerini[1], Paolo Bestagini[2], Roberto Caldelli[1,3], Matteo Casini[1], Stefano Tubaro[2], and Luca Bondi[2]; [1]University of Florence, [2]Polytechnic of Milano, and [3]CNIT - National Interuniversity Consortium for Telecommunications (Italy)*

12:10 – 2:00 pm Lunch Break

EI 2016 Wednesday Plenary and Symposium Awards
Session Chair: Choon-Woo Kim (Inha University)
2:00 – 3:00 PM
Continental Ballroom 5

Intel® RealSense Technology: Adding human-like sensing and interactions to computing devices, *Achin Bhowmik, Intel Corporation (USA)*

3:00 – 3:30 pm Coffee Break

Noise & Quality

Session Chair: Marc Chaumont, LIRMM Montpellier France (France)

3:30 – 4:30 pm
Continental Ballroom 3

3:30 MWSF-089
Experimental study of Print-and-Scan impact as random process, *Iuliia Tkachenko[1,2], William Puech[1], Olivier Strauss[1], and Christophe Destruel[2]; [1]University of Montpellier and [2]Authentication Industries (France)*

3:55 MWSF-090
Quality metric for 2D textures on 3D objects, *Waldemar Berchtold, Marcel Schaefer, Sascha Wombacher, and Martin Steinebach, Fraunhofer SIT (Germany)*

4:20
Media Watermarking, Security, and Forensics Concluding Remarks

EI 2016 Symposium Interactive Papers Session
5:30 – 7:00 PM
Continental Ballroom 6

Computational Imaging XIV

Conference grouping: Image and Video Processing, Quality, and Systems

Conferences in this grouping discuss electrical resistance and impedance imaging; diffusion optical imaging; imagery-based surveillance and tracking; the readability of electronic paper and mobile displays; image preference measurement and modeling; medical and forensic imaging; genetic and evolutionary computing; steganography and data hiding, microarray imaging; electronic cinema; multimedia content retrieval; and image and video compression, communications, segmentation and recognition, restoration and enhancement, among other topics.

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.

Photo: Dietmar Wueller.

Conference Chairs and Program Committee:
Charles A. Bouman, Purdue Univ. (USA), and
Ken D. Sauer, Univ. of Notre Dame (USA)

Computational Imaging XIV

Tuesday, February 16, 2016

Keynote: Indoor and Outdoor Image Based Localization for Mobile Devices
Session Chair: Charles Bouman, Purdue University (USA)
8:50 – 9:50 am
Golden Gate 1

8:50 COIMG-147
Indoor and outdoor image based localization for mobile devices, *Avideh Zakhor, University of California, Berkeley (USA)*

Optimization and Learning

Session Chair: Peyman Milanfar, Google, Inc. (USA)

9:50 – 10:30 am
Golden Gate 1

9:50 COIMG-148
An alternating direction method of multiplier algorithm for single-photon imaging sensors, *Stanley Chan, Purdue University (USA)*

10:10 COIMG-149
Adaptive activation functions for deep networks, *Michael Dushkoff, Rochester Institute of Technology (USA)*

10:30 – 10:50 am Coffee Break

Optimization and Learning (continued)

Session Chair: Peyman Milanfar, Google, Inc. (USA)

10:50 – 12:30 pm
Golden Gate 1

10:50 COIMG-150
Filtering without normalization, *Peyman Milanfar, Google, Inc. (USA)*

11:10 COIMG-151
Sparse non-local interpolation for nano-scale imaging, *Suhas Sreehari[1], Singanallur Venkatakrishnan[2], Jeffrey Simmons[3], Lawrence Drummy[3], and Charles Bouman[1]; [1]Purdue University, [2]Lawrence Berkeley National Laboratory, and [3]Air Force Research Laboratory (USA)*

11:30 COIMG-152
Hierarchical decomposition of large deep networks, *Vijaya Naga Jyoth Sumanth Chennupati, Shagan Sah, Sai Prasad Nooka, and Raymond Ptucha, Rochester Institute of Technology (USA)*

11:50 COIMG-153
A supervised learning approach for dynamic image sampling, *G.M. Dilshan Godaliyadda[1], Dong Ye[1], Michael Uchic[2], Michael Groeber[2], Gregery Buzzard[3], and Charles Bouman[1]; [1]Purdue University and [2]Air Force Research Laboratory (USA)*

12:10 COIMG-154
Stochastic first-order minimization techniques using Jensen's surrogates for x-ray transmission tomography, *Soysal Degirmenci[1], Joseph O'Sullivan[1], and David Politte[2]; [1]Washington University and [2]Washington University School of Medicine (USA)*

12:30 – 2:00 pm Lunch Break

EI 2016 Tuesday Plenary and Symposium Awards
Session Chair: Nitin Sampat (Rochester Institute of Technology)
2:00 – 3:00 PM
Continental Ballroom 5

Pushing computational photography deeper into imaging system design, *Ren Ng, University of California, Berkeley (USA)*

3:00 – 3:30 pm Coffee Break

Scientific Imaging

Session Chair: Dilworth Parkinson, University of California, Berkeley (USA)

3:30 – 5:10 pm
Golden Gate 1

3:30 COIMG-155
Making advanced scientific algorithms and big scientific data management more accessible, *Dilworth Parkinson[1], Luis Barroso-Luque[1], Keith Beattie[2], Joaquin Correa[3], Eli Dart[4], Jack Deslippe[3], Alexander Hexemer[1], Harinarayan Krishnan[2], Alastair MacDowell[1], Stefano Marchesini[1], Simon Patton[2], Talita Perciano[2], James Sethian[2,5], Rune Stromsness[6], Michael Tang[1], Brian Tierney[4], Craig Tull[2], Daniela Ushizima[2], and Singanallur Venkatakrishnan[1]; [1]Lawrence Berkeley National Laboratory, [3]National Energy Research Scientific Computing Center, [4]Energy Sciences Network, and [5]University of California, Berkeley (USA)*

3:50 COIMG-156
Simulation of abnormal grain growth in polycrystalline materials, *Shruthi Kubatur and Mary Comer, Purdue University (USA)*

4:10 COIMG-157
Reducing restoration artifacts in 3D computational microscopy using wavefront encoding, *Nurmohammed Patwary and Chrysanthe Preza, University of Memphis (USA)*

4:30 COIMG-158
Single shot digital holography based on iterative reconstruction with alternating updates of amplitude and phase, *Dennis Lee[1,2], Charles Bouman[2], and Andrew Weiner[2]; [1]Sandia National Laboratories and [2]Purdue University (USA)*

4:50 COIMG-159
Remote heart rate estimation using small variation amplification, *Dahjung Chung, Jeehyun Choe, Marguerite E. O'Haire, A.J. Schwichtenberg, and Edward Delp, Purdue University (USA)*

EI 2016 Symposium Demonstration Session and Exhibit Hall Happy Hour
5:30 – 7:00 PM
Continental Ballroom Foyer

Wednesday, February 17, 2016

Image and Signal Analysis

Session Chair: James Theiler, Los Alamos National Laboratory (USA)

8:50 – 10:10 am
Golden Gate 1

8:50 COIMG-160
Right spectrum in the wrong place: A framework for local hyperspectral anomaly detection, *James Theiler, Los Alamos National Laboratory (USA)*

9:10 COIMG-161
Data adaptive affinity functions in unsupervised segmentation, *Reid Porter, Diane Oyen, and James Theiler, Los Alamos National Laboratory (USA)*

9:30 COIMG-162
A strip-based fast text detection algorithm for low cost embedded devices, *Jobin J. Mathew[1], Yue Wang[1], Eli Saber[1], David Larson[2], Peter Bauer[2], George Kerby[2], and Jerry Wagner[2]; [1]Rochester Institute of Technology and [2]Hewlett Packard Company (USA)*

9:50 COIMG-163
Automatic computer detection and power estimation in indoor environments from imagery, *Satarupa Mukherjee, Hariprasad P.S., Omar Oreifej, Brian Pugh, Eric Turner, and Avideh Zakhor, University of California, Berkeley (USA)*

10:10 – 10:30 am Coffee Break

Nondestructive Evaluation and Security Imaging

Session Chair: David Castañón, Boston University (USA)

10:30 am – 12:10 pm
Golden Gate 1

10:30 COIMG-164
Simulation of an inverse schlieren image acquisition system for inspecting transparent objects, *Johannes Meyer[1,2], Thomas Längle[1,2], Jürgen Beyerer[1,2], and Robin Gruna[2]; [1]Karlsruhe Institute for Technology and [2]Fraunhofer IOSB (Germany)*

10:50 COIMG-165
Enhancing nuclear resonance fluorescence with coded aperture for security based imaging, *Zachary Sun, Clem Karl, and David Castañón, Boston University (USA)*

11:10
The unavoidable use of computational imaging on next generation biometric identification systems, *Jens Gregor[1] and Hector Santos-Villalobos[2]; [1]University of Tennessee and [2]Oak Ridge National Laboratory (USA)*

11:30 COIMG-167
Sparse angle 3-D X-ray reconstructions on GPU processors, *Fernando Quivira[1], Simon Bedford[2], Richard Moore[3], John Beaty[4], and David Castañón[5]; [1]Northeastern University, [2]Astrophysics, [3]Massachusetts General Hospital, and [5]Boston University (USA)*

11:50 COIMG-521
Non-destructive evaluation for destruction: x-ray imaging for hard drive magnet recovery, *Jeffrey S. Kallman, Karina P. Bond, William D. Brown, and Harry E. Martz; Lawrence Livermore National Laboratory (USA)*

12:10 – 2:00 pm Lunch Break

EI 2016 Wednesday Plenary and Symposium Awards
Session Chair: Choon-Woo Kim (Inha University)
2:00 – 3:00 PM
Continental Ballroom 5

Intel® RealSense Technology: Adding human-like sensing and interactions to computing devices, *Achin Bhowmik, Intel Corporation (USA)*

3:00 – 3:30 pm Coffee Break

Reconstruction and Restoration

Session Chair: Hector Santos-Villalobos, Oak Ridge National Laboratory (USA)

3:30 – 5:30 pm
Golden Gate 1

3:30 COIMG-168
Depth-guided deblurring, *Thomas Hach[1] and Arvind Amruth[2]; [1]Arnold & Richter Cinetechnik and [2]Technical Univ. Munich (Germany)*

3:50 COIMG-169
Spectral resolution enhancement of hyperspectral images via sparse representations, *Konstantina Fotiadou[1,2], Grigorios Tsagkatakis[1], and Panagiotis Tsakalides[1,2]; [1]Foundation for Research and Technology (FORTH), Institute of Computer Science (ICS) and [2]University of Crete (Greece)*

4:10 COIMG-170
Multi-spectral infrared computed tomography, *Philip Bingham, Marissa Morales, Panos Datskos, and David Graham, Oak Ridge National Laboratory (USA)*

4:30 COIMG-171
Multi-modal kHz frame rate multi-photon microscopy pairing Lissajous trajectory beam-scanning with model-based image reconstruction, *Garth Simpson, Shane Sullivan, Ryan Muir, Justin Newman, Suhas Sreehari, and Charles Bouman, Purdue University (USA)*

4:50 COIMG-172
Non-uniform neutron source approximation for the iterative reconstruction of coded source images, *Hector Santos-Villalobos[1], Dustin Morris[1], Jens Gregor[2], and Philip Bingham[1]; [1]Oak Ridge National Laboratory and [2]University of Tennessee (USA)*

5:10 COIMG-173
Exploiting structure and variable-dependency modeling in block-based compressed sensing image reconstruction in the presence of non-linear mixtures (JIST-first), *Lynn Keuthan[1], Robert Harrington[1], and Jefferson Willey[2]; [1]The George Washington University and [2]U.S. Naval Research Lab. (USA)*

Computational Imaging XIV Interactive Papers Session

5:30 – 7:00 pm
Continental Ballroom 6

The following works will be presented at the EI 2016 Symposium Interactive Papers Session.

COIMG-174
Gradient enhanced image pyramid for improved nonlinear image registration, *Lin Gan and Gady Agam, Illinois Institute of Technology (USA)*

COIMG-175
Hidden watermark of 3D models by just noticeable color difference, *Tzung-Han Lin, National Taiwan University of Science and Technology (Taiwan)*

COIMG-176
Illumination normalization and skin color verification for robust face detection, *Sanghun Lee and Chulhee Lee, Yonsei University (South Korea)*

COIMG-177
Improved reconstruction for compressive hyperspectral imaging using spatial-spectral non-local means regularization, *Pablo Meza[1], Esteban Vera[2], and Javier Martínez[1]; [1]Universidad de La Frontera (Chile) and [2]Duke University (USA)*

COIMG-178
Protein chemical cross-linking/mass spectrometry: From raw data to fully immersive visualizations, *Islam Ebeid[1], Carolina Cruz-Neira[1], Mihir Jaiswal[2], and Boris Zybaylov[2]; [1]University of Arkansas at Little Rock and [2]University of Arkansas for Medical Sciences (USA)*

COIMG-179
Real-time depth estimation and view interpolation using Quasar, *Bart Goossens, Simon Donne, Jan Aelterman, Jonas De Vylder, Dirk Van Haerenborgh, and Wilfried Philips, Universiteit Gent (Belgium)*

EI 2016 Symposium Interactive Papers Session
5:30 – 7:00 PM
Continental Ballroom 6

Image Processing: Algorithms and Systems XIV

Conference grouping: Image and Video Processing, Quality, and Systems
Conferences in this grouping discuss electrical resistance and impedance imaging; diffusion optical imaging; imagery-based surveillance and tracking; the readability of electronic paper and mobile displays; image preference measurement and modeling; medical and forensic imaging; genetic and evolutionary computing; steganography and data hiding, microarray imaging; electronic cinema; multimedia content retrieval; and image and video compression, communications, segmentation and recognition, restoration and enhancement, among other topics.

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 Award

Joint Sessions: **3D Scene Sensing and Object Recording** with the 3D Image Processing, Measurement, and Applications Conference; **Blur Removal and Synthesis** with the Digital Photography and Mobile Imaging and the Visual Information Processing and Communication (VIPC) Conferences; **Color Filter Array Interpolation and Superresolution** with the Digital Photography and Mobile Imaging Conference; and **Image Filtering and Denoising** with the Digital Photography and Mobile Imaging Conference.

Photo: Stephan Keith

Conference Chairs: **Karen O. Egiazarian,** Tampere Univ. of Technology (Finland); **Sos S. Agaian,** The Univ. of Texas at San Antonio (USA); and **Atanas P. Gotchev,** Tampere Univ. of Technology (Finland)

Program Committee: **Gözde Bozdagi Akar,** Middle East Technical Univ. (Turkey); **Junior Barrera,** Univ. de São Paulo (Brazil); **Jenny Benois-Pineau,** Bordeaux Univ. (France); **Giacomo Boracchi,** Politecnico di Milano (Italy); **Reiner Creutzburg,** Fachhochschule Brandenburg (Germany); **Alessandro Foi,** Tampere Univ. of Technology (Finland); **Paul D. Gader,** Univ. of Florida (USA); **John C. Handley,** Xerox Corp. (USA); **Vladimir V. Lukin,** National Aerospace Univ. (Ukraine); **Stephen Marshall,** Univ. of Strathclyde (UK); **Alessandro Neri,** RadioLabs (Italy); **Marek R. Ogiela,** AGH Univ. of Science and Technology (Poland); **Ljiljana Platisa,** Univ. Gent (Belgium); **Françoise Prêteux,** Mines ParisTech (France); **Gianni Ramponi,** Univ. degli Studi di Trieste (Italy); Ivan W. Selesnick, Polytechnic Institute of New York Univ. (USA); **Damir Sersic,** Univ. of Zagreb (Croatia); and **Vladimir I. Marchuk,** Don State Technical Univ. (Russia)

Image Processing: Algorithms and Systems XIV

Monday, February 15, 2016

Image Processing Algorithms

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

8:50 – 10:10 am
Golden Gate 4

8:50 IPAS-180
Combined full-reference image visual quality metrics, *Oleg Ieremeiev[1], Vladimir Lukin[1], Nikolay Ponomarenko[1], Karen Egiazarian[2], and Jaakko Astola[2]; [1]National Aerospace University (Ukraine) and [2]University of Tampere (Finland)*

9:10 IPAS-181
Automatic face anonymization in visual data: Are we really well protected?, *Natacha Ruchaud and Jean-luc Dugelay, Eurecom (France)*

9:30 IPAS-182
Non photorealistic rendering in frequency domain, *Federica Mangiatordi, Emiliano Pallotti, Vittorio Baroncini, and Licia Capodiferro, Fondazione Ugo Bordoni (Italy)*

9:50 IPAS-183
Comparison study of Gaussian mixture models for fingerprints image duplication with new one, *Rushikesh Yeole[1], Sos Agaian[1], Mary Ann[1], Mike Troy[1], and Gary Reinecke[2];[1]University of Texas at San Antonio and [2]Boston University, School of Medicine (USA)*

10:10 – 10:50 am Coffee Break

Image and Video Processing Algorithms

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

10:50 am – 12:10 pm
Golden Gate 4

10:50 IPAS-184
Image stitching by means of adaptive normalization, *Oleg Michailovich, University of Waterloo (Canada)*

4:25 IPAS-193
Video inpainting of complex scenes based on local statistical model, *Viacheslav Voronin[1], Vladimir Frantc[1], Vladimir Marchuk[1], Yigang Cen[4], Ilya Svirin[3], and Karen Egiazarian[2]; [1]Don State Technical University, [2]University of Tampere (Finland), [3]CJSC Nordavind (Russian Federation), and [4]Beijing Jiaotong University (China)*

11:30 IPAS-186
Spatio-temporal video background inpainting, *Petr Pohl, Alexander Molchanov, Artem Shamsuarov, and Victor Bucha, Samsung R&D Institute Russia (Russian Federation)*

11:50 IPAS-187
Video segmentation in presence of static and dynamic textures, *Vladimir Frantc[1], Sergey Makov[1], Viacheslav Voronin[1], Vladimir Marchuk[1], Sergei Stradanchenko[1], and Karen Egiazarian[2]; [1]Don State Technical University (Russian Federation) and [2]University of Tampere (Finland)*

12:10 – 2:00 pm Lunch Break

EI 2016 Opening Plenary and Symposium Awards
Session Chair: Choon-Woo Kim (Inha University)
2:00 – 3:00 PM
Continental Ballroom 5

Illuminating a bright future for medicine, *Audrey K. Bowden, Stanford University (USA)*

3:00 – 3:30 pm Coffee Break

Image Processing Tools 1

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

3:30 – 4:10 pm
Golden Gate 4

3:30 IPAS-188
Refractory neural nets and vision – a deeper look, *Thomas Fall, Kalyx Associates (USA)*

3:50 IPAS-189
Prostate cancer detection using photoacoustic imaging and deep learning, *Arjun Raj Rajanna[1], Raymond Ptucha[2], Saugata Sinha[3], Bhargava Chinni[4], Vikram Dogra[4], and Navalgund A. Rao[3]; [1]Rochester Institute of technology and [4]University of Rochester (USA)*

Image Processing: Algorithms and Systems XIV Interactive Papers Oral Previews I

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

4:10 – 4:30 pm
Golden Gate 4

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 Processing: Algorithms and Systems XIV Interactive Papers Session at 5:30 pm on Wednesday.

4:10 IPAS-190
SENSE, GRAPPA and ESPIRIT reconstructions in parallel imaging, *Smain Femmam, UHA France (France)*

4:15 IPAS-191
Approximate subgraph isomorphism for image localization, *Vaishaal Shankar, Avideh Zakhor, Jerry Chen, Jordan Zhang, Chris Dinh, and Matthew Clements, University of California, Berkeley (USA)*

4:20 IPAS-192
2-D left-side quaternion discrete Fourier \\ transform: Fast algorithm, *Artyom Grigoryan and Sos Agaian, University of Texas at San Antonio (USA)*

5:00 – 6:00 pm EI 2016 Symposium Reception

Tuesday, February 16, 2016

DPMI/IPAS: Image Filtering and Denoising Joint Session

Session Chairs: Karen Egiazarian, Tampere University of Technology (Finland) and Zhen He, Intel Corporation (USA)

8:50 – 10:10 AM
Golden Gate 6/7

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

8:50 IPAS-013
Intelligent image filtering using multilayer neural network with multi-valued neurons, *Igor Aizenberg, Texas A&M University-Texarkana (USA)*

9:10 IPAS-014
Robust extensions to guided image filtering, *Oleg Michailovich, University of Waterloo (Canada)*

9:30 DPMI-015
Local denoising applied to RAW images may outperform non-local patch-based methods applied to the camera output, *Gabriela Ghimpeteanu[1], Thomas Batard[1], Tamara Seybold[2], and Marcelo Bertalmio[1]; [1]University Pompeu Fabra (Spain) and [2]ARRI Arnold & Richter Cine Technik GmbH & Co. Betriebs KG (Germany)*

9:50 DPMI-016
Use of flawed and ideal image pairs to drive filter creation by genetic programming, *Subash Sridhar, Henry Dietz, and Paul Eberhart, University of Kentucky (USA)*

10:10 – 10:50 am Coffee Break

DPMI/IPAS: Color Filter Array Interpolation and Superresolution Joint Session

Session Chairs: Ajit Bopardikar, Samsung R&D Institute India-Bangalore (India) and Atanas Gotchev, Tampere University of Technology (Finland)

10:50 am – 12:30 pm
Golden Gate 6/7

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

10:50 IPAS-024
Optimal transparent wavelength and arrangement for multispectral filter array, *Yudai Yanagi[1], Kazuma Shinoda[1], Madoka Hasegawa[1], Shigeo Kato[1], Masahiro Ishikawa[2], Hideki Komagata[2], and Naoki Kobayashi[2]; [1]Utsunomiya University and [2]Saitama Medical University (Japan)*

11:10 DPMI-025
Multi-spectrum to RGB with direct structure-tensor reconstruction, *Takashi Shibata[1,2], Masayuki Tanaka[1], and Masatoshi Okutomi[1]; [1]Tokyo Institute of Technology and [2]NEC Corporation (Japan)*

11:30 IPAS-026
Edge-directional interpolation algorithm using structure tensor, *Andrey Nasonov[1], Andrey Krylov[1], Xenya Petrova[2], and Michael Rychagov[2]; [1]Lomonosov Moscow State University and [2]Samsung R&D Institute Rus (Russian Federation)*

11:50 IPAS-027
Fast edge-directed single-image super-resolution, *Mushfiqur Rouf[1], Dikpal Reddy[2], Kari Pulli[2], and Rabab Ward[3]; [1]University of British Columbia (Canada) and [2]Light Co (USA)*

12:10 DPMI-028
Light-weight single image super-resolution via pattern-wise regression function, *Kohei Kurihara[1], Yoshitaka Toyoda[1], Shotaro Moriya[2], Daisuke Suzuki[1], Takeo Fujita[1], Narihiro Matoba[1], Jay Thornton[3], and Fatih Porikli[4]; [1]Mitsubishi Electric Corporation (Japan), [3]Mitsubishi Electric Research Laboratories (MERL) (USA), and [4]Australian National University (Australia)*

12:30 – 2:00 pm Lunch Break

EI 2016 Tuesday Plenary and Symposium Awards
Session Chair: Nitin Sampat (Rochester Institute of Technology)
2:00 – 3:00 PM
Continental Ballroom 5

Pushing computational photography deeper into imaging system design, *Ren Ng, University of California, Berkeley (USA)*

3:00 – 3:30 pm Coffee Break

Image Processing Tools 2

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

3:30 – 4:10 pm
Golden Gate 4

3:30 IPAS-194
Most luminous tetrachromatic surfaces, *Alfredo Restrepo, Universidad de los Andes (Colombia)*

3:50 IPAS-195
Zonal-alpha-rooting color image enhancement by the two-side 2D quaternion discrete Fourier transform, *Artyom Grigoryan, Aparna John, and Sos Agaian, University of Texas at San Antonio (USA)*

Image Processing: Algorithms and Systems XIV Interactive Papers Oral Previews II

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

4:10 – 4:40 pm
Golden Gate 4

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 Processing: Algorithms and Systems XIV Interactive Papers Session at 5:30 pm on Wednesday.

4:10 IPAS-196
JPEG compression with recursive group coding, *Nadezhda Kozhemiakina[1], Vladimir Lukin[1], Nikolay Ponomarenko[1], Jaakko Astola[2], and Karen Egiazarian[2]; [1]National Aerospace University (Ukraine) and [2]University of Tampere (Finland)*

4:15 IPAS-197
Video quality of experience metric for streaming services, *Pradip Paudyal, Federica Battisti, Yiwei Liu, and Marco Carli, Roma TRE University (Italy)*

4:20 IPAS-198
Image fusion method for a single sensor based multispectral filter array containing a near infra-red channel, *Seung Hoon Jee and Moon Gi Kang, Yonsei University (South Korea)*

4:25 IPAS-199
Fréchet MIMO-filters for hyperspectral images, *Valeri Labunets[1] and E. Ostheimer[2]; [1]Ural Federal University (Russian Federation) and [2]Capricat LLC (USA)*

4:30 IPAS-200
A comparative study of image feature detection and matching algorithms for touchless fingerprint systems, *Sos Agaian[1], Rahul Rajendran[1], Shishir Paramathma Rao[1], Shreyas Kamath K.M.[1], Srijith Rajeev[1], and Marzena Mulawka[2]; [1]The University of Texas at San Antonio and [2]FlashScan3D (USA)*

EI 2016 Symposium Demonstration Session and Exhibit Hall Happy Hour
5:30 – 7:00 PM
Continental Ballroom Foyer

Wednesday, February 17, 2016

DPMI/IPAS/VIPC: Blur Removal and Synthesis Joint Session

Session Chair: Radka Tezaur, Nikon Research Corp. of America (USA)

10:50 am – 12:10 pm
Golden Gate 6/7

This session is jointly sponsored by: Digital Photography and Mobile Imaging XII, Image Processing: Algorithms and Systems XIV, and Visual Information Processing and Communication VII.

10:50 DPMI-030
Multi-image sparse motion-invariant photography, *Bart Kofoed[1,2], Peter de With[1], and Eric Janssen[2]; [1]Eindhoven University of Technology and [2]Prodrive Technologies (Netherlands)*

11:10 DPMI-031
Virtual DSLR: High quality dynamic depth-of-field synthesis on mobile platforms, *Yang Yang[1], Haiting Lin[1], Zhan Yu[2], Sylvain Paris[2], and Jingyi Yu[1]; [1]University of Delaware and [2]Adobe (USA)*

11:30 DPMI-032
Robust blur estimation for blind image deblurring, *Jan Kotera[1,2] and Filip Šroubek[1]; [1]UTIA and [2]Charles University (Czech Republic)*

11:50 VIPC-033
Motion deblurring for depth-varying scenes, *Ruiwen Zhen and Robert Stevenson, University of Notre Dame (USA)*

12:10 – 2:00 pm Lunch Break

EI 2016 Wednesday Plenary and Symposium Awards
Session Chairs: Choon-Woo Kim (Inha University)
2:00 – 3:00 PM
Continental Ballroom 5

PLENARY - 001
Intel® RealSense Technology: Adding human-like sensing and interactions to computing devices, *Achin Bhowmik, Intel Corporation (USA)*

3:00 – 3:30 pm Coffee Break

EI 2016 Symposium Interactive Papers Session
5:30 – 7:00 PM
Continental Ballroom 6

Image Processing: Algorithms and Systems XIV Interactive Papers Session

5:30 – 7:00 pm
Continental Ballroom 6

The Image Processing: Algorithms & Systems XIV interactive papers will be presented in the EI 2016 Symposium Interactive Papers Session.

Thursday, February 18, 2016

3DIPM/IPAS: 3D Scene Sensing and Object Recording Joint Session

Session Chair: Robert Sitnik, Warsaw University of Technology (Poland)

10:40 am – 12:10 pm
Golden Gate 6/7

This session is jointly sponsored by: 3D Image Processing, Measurement (3DIPM) , and Applications 2016, and Image Processing: Algorithms and Systems XIV.

10:40
Joint Session Introduction

10:50 3DIPM-044
Shadow detection on 3D point cloud, *Shuyang Sheng and B. Keith Jenkins, University of Southern California (USA)*

11:10 3DIPM-045
Im2Fit: Fast 3D model fitting and anthropometrics using single consumer depth camera and synthetic data, *Qiaosong Wang[1], Vignesh Jagadeesh[3], Bryan Ressler[3], and Robinson Piramuthu[3]; [1]University of Delaware and [3]eBay Research Labs (USA)*

11:30 3DIPM-046
Human detection from still depth images, *Gulsum Can and Helin Dutagaci, Eskisehir Osmangazi University (Turkey)*

11: 50 IPAS-047
Tracking the guitarist's fingers as well as recognizing pressed chords from a video sequence, *Zhao Wang and Jun Ohya, Waseda University (Japan)*

Image Quality and System Performance XIII

Conference grouping: Image and Video Processing, Quality, and Systems

Conferences in this grouping discuss electrical resistance and impedance imaging; diffusion optical imaging; imagery-based surveillance and tracking; the readability of electronic paper and mobile displays; image preference measurement and modeling; medical and forensic imaging; genetic and evolutionary computing; steganography and data hiding, microarray imaging; electronic cinema; multimedia content retrieval; and image and video compression, communications, segmentation and recognition, restoration and enhancement, among other topics.

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

Joint Sessions: **Perception and Quality** with the Human Vision and Electronic Imaging (HVEI) Conference; **Image Capture I** with the Digital Photography and Mobile Imaging Conference; and **Mobile and Digital Camera Image Quality Evaluation** with the Digital Photography and Mobile Imaging Conference.

Photo: San Francisco Travel Association

Conference Chairs: *Mohamed-Chaker Larabi*, Univ. de Poitiers (France), and **Robin Jenkin,** ON Semiconductor Corp. (USA)

Program Committee: **Alan C. Bovik,** Univ. of Texas at Austin (USA); **Nicolas Bonnier,** Apple Inc. (USA); **Peter D. Burns,** Burns Digital Imaging (USA); **Luke C. Cui,** Microsoft Corp. (USA); **Susan P. Farnand,** Rochester Institute of Technology (USA); **Robert D. Fiete,** Exelis (USA); **Frans Gaykema,** Océ Technologies B.V. (the Netherlands); **Jukka Häkkinen,** Univ. of Helsinki (Finland); **Dirk W. Hertel,** E Ink Corp. (USA); **Elaine W. Jin,** Intel Corp. (USA); **Sang Ho Kim,** SAMSUNG Electronics Co., Ltd. (Republic of Korea); **Toshiya Nakaguchi,** Chiba Univ. (Japan); **Göte S. Nyman**, Univ. of Helsinki (Finland); **Stuart W. Perry,** Canon Information Systems Research Australia Pty. Ltd. (Australia); **Jonathan B. Phillips,** Google Inc. (USA); **Reza Safaee-Rad,** Qualcomm Technologies Inc. (USA); and **Sophie Triantaphillidou,** Univ. of Westminster (UK)

Conference Sponsors

Image Quality and System Performance XIII

Monday, February 15, 2016

Mobile Quality

Session Chair: Jonathan Phillips, Google Inc. (USA)

8:40 – 10:20 am
Golden Gate 5

8:40
IQSP Conference Opening Remarks

8:50 IQSP-201
Development of a perceptually calibrated objective metric for exposure, *Zhen He, Elaine Jin, and Yongshen Ni, Intel Corporation (USA)*

9:10 IQSP-202
A methodology for perceptual image quality assessment of smartphone cameras, *Susan Farnand[1], Young Jang[2], Chuck Han[2], and Hau Hwang[2]; [1]Rochester Institute of Technology and [2]Qualcomm Technologies, Inc. (USA)*

9:30 IQSP-203
Correlation of photo-response blooming metrics with image quality in CMOS image sensors, *Pulla Reddy Ailuri, Orit Skorka, Ning Li, Radu Ispasoiu, and Vladi Koborov, ON Semiconductor (USA)*

9:50 IQSP-204
IEEE standard for mobile device image quality, *Margaret Belska, NVIDIA (USA)*

10:20 – 10:40 am Coffee Break

DPMI/IQSP: Mobile and Digital Camera Image Quality Evaluation Joint Session

Session Chairs: Joyce Farrell, Stanford University (USA) and Elaine Jin, Intel Corporation (USA)

10:40 am – 12:30 pm
Golden Gate 6/7

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

10:40
Conference Opening Remarks

10:50 DPMI-004
Image stabilization performance – existing standards and the challenges for mobile imaging, *Uwe Artmann and Philipp Feldker, Image Engineering GmbH & Co. KG (Germany)*

11:10 DPMI-005
Image flare measurement according to ISO 18844, *Dietmar Wueller, Image Engineering GmbH & Co. KG (Germany)*

11:30 DPMI-006
MTF measurements of wide field of view cameras, *Boyd Fowler, Vlad Cardei, and Sam Kavusi, Google Inc. (USA)*

11:50 DPMI-007
Method for quantifying image sensor susceptibility to chromatic flare artifacts, *Orit Skorka, Dave Jasinski, Radu Ispasoiu, and Vladi Koborov, ON Semiconductor (USA)*

12:10 DPMI-008
"Which factor is more important in obtaining good capture characterization, and, consequently, render higher color accuracy: The characterization of the camera's sensor, or the characterization of illuminant?", *Nitin Sampat and Stephen Viggiano, Rochester Institute of Technology (USA)*

12:30 – 2:00 pm Lunch Break

EI 2016 Opening Plenary and Symposium Awards
Session Chair: Choon-Woo Kim (Inha University)
2:00 – 3:00 PM
Continental Ballroom 5

Illuminating a bright future for medicine, *Audrey K. Bowden, Stanford University (USA)*

3:00 – 3:30 pm Coffee Break

DPMI/IQSP: Image Capture I Joint Session

Session Chairs: Susan Farnand, Rochester Institute of Technology (USA) and Dietmar Wueller, Image Engineering GmbH & Co. KG (Germany)

3:30 – 5:00 pm
Golden Gate 6/7

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

3:30 IQSP-009
Adaptive geometric calibration correction for camera array, *Florian Ciurea, Dan Lelescu, and Priyam Chatterjee, Pelican Imaging (USA)*

4:00 IQSP-010
A filter design approach for consistent image quality, *Ahmed Eid, Michael Phelps, and Brian Cooper, Lexmark International (USA)*

4:20 IQSP-011
Linearization and normalization in spatial frequency response measurement, *Uwe Artmann, Image Engineering GmbH & Co. KG (Germany)*

4:40 IQSP-012
Optimized tone curve for in-camera image processing, *Praveen Cyriac, David Kane, and Marcelo Bertalmio, Universitat Pompeu Fabra (Spain)*

5:00 – 6:00 pm EI 2016 Symposium Reception

Tuesday, February 16, 2016

Keynote: Objective Quality Assessment
Session Chair: Robin Jenkin, ON Semiconductor (USA)
8:50 – 9:40 am
Golden Gate 5

IQSP-205
Objective image quality assessment: Facing the real-world challenges, *Zhou Wang, University of Waterloo (Canada)*

Objective Quality Assessment

Session Chair: Nicolas Bonnier, Apple Inc. (USA)

9:40 – 10:20 am
Golden Gate 5

9:40 IQSP-206
Applicability of existing objective metrics of perceptual quality for adaptive video streaming, *Jacob Søgaard[1], Lukáš Krasula[2,3], Muhammad Shahid[4], Dogancan Temel[5], Kjell Brunnstrom[6,7], and Manzoor Razaak[8]; [1]Technical University of Denmark (Denmark), [2]Czech Technical University (Czech Republic), [3]Université de Nantes (France), [4]Blekinge Tekniska Högskola (Sweden), [5]Georgia Institute of Technology (USA), [6]Acreo, Swedish ICT (Sweden), [7]Mid Sweden University (Sweden), and [8]Kingston University London (United Kingdom)*

10:00 IQSP-207
Local defect detection and print quality assessment, *Jianyu Wang[1], Terry Nelson[2], Renee Jessome[2], Steve Astling[2], Eric Maggard[2], Mark Shaw[2], and Jan Allebach[1]; [1]Purdue University and [2]Hewlett-Packard Company (USA)*

10:20 – 10:40 am Coffee Break

3D Comfort and Quality

Session Chair: Jukka Häkkinen, University of Helsinki (Finland)

10:40 am – 12:30 pm
Golden Gate 5

10:40 IQSP-208
System performance of light-field 3D displays, *Péter Kovács[1], Robert Bregovic[2], and Atanas Gotchev[2]; [1]Holografika Ltd. (Hungary) and [2]Tampere University of Technology (Finland)*

11:10 IQSP-209
Improving visual discomfort prediction for stereoscopic images via disparity-based contrast (JIST-first), *Werner Zellinger and Bernhard Moser, Software Competence Center Hagenberg (Austria)*

11:30 IQSP-210
The disparity cue and blur on the relative visual comfort of stereoscopic contents (JIST-first), *Yaohua Xie[1], Fang Sun[2], Danli Wang[1], and Heng Qiao[3]; [1]Chinese Academy of Sciences, [2]Liaoning Normal University, and [3]Central University of Finance and Economics (China)*

11:50 IQSP-211
Using binocular and monocular properties for the construction of a quality assessment metric for stereoscopic images, *Iana Iatsun, Chaker Larabi, and Christine Fernandez Maloigne, Université de Poitiers (France)*

12:10 IQSP-212
An adaptive contrast enhancement method for stereo endoscopic images combining binocular just noticeable difference model and depth information, *Bilel Sdiri[1,2], Azeddine Beghdadi[1], Faouzi Alaya Cheikh[2], and Ole Jakob Elle[3]; [1]Université Paris 13 (France), [2]Gjøvik University College, and [3]Oslo University Hospital (Norway)*

12:30 – 2:00 pm Lunch Break

EI 2016 Tuesday Plenary and Symposium Awards
Session Chair: Nitin Sampat (Rochester Institute of Technology)
2:00 – 3:00 PM
Continental Ballroom 5

Pushing computational photography deeper into imaging system design, *Ren Ng, University of California, Berkeley (USA)*

3:00 – 3:30 pm Coffee Break

Image Capture II

Session Chair: Frans Gaykema, Océ Technologies (Netherlands)

3:30 – 4:40 pm
Golden Gate 5

3:30 IQSP-213
Imaging applications of noise equivalent quanta, *Brian Keelan, ON Semiconductor (USA)*

4:00 IQSP-214
Effects on Fourier peaks used for periodic pattern detection, *Chun-Jung Tai[1], Robert Ulichney[2], and Jan Allebach[1]; [1]Purdue University and [2]HP Lab (USA)*

4:20 IQSP-215
Mixing and matching sensor format with lens coverage, *Henry Dietz, University of Kentucky (USA)*

Panel on Image Quality and System Performance
Panel Moderators: Robin Jenkin, ON Semiconductor (USA); Chaker Larabi, Université de Poitiers (France); and Sophie Triantaphillidou, University of Westminster (United Kingdom)
4:40 – 5:30 pm
Golden Gate 5

EI 2016 Symposium Demonstration Session and Exhibit Hall Happy Hour
5:30 – 7:00 PM
Continental Ballroom Foyer

Wednesday, February 17, 2016

IQSP/HVEI: Keynote: Perception and Quality Joint Session

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

8:50 – 9:40 am
Continental Ballroom 4

This session is jointly sponsored by: Image Quality and System Performance XIII, and Human Vision and Electronic Imaging (HVEI) 2016.

8:50 IQSP-029
Up Periscope! Designing a new perceptual metric for imaging system performance, *Andrew Watson, NASA Ames Research Center (USA)*

Perception and Quality

Session Chair: Göte Nyman, University of Helsinki (Finland)

9:40 – 10:30 am
Golden Gate 5

9:40 IQSP-216
How saccadic models help predict where we look during a visual task? Application to visual quality assessment, *Olivier Le Meur[1] and Antoine Coutrot[2]; [1]University of Rennes 1 (France) and [2]University College London (United Kingdom)*

10:10 IQSP-217
An audiovisual saliency model for conferencing and conversation videos, *Naty Sidaty, Chaker Larabi, and Abdelhakim Saadane, Université de Poitiers (France)*

10:30 – 10:50 am Coffee Break

Image Capture III

Session Chair: Luke Cui, Microsoft Co. (USA)

10:50 – 11:30 am
Golden Gate 5

10:50 IQSP-218
Color correction meets blind validation for image capture: Are we teaching to the test?, *Don Williams[1] and Peter Burns[2]; [1]Image Science Associates and [2]Burns Digital Imaging (USA)*

11:10 IQSP-219
Effect of capture illumination on preferred white point for camera automatic white balance, *Ben Bodner, Yixuan Wang, and Susan Farnand, Rochester Institute of Technology (USA)*

11:30 – 2:00 pm Lunch Break

EI 2016 Wednesday Plenary and Symposium Awards
Session Chair: Choon-Woo Kim (Inha University)
2:00 – 3:00 PM
Continental Ballroom 5

Intel® RealSense Technology: Adding human-like sensing and interactions to computing devices, *Achin Bhowmik, Intel Corporation (USA)*

3:00 – 3:30 pm Coffee Break

Psychophysics, Quality, and Perception

Session Chair: Peter Burns, Burns Digital Imaging (USA)

3:30 – 5:20 pm
Golden Gate 5

3:30 IQSP-220
The influence of lightness, and the 'crispening' effect on the perceived contrast of textured images, *David Kane and Marcelo Bertalmio, Universitat Pompeu Fabra (Spain)*

3:50 IQSP-221
Study on perceptible and acceptable ranges for color gamut of transparent displays, *Suhyun Kwon, Sunhee Park, and Jaehong Kim, LG Display Co., Ltd. (South Korea)*

4:10 IQSP-222
Statistical study on perceived JPEG image quality via MCL-JCI dataset construction and analysis, *Haiqiang Wang, University of Southern California (USA)*

4:30 IQSP-223
Perceptual picture quality analysis of UHD signals in terms of spatial information and noises, *Chulhee Lee, Sangwook Baek, Sungwook Youn, Seongyoun Woo, and Jeongyeol Baek, Yonsei University (South Korea)*

4:50 IQSP-224
Visual assessment of HDR video, *Vittorio Baroncini[1], Massimiliano Agostinelli[2], Federica Mangiatordi[1], and Emiliano Pallotti[1]; [1]Fondazione Ugo Bordoni and [2]Tretag s.r.l. (Italy)*

5:10
IQSP Conference Closing Remarks

Image Quality and System Performance XIII Interactive Papers Session

5:30 – 7:00 pm
Continental Ballroom 6

The following works will be presented at the EI 2016 Symposium Interactive Papers Session.

IQSP-225
Noise-free rule-based fuzzy image enhancement, *Mehdi Roopaei, Sos Agaian, Mehdi Shadaram, and Morad Khosravi Eghbal, University of Texas at San Antonio (USA)*

IQSP-226
Large-scale image processing using Amazon EC2 spot instances, *Youngsol Koh and Yung-Hsiang Lu, Purdue University (USA)*

EI 2016 Symposium Interactive Papers Session
5:30 – 7:00 PM
Continental Ballroom 6

Visual Information Processing and Communication VII

Conference grouping: Image and Video Processing, Quality, and Systems

Conferences in this grouping discuss electrical resistance and impedance imaging; diffusion optical imaging; imagery-based surveillance and tracking; the readability of electronic paper and mobile displays; image preference measurement and modeling; medical and forensic imaging; genetic and evolutionary computing; steganography and data hiding, microarray imaging; electronic cinema; multimedia content retrieval; and image and video compression, communications, segmentation and recognition, restoration and enhancement, among other topics.

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.

Joint Session: **Blur Removal and Synthesis** with the Digital Photography and Mobile Imaging and the Image Processing: Algorithms and Systems Conferences.

Photo: Dietmar Wueller.

Conference Chairs: **Onur G. Guleryuz,** LG Electronics MobileComm U.S.A., Inc. (USA); **Amir Said,** Qualcomm Technologies Inc. (USA); and **Robert L. Stevenson,** Univ. of Notre Dame (USA)

Program Committee: **John G. Apostolopoulos,** Hewlett-Packard Labs. (USA); **Vasudev Bhaskaran,** Qualcomm Technologies Inc. (USA); **Mireille Boutin,** Purdue Univ. (USA); **Chang Wen Chen,** Univ. at Buffalo (USA); **Gerard de Haan,** Philips Research Nederland B.V. (the Netherlands); **Edward J. Delp,** Purdue Univ. (USA); **Eric Dubois,** Univ. of Ottawa (Canada); **Frederic Dufaux,** Télécom ParisTech (France); **Keigo Hirakawa,** Univ. of Dayton (USA); **Marta Karczewicz,** Qualcomm Technologies Inc. (USA); **Lisimachos P. Kondi,** Univ. of Ioannina (Greece); **Janusz Konrad,** Boston Univ. (USA); **Chun-Chieh J. Kuo,** The Univ. of Southern California (USA); **Peyman Milanfar,** Univ. of California, Santa Cruz (USA); **Antonio Ortega,** The Univ. of Southern California (USA); **Thrasyvoulos N. Pappas,** Northwestern Univ. (USA); **William A. Pearlman,** Rensselaer Polytechnic Institute (USA); **Fernando Pereira,** Instituto de Telecomunicações (Portugal); **Béatrice Pesquet-Popescu,** Télécom ParisTech (France); **Majid Rabbani,** Eastman Kodak Co. (USA); **Eli Saber,** Rochester Institute of Technology (USA); **Dan Schonfeld,** Univ. of Illinois at Chicago (USA); **Andrew Segall,** Sharp Labs. of America, Inc. (USA); **Gaurav Sharma,** Univ. of Rochester (USA); **Andrew G. Tescher,** AGT Associates (USA); **Anthony Vetro,** Mitsubishi Electric Research Labs. (USA); **John W. Woods,** Rensselaer Polytechnic Institute (USA); and **Wenwu Zhu,** Tsinghua Univ. (China)

Visual Information Processing and Communication VII

Wednesday, February 17, 2016

DPMI/IPAS/VIPC: Blur Removal and Synthesis Joint Session

Session Chair: Radka Tezaur, Nikon Research Corp. of America (USA)

10:50 am – 12:10 pm
Golden Gate 6/7

This session is jointly sponsored by: Digital Photography and Mobile Imaging XII, Image Processing: Algorithms and Systems XIV, and Visual Information Processing and Communication VII.

10:50 DPMI-030
Multi-image sparse motion-invariant photography, *Bart Kofoed[1,2], Peter de With[1], and Eric Janssen[2]; [1]Eindhoven University of Technology and [2]Prodrive Technologies (Netherlands)*

11:10 DPMI-031
Virtual DSLR: High quality dynamic depth-of-field synthesis on mobile platforms, *Yang Yang[1], Haiting Lin[1], Zhan Yu[2], Sylvain Paris[2], and Jingyi Yu[1]; [1]University of Delaware and [2]Adobe (USA)*

11:30 DPMI-032
Robust blur estimation for blind image deblurring, *Jan Kotera[1,2] and Filip Šroubek[1]; [1]UTIA and [2]Charles University (Czech Republic)*

11:50 VIPC-033
Motion deblurring for depth-varying scenes, *Ruiwen Zhen and Robert Stevenson, University of Notre Dame (USA)*

12:10 – 2:00 pm Lunch Break

EI 2016 Wednesday Plenary and Symposium Awards
Session Chair: Choon-Woo Kim (Inha University)
2:00 – 3:00 PM
Continental Ballroom 5

Intel® RealSense Technology: Adding human-like sensing and interactions to computing devices, *Achin Bhowmik, Intel Corporation (USA)*

3:00 – 3:30 pm Coffee Break

Image Enhancement and Analysis

Session Chair: Robert Stevenson, University of Notre Dame (USA)

3:30 – 4:50 pm
Golden Gate 2

3:30 VIPC-227
Sony ARW2 compression: Artifacts and credible repair, *Henry Dietz, University of Kentucky (USA)*

3:50 VIPC-228
Guided filter demosaicking for Fourier spectral filter array, *Jie Jia, Chuan Ni, Andrew Sarangan, and Keigo Hirakawa, University of Dayton (USA)*

4:10 VIPC-229
Haze removal of single remote sensing image by combining dark channel prior with superpixel, *Yanlin Tian, Chao Xiao, Xiu Chen, Daiqin Yang, and Zhenzhong Chen, Wuhan University (China)*

4:30 VIPC-230
Towards region-of-attention analysis in eye tracking protocols, *Yingbin Wang Wang, Xiu Chen, and Zhenzhong Chen, Wuhan University (China)*

Image Databases

Session Chair: Robert Stevenson, University of Notre Dame (USA)

4:50 – 5:30 pm
Golden Gate 2

4:50 VIPC-231
Using deep convolutional neural networks for image retrieval, *Pao-Chi Chang, National Central University (Taiwan)*

5:10 VIPC-232
Visual attention model and relevant feedback based image retrieval, *Zhijiang Li[1,2]; [1]Wuhan University (China) and [2]University of Leeds (United Kingdom)*

EI 2016 Symposium Interactive Papers Session
5:30 – 7:00 PM
Continental Ballroom 6

Thursday, February 18, 2016

Error Resilient Video Coding

Session Chairs: Onur Guleryuz, LG Electronics MobileComm U.S.A., Inc. (USA) and Amir Said, Qualcomm Technologies Inc. (USA)

9:30 – 10:10 am
Golden Gate 2

9:30 VIPC-233
A doubly error resilient coder of image sequences, *William Pearlman[1] and Yang Hu[2]; [1]Rensselaer Polytechnic Institute and [2]Cisco Systems (USA)*

9:50 VIPC-234
Error resilient video coding using VPx codec for lossy network conditions, *Neeraj Gadgil and Edward Delp, Purdue University (USA)*

10:10 – 10:50 am Coffee Break

Video Coding

Session Chairs: Onur Guleryuz, LG Electronics MobileComm U.S.A., Inc. (USA) and Amir Said, Qualcomm Technologies Inc. (USA)

10:50 am – 12:30 pm
Golden Gate 2

10:50 VIPC-235
A subjective study for the design of multi-resolution ABR video streams with the VP9 Codec, *Chao Chen, Sasi Inguva, Andrew Rankin, and Anil Kokaram, Google Inc. (USA)*

11:10 VIPC-236
Machine learning-based early termination in prediction block decomposition for VP9, *Xintong Han[1], Yunqing Wang[2], Yaowu Xu[2], and James Bankoski[2]; [1]University of Maryland, College Park and [2]Google Inc. (USA)*

11:30 VIPC-237
Optimizing transcoder quality targets using a neural network with an embedded bitrate model, *Michele Covell[1], Martin Arjovsky[2], Yao-Chung Lin[1], and Anil Kokaram[1]; [1]Google, Inc (USA) and [2]University of Buenos Aires (Argentina)*

11:50 VIPC-238
A sample adaptive offset early termination method for HEVC parallel encoding, *Younhee Kim, ETRI (South Korea)*

12:10 VIPC-239
Pixel decimation of RD-cost functions in the HEVC encoder, *Ahmed Hamza[1], Abdelrahman Abdelazim[2], and Djamel Ait-Boudaoud[1]; [1]University of Portsmouth (United Kingdom) and [2]American University of the Middle East (Kuwait)*

12:30 – 150 pm Lunch Break

Feature Detection

Session Chair: Robert Stevenson, University of Notre Dame (USA)

1:50 – 3:30 pm
Golden Gate 2

1:50 VIPC-240
Block equivalence algorithm for labeling 2D and 3D images on GPU, *Sergey Zavalishin[1], Ilia Safonov[2], Yury Bekhtin[4], and Ilya Kurilin[3]; [1]Ryazan State Radio Electronics University (RSREU), [2]National Research Nuclear University MEPhI, [3]Samsung R&D Institute Russia, and [4]Moscow State Technical University of Radio Engineering, Electronics and Automatics (Russian Federation)*

2:10 VIPC-241
Incorporating gradient magnitude in computation of Edge Oriented Histogram descriptor, *Xiang Shi, Chunxiao Fan, Yong Li, and Hongbin Jin, Beijing University of Posts and Telecommunications (China)*

2:30 VIPC-242
Fingerprint liveness detection using ensemble of local image quality assessments, *Wonjun Kim, Sungjoo Suh, Youngsung Kim, and Changkyu Choi, Samsung Advanced Institute of Technology (South Korea)*

2:50 VIPC-243
Optimizing color information processing inside an SVM network, *Jérôme Pasquet[1,2], Gérard Subsol[2], Mustapha Derras[1], and Marc Chaumont[2,3]; [1]Berger Levrault, [2]Université de Montpellier/CNRS, and [3]Université de Nîmes (France)*

3:10 VIPC-244
Register multimodal images of large scene depth variation with global information, *Hongbin Jin[1], Yong Li[1], and Robert Stevenson[2]; [1]Beijing University of Posts and Teles. (China) and [2]University of Notre Dame (USA)*

3:30 – 3:50 pm Coffee Break

3D Image Processing, Measurement (3DIPM), and Applications 2016

Conference grouping: Virtual Reality, 3D, and Stereoscopic Systems

Conferences in this grouping discuss virtual reality UI and UX; virtual and augmented reality in education, learning, gaming, art; 3D shape indexing and retrieval; scene analysis: from 2D views to 3D reconstruction and interpretation; stereoscopic image synthesis: 2D to 3D conversion, depth map generation, multi-viewpoint generation; the geometry of 3D perceptual space; and 3D measurement, data processing and recognition among other topics.

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 given to the author(s) of a full paper presented at the conference, selected by the Organizing Committee.

Joint Sessions: **3D Scene Sensing and Object Recording** with the Image Processing: Algorithms and Systems Conference; **Image Sensors and Systems for 3D Imaging** with the Image Sensors and Imaging Systems Conference; and **Stereoscopic Image Processing and Depth Mapping** with the Stereoscopic Displays and Applications (SD&A) Conference.

Conference Chairs: **William Puech,** Lab. d'Informatique de Robotique et de Microelectronique de Montpellier (France), and **Robert Sitnik,** Warsaw Univ. of Technology (Poland);

Program Committee: **Atilla M. Baskurt,** Univ. de Lyon (France); **Hugues Benoit-Cattin,** Institut National des Sciences Appliquées de Lyon (France); **Silvia Biasotti,** Consiglio Nazionale delle Ricerche (Italy); **Adrian G. Bors,** The Univ. of York (UK); **Saida Bouakaz,** Univ. Claude Bernard Lyon 1 (France); **Benjamin Bustos,** Univ. de Chile (Chile); **Eduardo da Silva,** UFRJ (Brazil); **Mohamed Daoudi,** Télécom Lille 1 (France); **Florent Dupont,** Univ. Claude Bernard Lyon 1 (France); **Gilles Gesquière,** Lab. des Sciences de l'Information et des Systèmes (France); **Afzal Godil,** National Institute of Standards and Technology (USA); **Serge Miguet,** Univ. Lumière Lyon 2 (France); **Eric Paquet,** National Research Council Canada (Canada); **Tobias Schreck,** Graz Univ. of Technology (Austria); **Frédéric Truchetet,** Univ. de Bourgogne (France); and **Stefano Tubaro,** Politecnico di Milano (Italy)

Photo: Diana Gonzalez.

3D Image Processing, Measurement (3DIPM), and Applications 2016

Wednesday, February 17, 2016

3DIPM/SD&A: Stereoscopic Image Processing and Depth Mapping

Joint Session

Session Chairs: William Puech, University of Montpellier (France) and Michael Weissman, TrueVision Systems (USA)

10:50 am – 12:30 pm
Continental Ballroom 5

This session is jointly sponsored by: Stereoscopic Displays and Applications XXVII and 3D Image Processing, Measurement (3DIPM), and Applications 2016.

10:50 SDA-034
Geometrically constrained sub-pixel disparity estimation from stereo images of the retinal fundus, *Mohamad Kharboutly, Carlos Vazquez, Stéphane Coulombe, and Jacques De Guise, École de technologie supérieure (Canada)*

11:10 3DIPM-035
3D autostereoscopic display image generation using direct light field rendering, *Young Ju Jeong and Hyunsung Chang, Samsung Advanced Institute of Technology (South Korea)*

11:30 SDA-036
A new hole filling method based on 3D geometric transformation for synthesized image, *Hak Gu Kim and Yong Man Ro, Korea Advanced Institute of Science and Technology (South Korea)*

11:50 3DIPM-037
Blue noise sampling of surfaces from stereoscopic images, *Frederic Payan, Jean-Luc Peyrot, and Marc Antonini, Laboratory I3S, University Nice - Sophia Antipolis and CNRS (France) - UMR 7271 (France)*

12:10 SDA-038
3D image warping based on linear disparity mapping, *Riddhi Ray Chaudhuri and Prabir Kumar Biswas, Indian Institute of Technology (India)*

12:30 – 2:00 pm Lunch Break

EI 2016 Wednesday Plenary and Symposium Awards
Session Chair: Choon-Woo Kim (Inha University)
2:00 – 3:00 PM
Continental Ballroom 5

Intel® RealSense Technology: Adding human-like sensing and interactions to computing devices, *Achin Bhowmik, Intel Corporation (USA)*

3:00 – 3:30 pm Coffee Break

3D Data Processing and Compression

Session Chair: Robert Sitnik, Warsaw University of Technology (Poland)

3:30 – 5:10 pm
Union Square 25

3:30 3DIPM-396
Secure high capacity data hiding for 3D meshes, *Vincent Itier[1,3], Adrian Bors[2], William Puech[1], and Jean-Pierre Pedeboy[3]; [1]LIRMM (France), [2]University of York (United Kingdom), and [3]STRATEGIES (France)*

3:50 3DIPM-397
Point cloud compression using depth-maps, *Arnaud Bletterer[1], Frederic Payan[1], Marc Antonini[1], and Anis Meftah[2]; [1]Laboratory I3S, University of Nice - Sophia Antipolis and CNRS (France) - UMR 7271 and [2]Cintoo3D (France)*

4:10 3DIPM-398
Truncated signed distance function volume integration based on voxel-level optimization for 3D reconstruction, *Fei Li, Yunfan Du, and Rujie Liu, Fujitsu Research & Development Center Co., Ltd. (China)*

4:30 3DIPM-399
Depth assisted composition of synthetic and real 3D scenes, *Santiago Cortés, Olli Suominen, and Atanas Gotchev, Tampere University of Technology (Finland)*

4:50 3DIPM-400
Parallax scan based image segmentation using lens supplied metadata, *Christopher Mayhew, Ji Gou, and Sanjay Oak, Vision III Imaging, Inc. (USA)*

3D Image Processing, Measurement (3DIPM), and Applications 2016 Interactive Papers Session

5:30 – 7:00 pm
Continental Ballroom 6

The following works will be presented at the EI 2016 Symposium Interactive Papers Session.

3DIPM-401
Efficient filling of disparity holes using resolution decoupling, *Alexey Supikov, Maha El Choubassi, and Oscar Nestares, Intel Corporation (USA)*

3DIPM-402
Temporal domain stereo matching based on feature points for restriction of error propagation, *Ji-Hun Mun and Yo-Sung Ho, GIST (South Korea)*

3DIPM-403
Cavern halos: Exploring spatial and nonspatial cosmological data in an immersive virtual enviroment, *Carlos Uribe; University of Illinois at Chicago and EVL (USA)*

3DIPM-404
Non-uniform resampling in perspective compensated large scale 3D visualization, *Maria Shcherban, Olli Suominen, and Atanas Gotchev, Tampere University of Technology (Finland)*

3DIPM-405
Depth estimation algorithm for color coded aperture camera, *Ivan Panchenko, Vladimir Paramonov, and Victor Bucha, Samsung R&D Institute Russia (Russian Federation)*

EI 2016 Symposium Interactive Papers Session
5:30 – 7:00 PM
Continental Ballroom 6

Thursday February 18, 2016

3D Acquisition and Preprocessing

Session Chair: Robert Sitnik, Warsaw University of Technology (Poland)

9:10 – 10:10 am
Golden Gate 6/7

9:10 3DIPM-406
High-fidelity Time-of-Flight edge sampling using superpixels, *Thomas Hach[1], Sascha Knob[2], and Johannes Steurer[1]; [1]Arnold & Richter Cinetechnik and [2]Hochschule RheinMain (Germany)*

9:30 3DIPM-407
Generating a 3D shape template of a moving and deforming object from an RGB-D image sequence, *Hikari Takehara, Yuta Nakashima, Tomokazu Sato, and Naokazu Yokoya, Nara Institute of Science and Technology (Japan)*

9:50 3DIPM-408
Implementation of 3D object reconstruction using multiple Kinect cameras, *Dong-won Shin and Yo-Sung Ho, Gwangju Institute of Science and Technology (South Korea)*

10:10 – 10:40 am Coffee Break

3DIPM/IPAS: 3D Scene Sensing and Object Recording Joint Session

Session Chair: Robert Sitnik, Warsaw University of Technology (Poland)

10:40 am – 12:10 pm
Golden Gate 6/7
This session is jointly sponsored by: 3D Image Processing, Measurement (3DIPM), and Applications 2016, and Image Processing: Algorithms and Systems XIV.

10:40
Joint Session Introduction

10:50 3DIPM-044
Shadow detection on 3D point cloud, *Shuyang Sheng and B. Keith Jenkins, University of Southern California (USA)*

11:10 3DIPM-045
Im2Fit: Fast 3D model fitting and anthropometrics using single consumer depth camera and synthetic data, *Qiaosong Wang[1], Vignesh Jagadeesh[3], Bryan Ressler[3], and Robinson Piramuthu[3]; [1]University of Delaware and [3]eBay Research Labs (USA)*

11:30 3DIPM-046
Human detection from still depth images, *Gulsum Can and Helin Dutagaci, Eskisehir Osmangazi University (Turkey)*

11:50 IPAS-047
Tracking the guitarist's fingers as well as recognizing pressed chords from a video sequence, *Zhao Wang and Jun Ohya, Waseda University (Japan)*

12:10 – 2:00 pm Lunch Break

3DIPM/IMSE: Image Sensors and Systems for 3D Imaging Joint Session

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

1:50 – 3:20 pm
Golden Gate 6/7

This session is jointly sponsored by: Image Sensors and Imaging Systems 2016, and 3D Image Processing, Measurement (3DIPM), and Applications 2016.

1:50
Joint conference introduction

2:00 IMSE-048
A time-of-flight CMOS range image sensor using 4-tap output pixels with lateral-electric-field control, *Taichi Kasugai[1], Sang-Man Han[1], Hanh Trang[1], Taishi Takasawa[1], Satoshi Aoyama[2], Keita Yasutomi[1], Keiichiro Kagawa[1], and Shoji Kawahito[1]; [1]Shizuoka University and [2]Brookman Technology (Japan)*

2:20 IMSE-049
Design, implementation and evaluation of a TOF range image sensor using multi-tap lock-in pixels with cascaded charge draining and modulating gates, *Trang Nguyen[1], Taichi Kasugai[1], Keigo Isobe[2], Sang-Man Han[1], Taishi Takasawa[1], De Xlng Lioe[1], Keita Yasutomi[1], Keiichiro Kagawa[1], and Shoji Kawahito[1]; [1]Shizuoka University and [2]Brookman Technology (Japan)*

2:40 3DIPM-050
Markerless motion capture with multi-view structured light, *Ricardo Garcia and Avideh Zakhor, University of California, Berkeley (USA)*

3:00 3DIPM-051
Towards automated, high resolution 3D scanning of large surfaces for cultural heritage documentation, *Robert Sitnik[1], Eryk Bunsch[2], Grzegorz Maczkowski[1], Wojciech Zaluski[1], Krzysztof Lech[1], Jakub Michonski[1], and Jakub Krzeslowski[1]; [1]Warsaw University of Technology and [2]Museum of King Jan III's Palace at Wilanów (Poland)*

3:20 – 3:50 pm Coffee Break

3D Industrial Applications

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

3:50 – 5:00 pm
Golden Gate 6/7

3:50 3DIPM-409
Mobile version of Digital Image Correlation for deformation measurements of industrial objects, *Marcin Malesa, Dariusz Naploszek, Krzysztof Kuczynski, and Pawel Skrzypczak, Warsaw University of Technology (Poland)*

4:10 3DIPM-410
Structural internal deterioration detection with motion vector field image analysis using monocular camera, *Hiroshi Imai, Masahiko Ohta, and Kazuhito Murata, NEC Corporation (Japan)*

4:30 3DIPM-411
The relationship between stereo baseline distance and 3D projection accuracy for industrial robotic arm applications, *Wutthigrai Boonsuk, Eastern Illinois University (USA)*

4:50
Closing Remarks

The Engineering Reality of Virtual Reality 2016

Conference grouping: Image and Video Processing, Quality, and Systems
Conferences in this grouping discuss electrical resistance and impedance imaging; diffusion optical imaging; imagery-based surveillance and tracking; the readability of electronic paper and mobile displays; image preference measurement and modeling; medical and forensic imaging; genetic and evolutionary computing; steganography and data hiding, microarray imaging; electronic cinema; multimedia content retrieval; and image and video compression, communications, segmentation and recognition, restoration and enhancement, among other topics.

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.

Joint Session: **Virtual Reality and 3D** with the Stereoscopic Displays and Applications (SD&A) Conference.

Photo: San Francisco Travel Association–Scott Chernis.

Conference Chairs and Program Committee:
Margaret Dolinsky, Indiana Univ. (USA), and
Ian E. McDowall, Fakespace Labs, Inc. (USA)

ERVR

The Engineering Reality of Virtual Reality 2016

Wednesday, February 17, 2016

ERVR/SD&A: Virtual Reality and 3D Joint Session

Session Chairs: Margaret Dolinsky, Indiana University (USA) and Chris Ward, Lightspeed Design, Inc. (USA)

3:30 – 5:30 pm
Continental Ballroom 5

This session is jointly sponsored by: Stereoscopic Displays and Applications XXVII, and The Engineering Reality of Virtual Reality 2016.

3:30 SDA-039
LEIA 3D: Holographic reality, *David Fattal, LEIA Inc. (USA)*

3:50 SDA-040
Effect of inter-lens distance on fusional limit in stereoscopic vision using a simple smartphone head-mounted display, *Hiroyuki Morikawa[1,2], Yoshihiro Banchi[2], Shota Tsukada[2], Yusuke Hasegawa[2], Suguru Takahashi[2], Kaiji Ohta[3], and Takashi Kawai[2]; [1]Aoyama Gakuin University, [2]Waseda Univiersity, and [3]International Christian University (Japan)*

4:10 SDA-041
Investigating intermittent stereoscopy: Its effects on perception and visual fatigue, *Ari Bouaniche and Laure Leroy, Université Paris 8 (France)*

4:30 SDA-042
Stereoscopy-based procedural generation of virtual environments, *Manlio Scalabrin, Laura Anna Ripamonti, Dario Maggiorini, and Davide Gadia, University of Milan (Italy)*

4:50 ERVR-043
Beyond fun and games: VR as a tool of the trade, *Carolina Cruz-Neira and Dirk Reiners, University of Arkansas (USA)*

5:10
SD&A Conference Closing Remarks

EI 2016 Symposium Interactive Papers Session
5:30 – 7:00 PM
Continental Ballroom 6

Thursday, February 18, 2016

Workshop: Introduction to Unity for Use in Virtual Reality Development

Instructors: Margaret Dolinsky, Indiana University and Chauncey Eugene Frend, Indiana University (USA)

8:50 – 11:30 am
Continental Ballroom 3

As the popularity of virtual reality grows in studios, institutes, and industry the Unity game engine has emerged as a trusted tool. VR developers find that Unity along with 3rd party plugins can easily target all types of VR systems. Artists and coders may utilize the Unity editor in productive ways that make them comfortable due to the dynamic interface. This workshop will be presented in two parts. The first part of this workshop will be a fundamental introduction to the Unity Editor and how to best understand how the tool works. The second part of the workshop will focus on how Unity projects can be configured for CAVE systems as well as the Oculus Rift system. If you would like to follow along during these workshops please bring a laptop with Unity 5 installed. The free personal edition of Unity can be downloaded from this page https://unity3d.com/get-unity.

10:20 – 10:40 am Coffee Break

Shifting Perceptions in VR

Session Chair: Ian McDowall, Intuitive Surgical / Fakespace Labs (USA)

11:30 am – 12:30 pm
Continental Ballroom 3

11:30 ERVR-412
Perceptual calibration in virtual reality applications, *Daniel Mestre, Aix-Marseille Univ. (France)*

11:50 ERVR-413
***Mobius Floe*: an immersive virtual reality game for pain distraction,** *Xin Tong, Diane Gromala, and Chris Shaw, Simon Fraser University (Canada)*

12:10 ERVR-515
Immersive analytics, *Todd Margolis, Qlik (USA)*

12:30 – 1:50 pm Lunch Break

Moving & Shaking in VR

Session Chair: Margaret Dolinsky, Indiana University (USA)

1:50 – 3:30 pm
Continental Ballroom 3

1:50 ERVR-415
Towards naturally grabbing and moving objects in VR, *Jonathan Lin and Jürgen Schulze, UCSD (USA)*

2:10 ERVR-416
Camera pose estimation by vision-inertial sensor fusion: an application to augmented reality books, *Juan Li[3], Hamid Aghajan[2,1], José R. Casar[3], and Wilfried Philips[2]; [1]Stanford University (USA), [2]Universiteit Gent (Belgium), and [3]Technical University of Madrid (Spain)*

2:30 ERVR-417
Implementing native support for Oculus and leap motion in a commercial engineering visualization and analysis platform, *Anastacia MacAllister[1], Eliot Winer[1], and Tsung-Pin Yeh[2]; [1]Iowa State University and [2]Siemens PLM Software (USA)*

2:50 ERVR-418
Turning presence inside-out: metanarratives, *Max Parola, Samuel Johnson, and Ruth West, University of North Texas (USA)*

3:10 ERVR-419
Virtual reality system as an affective medium to induce specific emotion: a validation study, *Di Wu, Dongdong Wong, and Song Xue, Beijing Institute of Technology (China)*

3:30 – 3:50 pm Coffee Break

Art & Stories in VR

Session Chair: Ian McDowall, Intuitive Surgical / Fakespace Labs (USA)

3:50 – 5:00 pm
Continental Ballroom 3

3:50 ERVR-420
Paper-Thin: a virtual platform for art exhibition, *Cameron Buckley and Daniel Smith, Indiana University (USA)*

4:10 ERVR-421
Storyworld, Gesamtkunstwerk, art ecology: creating narrative geographies in the metavers, *Elif Ayiter, Sabanci University (Turkey)*

4:30 ERVR-422
Visual knowledge feedback through multi-camera vision system aided by augmented reality, *Josué Montes Martínez, Hugo Jimenez, Jorge Soto, Leonardo Barriga, Juan García, Alberto Vázquez, and Karla Hernández, Centro de Ingeniería y Desarrollo Industrial (Mexico)*

4:50
The Engineering Reality of Virtual Reality 2016: Wrap-up

Stereoscopic Displays and Applications (SD&A) XXVII

Conference grouping: Image and Video Processing, Quality, and Systems

Conferences in this grouping discuss electrical resistance and impedance imaging; diffusion optical imaging; imagery-based surveillance and tracking; the readability of electronic paper and mobile displays; image preference measurement and modeling; medical and forensic imaging; genetic and evolutionary computing; steganography and data hiding, microarray imaging; electronic cinema; multimedia content retrieval; and image and video compression, communications, segmentation and recognition, restoration and enhancement, among other topics.

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: 3D Theater awards are given for best CG film and best live action film. A 3D presentation award is given for best presentation using stereoscopic 3D.

Joint Session: Stereoscopic Image Processing and Depth Mapping with the 3D Image Processing, Measurement (3DIPM), and Applications Conference and Virtual Reality and 3D with the Engineering Reality of Virtual Reality Conference.

Events: 3D Theater

Conference Chairs: **Andrew J. Woods,** Curtin Univ. (Australia); **Nicolas S. Holliman,** Newcastle Univ. (United Kingdom); **Gregg E. Favalora,** VisionScope Technologies LLC (USA); and **Takashi Kawai,** Waseda Univ. (Japan)

Program Committee: **Neil A. Dodgson,** Univ. of Cambridge (UK); **Davide Gadia,** Univ. degli Studi di Milano (Italy); **Hideki Kakeya,** Univ. of Tsukuba (Japan); **Stephan R. Keith,** SRK Graphics Research (USA); **Michael Klug,** Magic Leap, Inc. (USA); **John D. Stern,** Intuitive Surgical, Inc. (Retired) (USA); **Chris Ward,** Lightspeed Design, Inc. (USA); and **Michael A. Weissman,** Perspective Systems (USA)

Founding Chair: **John O. Merritt,** The Merritt Group (USA)

Conference Sponsors

Stereoscopic Displays and Applications XXVII

Monday, February 15, 2016

Light-Field and Super-Multiview Displays

Session Chair: Neil Dodgson, University of Cambridge (United Kingdom)

8:40 – 10:10 am
Continental Ballroom 5

8:40 SDA-426
New visual coding exploration in MPEG: Super-MultiView and Free Navigation in Free viewpoint TV, *Gauthier Lafruit[10], Marek Domanski[1], Krzysztof Wegner[1], Tomasz Grajek[1], Takanori Senoh[2], Joël Jung[3], Péter Kovács[4], Patrik Goorts[5], Lode Jorissen[5], Adrian Munteanu[6], Beerend Ceulemans[6], Pablo Lopez[7], Sergio Lobo[7], Qing Wang[8], and Masayuki Tanimoto[9]; [1]Poznan University of Technology (Poland), [2]National Institute of Information and Communications Technology, [3]Orange Labs (France), [4]Holografika (Hungary), [5]Hasselt University (Belgium), [6]Vrije Universiteit Brussel (Belgium), [7]Universidad Politécnica de Madrid (Spain), [8]Zhejiang University (China), [9]Nagoya Industrial Science Research Institute (Japan), and [10]Université Libre de Bruxelles (Belgium)*

9:00 SDA-424
Application of light field displays to vision correction and accommodation support, *Fu-Chung Huang[1], Robert Konrad[2], and Gordon Wetzstein[2]; [1]NVIDIA Research and [2]Stanford University (USA)*

9:20 SDA-425
Light field modulation using a double-lenticular liquid crystal panel, *Hironobu Gotoda, National Institute of Informatics (Japan)*

9:40
TBA

10:00
SD&A Conference Opening Remarks

10:10 – 10:50 am Coffee Break

360° 3D

Session Chair: Gregg Favalora, VisionScope Technologies, LLC (USA)

10:50 am – 12:30 pm
Continental Ballroom 5

10:50 SDA-427
Multi-viewer autostereoscopic tabletop display with omnidirectional dynamic parallax barrier and novel time-multiplexed directional backlight, *Hagen Seifert and Quinn Smithwick, Disney Research (USA)*

11:10 SDA-428
360-degree three-dimensional display with the virtual display surface, *Hodaka Yamada[1], Kayo Yoshimoto[1], Hideya Takahashi[1], and Kenji Yamada[2]; [1]Osaka City University and [2]Osaka University (Japan)*

11:30 SDA-429
Stereoscopic space map – A semi-immersive navigation interface for 3D multi-display presentations, *Björn Sommer[1], Owen Kalutza[1], Andreas Hamacher[1], Tobias Czauderna[1], Matthias Klapperstück[1], Niklas Biere[2], Marco Civico[3], David G. Barnes[1], and Falk Schreiber[1]; [1]Monash University (Australia), [2]Bielefeld University, and [3]Gymnasium Schloss Holte-Stukenbrock (Germany)*

11:50 SDA-430
Optical realization for the computer-generated cylindrical hologram, *Munkh-Uchral Erdenebat, Erkhembaatar Dashdavaa, Ki-Chul Kwon, and Nam Kim, Chungbuk National University (South Korea)*

12:10
TBA

12:30 – 2:00 pm Lunch Break

EI 2016 Opening Plenary and Symposium Awards
Session Chair: Choon-Woo Kim (Inha University)
2:00 – 3:00 PM
Continental Ballroom 5

Illuminating a bright future for medicine, *Audrey K. Bowden, Stanford University (USA)*

3:00 – 3:30 pm Coffee Break

3D Content I

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

3:30 – 3:50 pm
Continental Ballroom 5

SDA-431
Linear optimization approach for depth range adaption of stereoscopic videos, *Werner Zellinger[1], Bernhard Moser[1], Ayadi Chouikhi[1], Florian Seitner[3], Matej Nezveda[2], and Margrit Gelautz[2]; [1]Software Competence Center Hagenberg GmbH, [2]Technical Univ. Vienna, and [3]Emotion3D GmbH (Austria)*

SD&A Keynote I
Session Chair: Nicolas Holliman, University of Newcastle (United Kingdom)
3:50 – 4:50 pm
Continental Ballroom 5

SDA-432
Two shipwrecks, 2500 metres underwater, six 3D cameras – let the survey begin, *Andrew Woods[1], Andrew Hutchison[1], Joshua Hollick[1], and Tim Eastwood[2]; [1]Curtin University and [2]Western Australian Museum (Australia)*

5:00 – 6:00 pm EI 2016 Symposium Reception

SD&A Conference 3D Theater

Hosts: John Stern, Intuitive Surgical, Inc. (USA); Chris Ward, Lightspeed Design, Inc. (USA); and Andrew Woods, Curtin University (Australia)

6:00 – 7:30 pm
Continental Ballroom 5

This ever-popular event allows attendees to see large-screen examples of 3D content from around the world. Program to be announced at the conference. 3D glasses provided.

SD&A Conference Annual Dinner
7:50 – 10:00 pm
TBA at Conference
SD&A attendees are invited to join the annual informal SD&A dinner. This is an opportunity to meet with colleagues and discuss the latest advances. There is no host for this event. Information on venue and cost will be provided on the day at the conference.

Tuesday, February 16, 2016

Human Factors and 2D to 3D Conversion

Session Chair: Takashi Kawai, Waseda University (Japan)

8:40 – 10:20 am
Continental Ballroom 5

8:40 SDA-433
Towards perceptually coherent depth maps in 2D-to-3D conversion, *Nicole Brosch, Tanja Schausberger, and Margrit Gelautz, Vienna University of Technology (Austria)*

9:00 SDA-434
Depth extraction from a single image based on block-matching and robust regression, *Hyeongju Jeong, Changjae Oh, and Kwanghoon Sohn, Yonsei University (South Korea)*

9:20 SDA-435
Emotional arousal by stereoscopic images and the effects on time perception, *Takashi Kawai, Risako Hama, and Masashi Horiuchi, Waseda University (Japan)*

9:40 SDA-436
A novel approach of generating stereoscopic images using defocus, *Tianteng Bi, Yue Liu, Dongdong Wong, and Yongtian Wang, Beijing Institute of Technology (China)*

10:00 SDA-437
Stereoscopic remote vision system aerial refueling visual performance, *Marc Winterbottom[1], Charles Lloyd[2], James Gaska[1], Steven Wright[3], and Steven Hadley[1]; [1]U.S. Air Force School of Aerospace Medicine and [2]Visual Performance LLC (USA)*

10:20 – 10:50 am Coffee Break

3D Image Quality and Visual Comfort

Session Chair: John Merritt, The Merritt Group (USA)

10:50 am – 12:30 pm
Continental Ballroom 5

10:50 SDA-438
An adaptive blur in peripheral vision to reduce visual fatigue in stereoscopic vision, *David Aurat[1], Laure Leroy[2], Olivier Hugues[1], and Philippe Fuchs[1]; [1]Mines Paristech — PSL and [2]University Paris 8 (France)*

11:10 SDA-439
Trends in S3D movies quality as evaluated on 105 movies and 10 quality metrics, *Dmitriy Vatolin, Alexander Bokov, Mikhail Erifeev, and Vyacheslav Napadovsky, Lomonosov Moscow State University (Russian Federation)*

11:30 SDA-440
Evaluation of the perception of dynamic horizontal image translation and a gaze adaptive approach, *Stefan Eickelberg, TU Dortmund University (Germany)*

11:50 SDA-441
Study on the influence of 3D motion characteristics on the blinking rate, *Yuan Gao, Yue Liu, Yiwang Qian, and Yongtian Wang, Beijing Institute Of Technology (China)*

12:10 SDA-442
Visual fatigue during continuous viewing the 3D Movie, *Danli Wang, Xinpan Yan Yang, and Haichen Hu, Institut of Software, CAS (China)*

12:30 – 2:00 pm Lunch Break

EI 2016 Tuesday Plenary and Symposium Awards
Session Chair: Nitin Sampat (Rochester Institute of Technology)
2:00 – 3:00 PM
Continental Ballroom 5

Pushing computational photography deeper into imaging system design, *Ren Ng, University of California, Berkeley (USA)*

3:00 – 3:30 pm Coffee Break

SD&A Keynote II
Session Chair: Andrew Woods, Curtin University (Australia)
3:30 – 4:30 pm
Continental Ballroom 5

SDA-443
3-D movie rarities, *Robert Furmanek and Greg Kintz, 3-D Film Archive (USA)*

Autostereoscopic Displays

Session Chair: Hideki Kakeya, University of Tsukuba (Japan)

4:30 – 5:30 pm
Continental Ballroom 5

4:30 SDA-444
A high resolution aerial 3D display using a directional backlight (JIST-first), *Hideki Kakeya and Shuta Ishizuka, University of Tsukuba (Japan)*

4:50 SDA-445
Electronical correction of misalignments between optical grid and pixel panel on autostereoscopic displays, *Silvio Jurk, Mathias Kuhlmey, Bernd Duckstein, and René de la Barré, Frauhofer Heinrich-Hertz-Institute (Germany)*

5:10 SDA-446
A discrete holography method for multiview glassless 3D display using dynamic address driver, *Laurence Chen, 4D perception LLC (USA)*

EI 2016 Symposium Demonstration Session and Exhibit Hall Happy Hour
5:30 – 7:00 PM
Continental Ballroom Foyer

Wednesday, February 17, 2016

3D Content II

Session Chair: John Stern, Intuitive Surgical, Inc. (USA)

8:40 – 9:20 am
Continental Ballroom 5

8:40 SDA-447
An efficient approach to playback of stereoscopic videos using a wide field-of-view, *Chris Larkee and John LaDisa, Marquette University (USA)*

9:00 SDA-448
Hybrid reality: Using 2D and 3D together in a mixed mode display, *Kurt Hoffmeister, Mechdyne Corp. (USA)*

SD&A Discussion Forum
9:20 – 10:20 am
Continental Ballroom 5
The SD&A Discussion Forum is a great opportunity to hear a panel of stereoscopic luminaries discuss a topic of high stereoscopic relevance. Topic and speakers to be announced closer to the event. Please visit the conference website www.stereoscopic.org or join the SD&A Linkedin group for updates.

10:20 – 10:50 am Coffee Break

3DIPM/SD&A: Stereoscopic Image Processing and Depth Mapping

Joint Session

Session Chairs: William Puech, University of Montpellier (France) and Michael Weissman, TrueVision Systems (USA)

10:50 am – 12:30 pm
Continental Ballroom 5

This session is jointly sponsored by: Stereoscopic Displays and Applications XXVII and 3D Image Processing, Measurement (3DIPM), and Applications 2016.

10:50 SDA-034
Geometrically constrained sub-pixel disparity estimation from stereo images of the retinal fundus, *Mohamad Kharboutly, Carlos Vazquez, Stéphane Coulombe, and Jacques De Guise, École de technologie supérieure (Canada)*

11:10 3DIPM-035
3D autostereoscopic display image generation using direct light field rendering, *Young Ju Jeong and Hyunsung Chang, Samsung Advanced Institute of Technology (South Korea)*

11:30 SDA-036
A new hole filling method based on 3D geometric transformation for synthesized image, *Hak Gu Kim and Yong Man Ro, Korea Advanced Institute of Science and Technology (South Korea)*

11:50 3DIPM-037
Blue noise sampling of surfaces from stereoscopic images, *Frederic Payan, Jean-Luc Peyrot, and Marc Antonini, Laboratory I3S, University Nice - Sophia Antipolis and CNRS (France) - UMR 7271 (France)*

12:10 SDA-038
3D image warping based on linear disparity mapping, *Riddhi Ray Chaudhuri and Prabir Kumar Biswas, Indian Institute of Technology (India)*

12:30 – 2:00 pm Lunch Break

EI 2016 Wednesday Plenary and Symposium Awards
Session Chair: Choon-Woo Kim (Inha University)
2:00 – 3:00 PM
Continental Ballroom 5

Intel® RealSense Technology: Adding human-like sensing and interactions to computing devices, *Achin Bhowmik, Intel Corporation (USA)*

3:00 – 3:30 pm Coffee Break

ERVR / SD&A: Virtual Reality and 3D

Joint Session

Session Chairs: Margaret Dolinsky, Indiana University (USA) and Chris Ward, Lightspeed Design, Inc. (USA)

3:30 – 5:30 pm
Continental Ballroom 5

This session is jointly sponsored by: Stereoscopic Displays and Applications XXVII, and The Engineering Reality of Virtual Reality 2016.

3:30 SDA-039
LEIA 3D: Holographic reality, *David Fattal, LEIA Inc. (USA)*

3:50 SDA-040
Effect of inter-lens distance on fusional limit in stereoscopic vision using a simple smartphone head-mounted display, *Hiroyuki Morikawa[1,2], Yoshihiro Banchi[2], Shota Tsukada[2], Yusuke Hasegawa[2], Suguru Takahashi[2], Kaiji Ohta[3], and Takashi Kawai[2]; [1]Aoyama Gakuin University, [2]Waseda Univiersity, and [3]International Christian University (Japan)*

4:10 SDA-041
Investigating intermittent stereoscopy: Its effects on perception and visual fatigue, *Ari Bouaniche and Laure Leroy, Université Paris 8 (France)*

4:30 SDA-042
Stereoscopy-based procedural generation of virtual environments, *Manlio Scalabrin, Laura Anna Ripamonti, Dario Maggiorini, and Davide Gadia, University of Milan (Italy)*

4:50 ERVR-043
Beyond fun and games: VR as a tool of the trade, *Carolina Cruz-Neira and Dirk Reiners, University of Arkansas (USA)*

5:10
SD&A Conference Closing Remarks

EI 2016 Symposium Interactive Papers Session
5:30 – 7:00 PM
Continental Ballroom 6

Stereoscopic Displays and Applications XXVII Interactive Papers Session

5:30 – 7:00 pm
Continental Ballroom 6

The following works will be presented at the EI 2016 Symposium Interactive Papers Session.

SDA-449
Occlusion and error detection for stereo matching and hole-filling using dynamic programming, *Eu-Tteum Baek and Yo-Sung Ho, Gwangju Institute of Science and Technology (GIST) (South Korea)*

SDA-450
Comparison of visual discomfort in viewing 3D video with various contrast changes on stereoscopic 3D display, autostereoscopic display and HMD, *Yoon-Suk Kang[1] and Sungho Cho[2]; [1]The Webb Schools (USA) and [2]MASTERIMAGE 3D (South Korea)*

SDA-451
An analysis of blue-light effect in reducing visual discomfort from watching stereoscopic 3D video, *Yong-Woo Kim and Hang-Bong Kang, Catholic University of Korea (South Korea)*

SDA-452
Retinal projection type 3D head-mounted display using an HOE lens array, *Yasuhiro Takatsuka, Kayo Yoshimoto, and Hideya Takahashi, Osaka City University (Japan)*

SDA-453
Disparity remapping considering the perception of depth structure, *Ikuko Tsubaki[1], Kenichi Iwauchi[1], and Hiroaki Shigemasu[2]; [1]Sharp Corp. and [2]Kochi University of Technology (Japan)*

SDA-454
The effects of functional binocular disparity on route memory in stereoscopic images, *Sanghyun Kim, Michika Takahashi, Katsumi Watanabe, and Takashi Kawai, Waseda University (Japan)*

EI 2016 Symposium Interactive Papers Session
5:30 – 7:00 PM
Continental Ballroom 6

Image Processing: Machine Vision Applications IX

Conference grouping: Real-time Image and Video
Conferences in this grouping discuss machine vision applications for industrial research and development; tracking and scene analysis for intelligent vehicles; 3D vision: modeling, representation, perception, processing, and recognition; and predictive 3D vision, among other topics.

Conference overview

This conference brings together real-world practitioners and laboratory researchers in machine vision to share recent applications and developments. Topics of interest include the integration of imaging sensors supporting hardware, computers, and algorithms for 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, and chemicals. Other industries, such as semiconductor and electronics manufacturing, have been employing machine vision technology for several years. Machine vision supporting handling robots is another main topic for industrial applications.

There is need of accurate, fast and robust detection of objects and their position in space. Their surface, the background and illumination is uncontrolled, 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 at-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.

Awards: Best Paper Award

Conference Chairs: **Edmund Y. Lam,** The Univ. of Hong Kong (Hong Kong, China); **Henry Ngan,** Hong Kong Baptist Univ. (Hong Kong, China); and **Kurt S. Niel,** Upper Austria Univ. of Applied Sciences (Austria)

Program Committee: **Philip R. Bingham,** Oak Ridge National Lab. (USA); **Ewald Fauster,** Montan Universität Leoben (Austria); **Daniel Fecker,** Technische Univ. Braunschweig (Germany); **Steven P. Floeder,** 3M Co. (USA); **David Fofi,** Univ. de Bourgogne (France); **Shaun Scott Gleason,** Oak Ridge National Lab. (USA); **Keith Jenkins,** The Univ. of Southern California (USA); **Olivier Laligant,** Univ. de Bourgogne (France); **Junning Li,** Keck School of Medicine of USC (USA); **Fabrice Meriaudeau,** Univ. de Bourgogne (France); **Vincent C. Paquit,** Oak Ridge National Lab. (USA); **Hamed Sari-Sarraf,** Texas Tech Univ. (USA); **Ralph Seulin,** Univ. de Bourgogne (France); **Svorad Štolc,** AIT Austrian Institute of Technology GmbH (Austria); **Christophe Stolz,** Univ. de Bourgogne (France); **Seung-Chul Yoon,** Agricultural Research Service (USA); **Gerald Zauner,** FH OÖ– Forschungs & Entwicklungs GmbH (Austria)

Image Processing: Machine Vision Applications IX

Wednesday, February 17, 2016

Inspection and Metrology

Session Chair: Edmund Lam, The University of Hong Kong (Hong Kong)

4:10 – 4:50 pm
Golden Gate 8

4:10 IPMVA-372
Development of multi-resolution microscope image processing system (JIST-first), *Tomohiro Suzuki, Shin Usuki, and Kenjiro Miura, Shizuoka University (Japan)*

4:30 IPMVA-373
Validation of a novel geometric coordination registration using manual and semi-automatic methods in cone-beam computed tomogram, *Walter Lam[1], Henry Ngan[2], Richard Hsung[1], Henry Luk[1], Tazuko Goto[1], and Edmond Pow[1]; [1]University of Hong Kong and [2]Hong Kong Baptist University (Hong Kong)*

Image Processing: Machine Vision Applications IX in the Interactive Papers Session

5:30 – 7:00 pm
Continental Ballroom 6

The following works will be presented at the EI 2016 Symposium Interactive Papers Session.

IPMVA-374
Data-driven approach to aesthetic enhancement, *Jihye Choi, Sung-Joon Koh, Jong Woo Kwack, Yonghun Kwon, and Hyunjung Shim, Yonsei University (South Korea)*

IPMVA-375
Real-time machine cision with GPU-acceleration using Quasar, *Jonas De Vylder[1,2], Simon Donne[1,2], and Bart Goossens[1,2]; [1]Ghent University and [2]iMinds (Belgium)*

IPMVA-376
Learning based hole filling method using deep convolutional neural networks for view synthesis, *Heountaek Lim, Hak Gu Kim, and Yong Man Ro, Korea Advanced Institute of Science and Technology (KAIST) (South Korea)*

IPMVA-377
Exploiting visual saliency for car detection and tracking, *Marco Moltisanti[1], Giovanni Farinella[1], Arcangelo Bruna[2], and Sebastiano Battiato[1]; [1]University of Catania and [2]STMicroelectronics (Italy)*

EI 2016 Symposium Interactive Papers Session
5:30 – 7:00 PM
Continental Ballroom 6

Thursday, February 18, 2016

Detection, Identification, and Monitoring I

Session Chair: Seung-Chul Yoon, US Department of Agriculture-Agricultural Research Service (USA)

8:50 – 10:10 am
Golden Gate 8

8:50 IPMVA-378
Low-level track finding and completion using random fields, *Tu-Thach Quach, Rebecca Malinas, and Mark Koch, Sandia National Laboratories (USA)*

9:10 IPMVA-379
H*yperSpectral Imaging* (HSI) applied to *in situ* vineyard monitoring: a basic-exploratory approach, *Giuseppe Bonifazi, Silvia Serranti, and Valentina Luciani, Universitá degli Studi di Roma La Sapienza (Italy)*

9:30 IPMVA-380
Fusion of optical coherence tomography and hyperspectral imaging for poultry meat quality assessment, *Seung-Chul Yoon, Brian Bowker, and Hong Zhuang, US Department of Agriculture-Agricultural Research Service (USA)*

9:50 IPMVA-381
Unsupervised tracking with a low computational cost using the doubly stochastic Dirichlet process mixture model, *Xing Sun, Nelson Yung, Edmund Lam, and Hayden So, The University of Hong Kong (Hong Kong)*

10:10 – 10:50 am Coffee Break

Detection, Identification, and Monitoring II

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

10:50 am – 12:30 pm
Golden Gate 8

10:50 IPMVA-382
Marker-less AR framework using on-site 3D line segment based model generation (JIST-first), *Yusuke Nakayama[1], Hideo Saito[1], Masayoshi Shimizu[2], and Nobuyasu Yamaguchi[2]; [1]Keio Univeristy and [2]Fujitsu Laboratories Ltd. (Japan)*

11:10 IPMVA-383
Bit depth expansion via estimation of bit value expectation, *Jihwan Woo, Seoyoung Lee, and Wonhee Choe, Samsung Electronics (South Korea)*

11:30 IPMVA-384
Multilevel segment based dense correspondence: An affine transformation approach, *Sungil Choi, Seungryong Kim, Kihong Park, and Kwanghoon Sohn, Yonsei University (South Korea)*

11:50 IPMVA-385
Density-based outlier detection by local outlier factor on large-scale traffic video data, *Mathew X. Ma[1], Henry Ngan[1], and Wei Liu[2]; [1]Hong Kong Baptist University (Hong Kong) and [2]The University of Sheffied (United Kingdom)*

12:10 IPMVA-386
Automated lane detection by K-means clustering: A machine learning approach, *Ajay Kumar and Arpit Gupta, Indian Institute of Technology, Bombay (India)*

12:30 – 2:00 pm Lunch Break

Classification Techniques

Session Chair: Reinhold Huber-Mörk, Austrian Institute of Technology (Austria)

2:00 – 3:00 pm
Golden Gate 8

2:00 IPMVA-387
STABLE: Stochastic binary local descriptor for high-performance dense stereo matching, *Svorad Štolc, Kristián Valentín, and Reinhold Huber-Mörk, AIT Austrian Institute of Technology GmbH (Austria)*

2:20 IPMVA-388
Noise tolerant histogram voting for gender classification based on LBP, *Sanghun Lee and Chulhee Lee, Yonsei University (South Korea)*

2:40 IPMVA-389
Sudoku texture classification, *Graham Finlayson and Seth Nixon, University of East Anglia (United Kingdom)*

Intelligent Robots and Computer Vision XXXIII: Algorithms and Techniques

Conference grouping: Real-time Image and Video

Conferences in this grouping discuss machine vision applications for industrial research and development; tracking and scene analysis for intelligent vehicles; 3D vision: modeling, representation, perception, processing, and recognition; and predictive 3D vision, among other topics.

Conference overview

This meeting focuses on new algorithms and techniques for intelligent robots and computer vision with emphasis on algorithms and techniques.

With computer vision, the conference looks at the development of the science of computer imaging, theory, algorithms, paradigms, and applications. It emphasizes intelligent robotics, new computer vision, and pattern recognition algorithms and applications in robotics and product inspection, modeling of human visual processing, learning for swarms of robots, etc.

In 2016, we plan several major sessions on new advances in intelligent mobile robots (systems, navigation, obstacle avoidance, route planning) with emphasis on results obtained in diverse government and other programs. We are interested especially in the diversity of vehicles including airborne, micro UAVs, and UAVs. Sessions are also planned on detection and tracking of people and vehicles in complex environments, product inspection, cognitive learning strategies and systems, autonomous multivehicle collaboration and vehicle automation and enhanced safety through driver assisted aids for manned and unmanned vehicles for the military and automotive applications. In 2016 we launch two new themes: computational attention (machine attention in robots, joint attention in human-robot cooperation and human factor analyses) and Mobile Mapping (visual infrastructure recognition and localization).

Awards: Best Oral and Best Poster Paper Presentation for student authors. For award consideration, the student author or co-author must present the paper and verify their student status to the session chair. Awards will be based on relevance, creativity, theoretical and experimental quality, and presentation effectiveness.

Conference Chairs: **David Casasent,** Carnegie Mellon Univ. (USA), and **Juha Röning,** Univ. of Oulu (Finland)

Program Committee: **Dah-Jye Lee,** Brigham Young Univ. (USA); **Charles A. McPherson,** Draper Lab. (USA); **Kurt S. Niel,** Upper Austria Univ. of Applied Sciences (Austria); **Yoshihiko Nomura,** Mie Univ. (Japan); **Lucas Paletta,** JOANNEUM RESEARCH Forschungsgesellschaft mbH (Austria); **Daniel Raviv,** Florida Atlantic Univ. (USA); **Bernard L. Theisen,** US Army Tank Automotive Research, Development, and Engineering Ctr. (USA); and **Dili Zhang,** Monotype Imaging (USA)

Intelligent Robots and Computer Vision XXXIII: Algorithms and Techniques

Wednesday, February 17, 2016

Keynote: The 23rd Annual Intelligent Ground Vehicle Competition: Building Engineering Students into Robotists
Session Chairs: David Casasent, Carnegie Mellon University (USA) and Juha Roning, University of Oulu (Finland)
9:10 – 9:50 am
Golden Gate 8

ROBVIS-390
The 23rd Annual Intelligent Ground Vehicle Competition: Building engineering students into robotists, *Bernard Theisen, US Army TARDEC (USA)*

Robotic Vision: Motion Accommodation

Session Chairs: David Casasent, Carnegie Mellon University (USA) and Juha Roning, University of Oulu (Finland)

9:50 – 10:20 am
Golden Gate 8

9:50 ROBVIS-391
Modeling active vision during smooth pursuit of a robotic eye, *Jacek Turski, University of Houston-Downtown (USA)*

10:20 – 10:50 am Coffee Break

Feature Extraction and Recognition

Session Chairs: David Casasent, Carnegie Mellon University (USA) and Juha Roning, University of Oulu (Finland)

10:50 am – 12:20 pm
Golden Gate 8

10:50
Conference Welcome

10:55 ROBVIS-392
Multiple objects extraction from aerial imagery with Convolutional Neural Networks (JIST-first), *Shunta Saito[1], Takayoshi Yamashita[2], and Yoshimitsu Aoki[1]; [1]Keio University and [2]Chubu University (Japan)*

11:20 ROBVIS-393
Pixel based cost computation using weighted distance information for cross-scale stereo matching, *Yong-Jun Chang and Yo-Sung Ho, Gwangju Institute of Science and Technology (South Korea)*

11:45 ROBVIS-394
Feature extraction using block-based Local Binary Pattern for face recognition, *Abdelmalik Moujahid, Amaia Abanda, and Fadi Dornaika, University of the Basque Country UPV/EHU (Spain)*

12:10 ROBVIS-395
Place recognition using image retrieval with covariance descriptors, *Fadi Dornaika[1], Ammar Assoum[2], and Abdelmalik Moujahid[1]; [1]University of the Basque Country (Spain) and [2]Lebanese University (Lebanon)*

12:20 – 2:00 pm Lunch Break

EI 2016 Wednesday Plenary and Symposium Awards
Session Chair: Choon-Woo Kim (Inha University)
2:00 – 3:00 PM
Continental Ballroom 5

Intel® RealSense Technology: Adding human-like sensing and interactions to computing devices, *Achin Bhowmik, Intel Corporation (USA)*

3:00 – 3:30 pm Coffee Break

Intelligent Robots and Computer Vision XXXIII: Algorithms and Techniques Interactive Papers Session

5:30 – 7:00 pm
Continental Ballroom 6

The Intelligent Robots and Computer Vision XXXIII interactive paper will be presented in the EI 2016 Symposium Interactive Papers Session.

Imaging and Multimedia Analytics in a Web and Mobile World 2016

Conference grouping: Web and Mobile Imaging and Visualization

Conferences in this grouping discuss image, video, and multimedia analytics: object tracking, face recognition, human detection and tracking; social networks: use of images and videos in social networks; video segmentation and tracking algorithms; Bayesian models for tracking and activity monitoring; social media; and multivariate time series visualization, among other topics.

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.

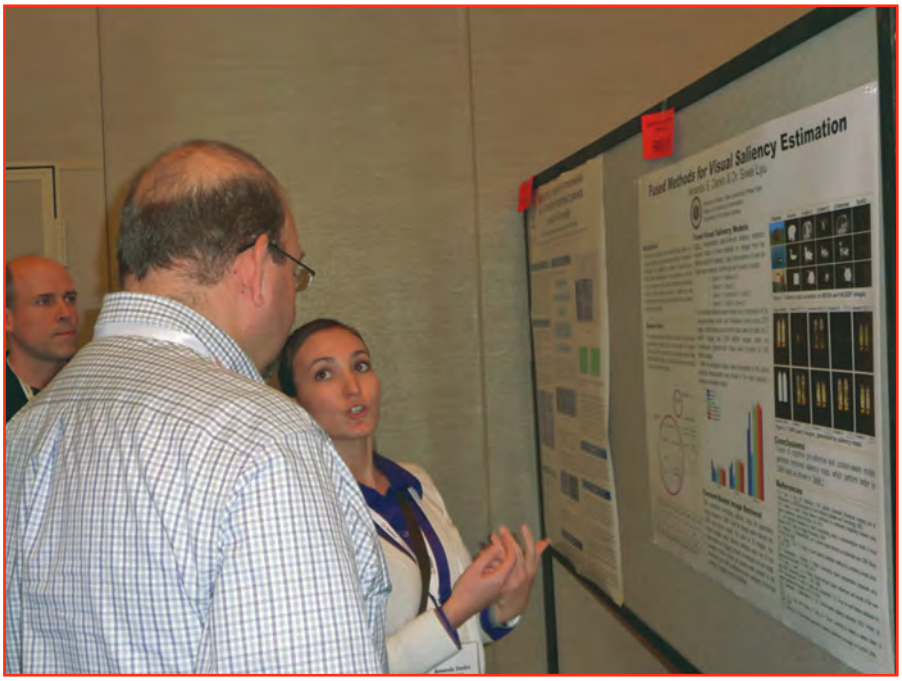

Photo: Diana Gonzalez.

Conference Chairs: **Jan P. Allebach,** Purdue Univ. (USA); **Zhigang Fan,** Apple Inc. (USA); and **Qian Lin,** Hewlett-Packard Labs. (USA)

Program Committee: **Gady Agam,** IIT (USA); **Vijayan K. Asari,** Univ. of Dayton (USA); **Reiner Fageth,** CEWE Stifung & Co. KGaA (Germany); **Michael J. Gormish,** Ricoh Innovations, Inc. (USA); **Yandong Guo,** Microsoft Corp. (USA); **Ali Jahanian,** MIT CSAIL Lab (USA); *Ramakrishna Kakarala,* Phasedoma.in (USA); **Xiaofan Lin,** A9.com, Inc. (USA); **Yung-Hsiang Lu,** Purdue Univ. (USA); **Mu Qiao,** Shutterfly (USA); **Alastair M. Reed,** Digimarc Corp. (USA); **Andreas Savakis,** RIT (USA); **Bin Shen,** Google Inc. (USA); **Wiley H. Wang** (USA); and **Buyue Zhang,** NVIDIA Corporation (USA)

Imaging and Multimedia Analytics in a Web and Mobile World 2016

Monday, February 15, 2016

Face Analysis and Recognition

Session Chair: Qian Lin, Hewlett-Packard Company (USA)

9:10 – 10:10 am
Golden Gate 8

9:10 IMAWM-455
Joint and discriminative dictionary learning for facial expression recognition, *Sriram Kumar, Behnaz Ghoraani, and Andreas Savakis, Rochester Institute of Technology (USA)*

9:30 IMAWM-456
Class specific discriminant dictionary learning with kernels for face recognition, *Bao-Di Liu[1], Yuting Wang[2], Liangke Gui[3], Yu-Xiong Wang[3], Bin Shen[4], Xue li[5], and Yan-Jiang Wang[1]; [1]China University of Petroleum (China), [2]Karlsruhe Institute of Technology (Germany), [3]Carnegie Mellon University (USA), [4]Purdue University (USA), and [5]Tsinghua University (China),*

9:50 IMAWM-457
Face pose normalization and simulation methods based on multi-view face alignment, *Changsong Liu[1,2,3] and Liting Wang[1]; [1]Department of Electronic Engineering, Tsinghua University (China), [2]State Key Laboratory of Intelligent Technology and Systems, and [3]Tsinghua National Laboratory for Information Science and Technology (China)*

10:10 – 10:30 am Coffee Break

Keynote: Social Media & Mobile Imaging
Session Chair: Zhigang Fan, Apple Inc (USA)
10:30 – 11:30 am
Golden Gate 8

IMAWM-458
Browsing heterogeneous multimedia social networks contents on mobile devices, *Chang Wen Chen, State University of New York at Buffalo (USA)*

Social Media & Mobile Imaging

Session Chair: Mu Qiao, Shutterfly Inc. (USA)

11:30 am – 12:30 pm
Golden Gate 8

11:30 IMAWM-459
Hazmat sign location detection based on Fourier shape descriptors, *Kharittha Thongkor[1], Albert Parra Pozo[2], Thumrongrat Amornraska[1], and Edward Delp[2]; [1]King Mongkut's University of Technology Thonburi (Thailand) and [2]Purdue University (USA)*

11:50 IMAWM-460
Is it possible to attract new customers via mobile services for printed products?, *Reiner Fageth, CEWE Stiftung & Co. KGAA (Germany)*

12:10 IMAWM-461
Robust and secure image encryption schemes during JPEG compression process, *Kun He[1], Christophe Bidan[1,2], Gaëtan Le Guelvouit[1], and Cyrielle Feron[1]; [1]B-Com and [2]CentraleSupélec (France)*

12:30 – 2:00 pm Lunch Break

EI 2016 Opening Plenary and Symposium Awards
Session Chair: Choon-Woo Kim (Inha University)
2:00 – 3:00 PM
Continental Ballroom 5

Illuminating a bright future for medicine, *Audrey K. Bowden, Stanford University (USA)*

3:00 – 3:30 pm Coffee Break

Image Analysis and Big Data

Session Chair: Bin Shen, Google Research (USA)

3:30 – 4:30 pm
Golden Gate 8

3:30 IMAWM-462
Face search in a big data system, *Qian Lin, Carlos Ceja, and Meichun Hsu, Hewlett-Packard Company (USA)*

3:50 IMAWM-463
MS-Celeb-1 Million: Celebrity recognition dataset and measurement, *Yandong Guo, Lei Zhang, Yuxiao Hu, Xiaodong He, and Jianfeng Gao, Microsoft (USA)*

4:10 IMAWM-464
Data analysis on camera data for willing-to-pay trend in online photo service, *Mu Qiao and Ariawan Suwendi, Shutterfly Inc. (USA)*

5:00 – 6:00 pm EI 2016 Symposium Reception

Tuesday, February 16, 2016

Video Analysis

Session Chair: Reiner Fageth, CEWE Stiftung & Co. KGAA (Germany)

9:30 – 10:10 am
Golden Gate 8

9:30 IMAWM-465
Touch event recognition for human interaction, *Qingshuang Chen, He Li, Rana Abu-Zhaya, Amanda Seidl, Fengqing Zhu, and Edward Delp, Purdue University (USA)*

9:50 IMAWM-466
Real time automatic machinery threat detection and identification system for protection of pipeline infrastructure, *Almabrok Essa, Paheding Sidike, and Vijayan Asari, University of Dayton (USA)*

10:10 – 10:30 am Coffee Break

Invited Talk: Deep Learning
Session Chair: Andreas Savakis, Rochester Institute of Technology (USA)
10:30 – 11:10 am
Golden Gate 8

IMAWM-467
Deep 3D shape representation, *Yi Fang, New York University Abu Dhabi (USA)*

Deep Learning

Session Chair: Yandong Guo, Microsoft (USA)

11:10 am – 12:30 pm
Golden Gate 8

11:10 IMAWM-468
Neon: Optimizing image selection, *Mark Desnoyer, Neon (USA)*

11:30 IMAWM-469
Automatic mobile retinal microaneurysm detection using handheld fundus camera via cloud computing, *Jane You[1], Qin Li[2], and Zhenhua Guo[3]; [1]The Hong Kong Polytechnic University, [2]Shenzhen Institute of Information Technology, and [3]Tsinghua University (China)*

11:50 IMAWM-470
Two-step learning of deep convolutional neural network for discriminative face recognition under varying illumination, *Yeoreum Choi, Hyung-Il Kim, and Yong Man Ro, Korea Advanced Institute of Science and Technology (South Korea)*

12:10 IMAWM-471
Deep network for accurate tracking and analyzing gait patterns in low resolution video surveillance towards threat and person identification, *Binu Nair and Kimberly Kendricks, University of Nevada, Las Vegas (USA)*

12:30 – 2:00 pm Lunch Break

EI 2016 Tuesday Plenary and Symposium Awards
Session Chair: Nitin Sampat (Rochester Institute of Technology)
2:00 – 3:00 PM
Continental Ballroom 5

Pushing computational photography deeper into imaging system design, *Ren Ng, University of California, Berkeley (USA)*

3:00 – 3:30 pm Coffee Break

Image Analysis and Machine Learning

Session Chair: Jan Allebach, Purdue University (USA)

3:30 – 4:50 pm
Golden Gate 8

3:30 IMAWM-472
One-class maximum margin matrix factorization, *Bin Shen, Cheng Lu, and Qifan Wang, Purdue University (USA)*

3:50 IMAWM-473
A multi-image super resolution via hybrid registration with depth information, *Lei Shi, Yongbing Zhang, Haoqian Wang, Xingzheng Wang, and Qionghai Dai, Tsinghua University (China)*

4:10 IMAWM-474
A Bayesian approach to infer ground truth photo aesthetic quality score from psychophysical experiment, *Jianyu Wang[1], Yandong Guo[2], and Jan Allebach[1]; [1]Purdue University and [2]Microsoft Research (USA)*

4:30 IMAWM-475
Stroke Width Reconstruction Algorithm for handwriting contour improvement, *Cao Shi, Canhui Xu, and Jiqiang Wang, Qingdao University of Science and Technology (China)*

EI 2016 Symposium Demonstration Session and Exhibit Hall Happy Hour
5:30 – 7:00 PM
Continental Ballroom Foyer

Video Surveillance and Transportation Imaging Applications 2016

Conference grouping: Web and Mobile Imaging and Visualization

Conferences in this grouping discuss image, video, and multimedia analytics: object tracking, face recognition, human detection and tracking; social networks: use of images and videos in social networks; video segmentation and tracking algorithms; Bayesian models for tracking and activity monitoring; social media; and multivariate time series visualization, among other topics.

Conference 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 hand held mobile devices. Major applications of these technologies span the spectrum from surveillance, transportation, remote sensing, social media, sports, retail, and biomedical to name a few. Only recently has the potential for these technologies begun to be realized in various commercial, government, and consumer based applications. For instance, 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. On the other hand, transportation systems, the life blood of our economic and social lives, are far from their ideal state. Vehicle accidents are the number one cause of death in the US for ages 4 to 34, and expected to surpass disease as a cause of death for all ages worldwide by 2020. By some estimates, half the fuel consumed in San Francisco is consumed while searching for a parking space. Vehicular congestion is a leading cause of lost productivity and the fuel efficiency considerations have traditionally received very limited attention in the design of present day systems.

Over the past two decades, various video analytics algorithms have been proposed for autonomous understanding of events for a variety of surveillance and transportation type 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 these areas have the potential for very 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 to monitor various facilities and smarter transportation networks to improve fuel efficiency, safety, and reduce emissions and congestions in various metropolitan areas throughout the world. The conference brings together world class researchers and practitioners that develop and deploy imaging and video technologies to enable novel solutions for problems in the surveillance, security, and transportation arenas

Conference Chair: **Eli Saber,** Rochester Institute of Technology (USA)

Program Committee: **Ghassan Al-Regib,** Georgia Institute of Technology (USA); **Vijayan K. Asari,** Univ. of Dayton (USA); **Farhan A. Baqai,** Apple Inc. (USA); **Elisa H. Barney Smith,** Boise State Univ. (USA); **Alessandro Bevilacqua,** Univ. degli Studi di Bologna (Italy); **Philip M. Birch,** Univ. of Sussex (UK); **Alberto Broggi,** Univ. degli Studi di Parma (Italy); **Yang Cai,** Carnegie Mellon Univ. (USA); **Peter H. N. de With,** Technische Univ. Eindhoven (the Netherlands); **Sohail A. Dianat,** Rochester Institute of Technology (USA); **Hassan Foroosh,** Univ. of Central Florida (USA); **Prudhvi Gurram,** US Army Research Lab. (USA); **Mustafa I. Jaber,** NantVision Inc. (USA); **Bo Ling,** Migma Systems, Inc. (USA); and **Fa-Long Luo,** Element CXI, Inc. (USA)

Photo: San Francisco Travel Association–Scott Chernis.

Video Surveillance and Transportation Imaging Applications 2016

Monday, February 15, 2016

Pedestrian and Position Detection

Session Chair: Sreenath Vantaram, Intel Corporation (USA)

8:50 –10:20 am
Golden Gate 3

8:50
Chair Remarks

9:00 VSTIA-511
Histograms of Oriented Phase and Gradient (HOPG) descriptor for improved pedestrian detection, *Hussin Ragb and Vijayan Asari, University of Dayton (USA)*

9:20 VSTIA-512
Pedestrian's intention prediction based on Fuzzy Finite Automata and spatial-temporal features, *Joon-Young Kwak, Eun Ju Lee, Byoung Chul Ko, and Mira Jeong, Keimyung University (South Korea)*

9:40 VSTIA-513
Tracking and estimating tridimensional position through camera-PT array, *Edrei Reyes and Josué Montes Martínez, CIDESI (Mexico)*

10:00 VSTIA-514
A real-time system for shoppers' action recognition, *Srenivas Varadarajan and Shahrokh Shahidzadeh, Intel Corporation (India)*

10:20 – 10:50 am Coffee Break

Vehicle Classification and Recognition

Session Chair: Mustafa Jaber, NantVision Inc. (USA)

10:50 AM – 12:00 pm
Golden Gate 3

10:50
Chair Remarks

11:00 VSTIA-515
Vehicle type recognition in video using multiple-feature combinations, *Quang Nguyen, Martins Irhebhude, Mohamand Ali, and Eran Edirisinghe, Loughborough University (United Kingdom)*

11:20 VSTIA-516
Camera-based vehicle speed estimation for speed correction in x-ray vehicle scanning systems, *Basak Oztan[1] and Lei Fan[2]; [1]American Science & Engineering Inc. and [2]Rochester Institute of Technology (USA)*

11:40 VSTIA-517
Detection and classification of vehicles in varying complexity of urban traffic scenes, *Muhammad Umair Arif[1], Zain Lodhi[1], Maheen Khan[2], and Rana Raza[1]; [1]National University of Science and Technology and [2]Bahria University (Pakistan)*

12:00 – 2:00 pm Lunch Break

EI 2016 Opening Plenary and Symposium Awards
Session Chair: Choon-Woo Kim (Inha University)
2:00 – 3:00 PM
Continental Ballroom 5

Illuminating a bright future for medicine, *Audrey K. Bowden, Stanford University (USA)*

3:00 – 3:30 pm Coffee Break

Detection, Visualization, and Tracking

Session Chair: Eli Saber, Rochester Institute of Technology (USA)

3:30 – 4:40 pm
Golden Gate 3

3:30 VSTIA-518
Arrayed laser image contrast evaluation (Alice) for human body detection, *Hisashi Watanabe and Tsuguhiro Korenaga, Panasonic Corporation (Japan)*

3:50 VSTIA-519
Discovering and visualizing underlying traffic regions from vehicle trajectories with multi-features (JIST-first), *Dongjin Yu, Ruiting Wang, and Wanqing Li, Hangzhou Dianzi University (China)*

4:10 VSTIA-520
Vector road map registration to oblique wide area motion imagery by exploiting vehicle movements, *Ahmed Elliethy and Gaurav Sharma, University of Rochester (USA)*

4:30
Chair Remarks

5:00 – 6:00 pm EI 2016 Symposium Reception

Visualization and Data Analysis (VDA) 2016

Conference grouping: Web and Mobile Imaging and Visualization

Conferences in this grouping discuss image, video, and multimedia analytics: object tracking, face recognition, human detection and tracking; social networks: use of images and videos in social networks; video segmentation and tracking algorithms; Bayesian models for tracking and activity monitoring; social media; and multivariate time series visualization, among other topics.

Conference overview

The Conference on Visualization and Data Analysis (VDA) 2016 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.

Awards: Authors of the top three papers will receive Best Paper Awards

Photo: San Francisco Travel Association–Can Balcioglu.

Conference Chairs: **David L. Kao,** NASA Ames Research Ctr. (USA); **Thomas Wischgoll,** Wright State Univ. (USA); and **Song Zhang,** Mississippi State Univ. (USA)

Program Committee: **Madjid Allili,** Bishop's Univ. (Canada); **Barry G. Becker,** Pros (USA); **Abon Chaudhuri,** Walmart Labs (USA); **Guoning Chen,** Univ. of Houston (USA); **Yi-Jen Chiang,** New York Univeristy (USA); **Hank Childs,** Univ. of Oregon (USA); **Jaegul Choo,** Korea Univ. (Republic of Korea); **Joseph A. Cottam,** Indiana Univ. (USA); **Sussan Einakian,** The Univ. of Alabama in Huntsville (USA); **Christoph Garth,** Technische Univ. Kaiserslautern (Germany); **John Gerth,** Stanford Univ. (USA); **Mohammad Ghoniem,** Luxembourg Institute of Science and Technology (Luxembourg); **Matti T. Gröhn,** Finnish Institute of Occupational Health (Finland); **Ming C. Hao,** Hewlett- Packard Labs. (USA); **Christopher G. Healey,** North Carolina State Univ. (USA); **Halldor Janetzko,** Univ. of Konstanz (Germany); **Ming Jiang,** Lawrence Livermore National Lab. (USA); **Alark Joshi,** Univ. of San Francisco (USA); **Andreas Kerren,** Linnaeus Univ. (Sweden); **Harinarayan Krishnan,** Lawrence Berkeley National Lab. (USA); **Tong-Yee Lee,** National Cheng Kung Univ. (Taiwan); **Robert R. Lewis,** Washington State Univ. (USA); **Peter Lindstrom,** Lawrence Livermore National Lab. (USA); **Lars Linsen,** Jacobs Univ. Bremen gGmbH (Germany); **Zhanping Liu,** Kentucky State Univ. (USA); **Aidong Lu,** The Univ. of North Carolina at Charlotte (USA); **Dmitriy Morozov,** Lawrence Berkeley National Lab. (USA); **Theresa-Marie Rhyne,** Computer Graphics and E-Learning (USA); **Ian Roberts,** Pacific Northwest National Lab. (USA); **René Rosenbaum,** meeCoda (Germany); **Jibonananda Sanyal,** Oak Ridge National Lab. (USA); **Inga Scheler,** Technische Univ. Kaiserslautern (Germany); **Tobias Schreck,** Graz Univ. of Technology (Austria); **Jürgen P. Schulze,** Univ. of California, San Diego (USA); **Chad A. Steed,** Oak Ridge National Lab. (USA); **Kalpathi R. Subramanian,** The Univ. of North Carolina at Charlotte (USA); **Shigeo Takahashi,** Univ. of Aizu (Japan); **Shyh-Kuang Ueng,** National Taiwan Ocean Univ. (Taiwan); **Chaoli Wang,** Univ. of Notre Dame (USA); **Yingcai Wu,** Zhejiang Univ. (China); **Caixia Zhang,** Google (USA); **Wenjin Zhou,** Oakland Univ. (USA); and **Caroline Ziemkiewicz,** Brown Univ. (USA)

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Visualization and Data Analysis 2016

Tuesday, February 16, 2016

Flow Visualization

Session Chair: Thomas Wischgoll, Wright State University (USA)

8:40 – 10:10 am
Golden Gate 3

8:40
Opening Remarks

8:50 VDA-476
FlowVisual: A visualization app for teaching and understanding 3D flow field concepts, *Man Wang[1], Jun Tao[1], Jun Ma[1], Yang Shen[2], and Chaoli Wang[2]; [1]Michigan Technological University and [2]University of Notre Dame (USA)*

9:15 VDA-477
Morse decomposition of 3D piecewise linear vector fields, *Marzieh Berenjkoub and Guoning Chen, University of Houston (USA)*

9:40 VDA-478
Flow visualization based on a derived rotation field, *Lei Zhang[1], Robert S. Laramee[2], David Thompson[3], Adrian Sescu[3], and Guoning Chen[1]; [1]University of Houston (USA), [2]Swansea University (United Kingdom), and [3]Mississippi State University (USA)*

10:10 – 10:40 am Coffee Break

Keynote: Visualization for the Masses, Redux
Session Chair: David Kao, NASA Ames Research Ctr. (USA)
10:40 – 11:40 am
Golden Gate 3

VDA-479
Visualization for the masses, redux, *Alex Pang, University of California at Santa Cruz (USA)*

Biomedical Visualization

Session Chair: Thomas Wischgoll, Wright State University (USA)

11:40 am – 12:30 pm
Golden Gate 3

11:40 VDA-480
Segmentation of zebrafish larva inhomogeneous 3D images using the level-set method, *Zhan Xiong and Fons Verbeek, LIACS (Netherlands)*

12:05 VDA-481
Visualizing the intrinsic geometry of the human brain connectome, *Giorgio Conte, Alex Leow, and Angus Forbes, University of Illinois at Chicago (USA)*

12:30 – 2:00 pm Lunch Break

EI 2016 Tuesday Plenary and Symposium Awards
Session Chair: Nitin Sampat (Rochester Institute of Technology)
2:00 – 3:00 PM
Continental Ballroom 5

Pushing computational photography deeper into imaging system design, *Ren Ng, University of California, Berkeley (USA)*

3:00 – 3:30 pm Coffee Break

Usability

Session Chair: Alex Pang, University of California at Santa Cruz (USA)

3:30 – 4:50 pm
Golden Gate 3

3:30 VDA-482
Towards the involvement of end-user developers in visualization development (JIST-first), *Kostas Pantazos and Soren Lauesen, IT University of Copenhagen (Denmark)*

3:55 VDA-483
Multiple independent highlighting techniques, *Colin Ware[1] and Nicholas Pioch[2]; [1]University of New Hampshire and [2]Systems Technology Research (USA)*

4:20 VDA-484
JASPER: Just A new Space-filling and Pixel-oriented layout for large graph ovERview, *Jason Vallet, Guy Melancon, and Bruno Pinaud, Univ. Bordeaux (France)*

Visualization and Data Analysis 2016 Interactive Papers Oral Previews I

Session Chair: Angus Forbes, University of Illinois at Chicago (USA)

4:50 – 5:40 pm
Golden Gate 3

In this session interactive poster authors will each provide a brief oral preview of their poster presentation, which will be presented fully in the Visualization and Data Analysis 2016 Interactive Papers Session at 5:30 pm on Wednesday.

4:50 VDA-485
Weatherbin: Visually exploring similar days in air traffic weather, *Christopher Skeels and Kyle Murray, RAND Corporation (USA)*

5:00 VDA-486
Enhancing parallel coordinates: Statistical visualizations for analyzing soccer data, *Halldor Janetzko[1], Manuel Stein[1], Dominik Sacha[1], and Tobias Schreck[2]; [1]University of Konstanz (Germany) and [2]Graz University of Technology (Austria)*

5:10 VDA-487
Togpu: Automatic source transformation from C++ to CUDA using Clang/LLVM, *Matthew Marangoni and Thomas Wischgoll, Wright State University (USA)*

5:20 VDA-488
An effective visualization technique for determining co-relations in high-dimensional medieval manuscripts data, *Swati Chandna[1], Danah Tonne[1], Rainer Stotzka[1], Philipp Vanschiedt[2], Celia Krause[2], and Hanah Busch[3]; [1]Karlsruhe Institute of Technology, [2]Technical University of Darmstadt, and [3]Universität Trier (Germany)*

5:30 VDA-489
Visualization tools for network security, *Antoinette Attipoe and Jie Yan, Bowie State University (USA)*

EI 2016 Symposium Demonstration Session and Exhibit Hall Happy Hour
5:30 – 7:00 PM
Continental Ballroom Foyer

Wednesday, February 17, 2016

High-dimensional and Big Data

Session Chair: Song Zhang, Mississippi State University (USA)

8:50 – 10:10 am
Golden Gate 3

8:50 VDA-490
Parameter space visualization for large-scale datasets using parallel coordinate plots (JIST-first), *Kurtis Glendenning[1], Thomas Wischgoll[1], Jack Harris[2], Rhonda Vickery[3], and Leslie Blaha[2]; [1]Wright State University, [2]Wright Patterson Air Force Base, and [3]Engility Corporation (USA)*

9:15 VDA-491
Interactive visualization for interdisciplinary research, *Naomi Keena and Mohamed Aly, RPI (USA)*

9:40 VDA-492
Interactive high-dimensional data analysis using the "Three Experts", *Georg Albrecht and Alex Pang, University of California, Santa Cruz (USA)*

10:10 – 10:40 am Coffee Break

Visual Analytics

Session Chair: Guoning Chen, University of Houston (USA)

10:40 am – 12:00 pm
Golden Gate 3

10:40 VDA-493
MaVis: Machine learning aided multi-model framework for time series visual analytics, *Kaiyu Zhao, Worcester Polytechnic Institute (USA)*

11:05 VDA-494
TRI-DIRECT: Interactive visual analysis of TRI data, *David Burlinson, Kalpathi Subramanian, and Aidong Lu, The University of North Carolina at Charlotte (USA)*

11:30 VDA-495
Interactive visual analytics in support of image-encoded LIDAR analysis, *Todd Eaglin, Xiaoyu Wang, and William Ribarsky, The University of North Carolina at Charlotte (USA)*

Comparison

Session Chair: David Kao, NASA Ames Research Ctr. (USA)

12:00 – 12:30 pm
Golden Gate 3

VDA-496
Spherical similarity explorer for comparative case analysis, *Leishi Zhang[1], Chris Rooney[1], Lev Nachmanson[2], William Wong[1], Bum Chul Kwon[3], Florian Stoffel[3], Michael Hund[3], Nadeem Qazi[1], Uchit Singh[1], and Daniel Keim[3]; [1]Middlesex University (United Kingdom), [2]Microsoft Research (USA), and [3]University of Konstanz (Germany)*

12:30 – 2:00 pm Lunch Break

EI 2016 Wednesday Plenary and Symposium Awards
Session Chair: Choon-Woo Kim (Inha University)
2:00 – 3:00 PM
Continental Ballroom 5

Intel® RealSense Technology: Adding human-like sensing and interactions to computing devices, *Achin Bhowmik, Intel Corporation (USA)*

3:00 – 3:30 pm Coffee Break

Visualization Tool and Techniques

Session Chair: Song Zhang, Mississippi State University (USA)

3:30 – 4:00 pm
Golden Gate 3

VDA-497
Tweether: A visualization tool displaying correlation of weather to tweets, *Shruti Daggumati, Igor Soares de Oliveira, Jieting Wu, Hongfeng Yu, and Jun Wang, University of Nebraska-Lincoln (USA)*

Visualization and Data Analysis 2016 Interactive Papers Oral Previews II

Session Chair: Kalpathi Subramanian, The University of North Carolina at Charlotte (USA)

4:00 – 5:10 pm
Golden Gate 3

In this session interactive poster authors will each provide a brief oral preview of their poster presentation, which will be presented fully in the Visualization and Data Analysis 2016 Interactive Papers Session at 5:30 pm on Wednesday.

4:00 VDA-498
Metrics visualization templates case study in aerospace product development, *Kathy Sonderer and Kevin Lynch, Raytheon Company (USA)*

4:10 VDA-499
The Aleph data relation in structured data, a tree within the tree structure, *H. Paul Zellweger, ArborWay Labs (USA)*

4:20 VDA-500
Exploiting regions of influence to visualize class boundaries, *Pallav Tinna[1] and Kamalakar Karlapalem[2]; [1]International Institute of Information Technology, Hyderabad and [2]Indian Institute of Technology, Gandhinagar (India)*

4:30 VDA-501
Exploring VR displays for malware analysis, *Myles Black, Swastik Singh, Song Zhang, Jean Mohammadi-Aragh, and Derek Irby, Mississippi State University (USA)*

4:40 VDA-502
Supporting hypotheses management during asynchronous collaboration for visual analytics for text analysis, *Ankit Gupta and Chris Shaw, Simon Fraser University (Canada)*

4:50 VDA-503
Visual data mining in closed contour coordinates, *Boris Kovalerchuk[1] and Vladimir Grishin[2]; [1]Central Washington University and [2]View Trends, Ltd. (USA)*

5:00 VDA-504
TennisMatchViz: A tennis match visualization, *Xi He and Ying Zhu, Georgia State University (USA)*

EI 2016 Symposium Interactive Papers Session
5:30 – 7:00 PM
Continental Ballroom 6

Visualization and Data Analysis 2016 Interactive Papers Session

5:30 – 7:00 pm
Continental Ballroom 6

The VDA interactive papers will be presented in the EI 2016 Symposium Interactive Papers Session.

Thursday, February 18, 2016

Multivariate Visualization

Session Chair: Thomas Wischgoll, Wright State University (USA)

8:50 – 10:10 am
Golden Gate 3

8:50 VDA-505
Ensemble traces: Interactive visualization of ensemble multivariate time series data, *Swastik Singh[1], Song Zhang[1], William Pruett[2], and Robert Hester[2]; [1]Mississippi State University and [2]University of Mississippi Medical Center (USA)*

9:15 VDA-506
Star glyph insets for overview preservation of multivariate data, *Dominik Jäckle, Johannes Fuchs, and Daniel Keim, University of Konstanz (Germany)*

9:40 VDA-507
Visual descriptors for dense tensor fields in computational turbulent combustion: A case study (JIST-first), *G. Elisabeta Marai[1], Timothy Luciani[1], Adrian Maries[2], S. Levent Yilmaz[3], and Mehdi Nik[4]; [1]University of Illinois at Chicago, [2]UPMC, [3]Mathworks, and [4]Stanford University (USA)*

10:10 – 10:40 am Coffee Break

Exploratory Data Visualization

Session Chair: David Kao, NASA Ames Research Ctr. (USA)

10:40 am – 12:10 pm
Golden Gate 3

10:40 VDA-508
Visual analysis of transport similarity in 2D CFD ensembles, *Brad Hollister and Alex Pang, University of California (USA)*

11:05 VDA-509
Visualizing ensembles for effective shape and data comparison, *Lihua Hao[1], Christopher Healey[1], Steffen Bass[2], and Hsuan-Ya Yu[1]; [1]North Carolina State University and [2]Duke University (USA)*

11:30 VDA-510
Visual-interactive search for soccer trajectories to identify interesting game situations, *Lin Shao[1], Dominik Sacha[1], Benjamin Neldner[1], Manuel Stein[1], and Tobias Schreck[2]; [1]Univ. of Konstanz (Germany) and [2]Graz University of Technology (Austria)*

11:55
Chair Remarks

Short Courses

See page 9 for daily schedule grid.
Tickets required, purchase at registration desk.

Sunday, February 14, 2016

NEW for 2016 EI01: 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

Course Level: Introductory

This new 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 adapted 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 RIT Center for Imaging Science.

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 21550), and is the editor for the second edition to digital camera resolution (ISO 12233).

NEW for 2016 EI02: Color and Calibration in Mobile Imaging Devices

Instructors: Uwe Artmann, Image Engineering GmbH & Co KG (Germany) and Kevin Matherson, Microsoft Corporation (United States)

8:00 – 10:00 am

Course Level: Introductory/Intermediate

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 and 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 will get to examine the basic color image capture and how calibration can improve images using a typical color imaging pipeline. In the course, participants will be shown how raw image data influences color transforms and white balance. The knowledge acquired in understanding the image capture and calibration process will 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 will 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.

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 principal optical engineer 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 the 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.

NEW for 2016 EI03: Fundamentals of Deep Learning

Instructors: Allison Gray, NVIDIA (United States) and Raymond Ptucha, Rochester Institute of Technology (United States)

8:00 am – 12:15 pm

Course Level: Intermediate. Basic machine learning exposure and prior experience programming using a scripting language helpful.

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). It 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 classifying 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 course describes what deep networks are, how they evolved over the years, and how they differ from competing technologies. Examples will be 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, the hands-on portion of the talk demonstrates 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 will be 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 although not essential for an intuitive understanding.

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.

Allison Gray is a solutions architect at NVIDIA and supports customers interested in using graphics processing units to help them accelerate their applications. At this time she is also a part-time graduate student in the imaging science program at the Rochester Institute of Technology. Before coming to NVIDIA, she was a research engineer at the National Renewable Energy Laboratory in the Concentrating Solar Power group. She performed surface characterization testing on large aperture solar concentrators. She earned her BS and MS in mechanical engineering from the University of Nevada, Las Vegas specializing in thermal sciences.

NEW for 2016 EI04: 3D Video Processing Techniques for Realistic Contents Generation

Instructor: Yo-Sung Ho, Gwangju Institute of Science and Technology (South Korea)

8:00 am – 12:15 pm

Course Level: Intermediate

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 auto-stereoscopic display is a more promising solution that requires more research endeavors to resolve the associated technical difficulties. In this short course lecture, we are going to cover the current state-of-the-art technologies for 3D contents generation. After defining the basic requirements for 3D realistic multimedia services, we will cover various multi-modal immersive media processing technologies. We also address the depth estimation problem for natural 3D scenes and discuss several challenging issues of 3D video processing, such as camera calibration, image rectification, illumination compensation and color correction. In addition, we are going to discuss the JCT-3V activities for 3D video coding, including depth map estimation, prediction structure for multi-view video coding, multi-view video-plus-depth coding, and intermediate view synthesis for multi-view 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.
- Design a 3D video system to handle multi-view video-plus-depth data.
- Discuss various challenging problems related to 3D video services.

Intended Audience: This short course is intended for engineers, scientists and students interested in acquiring a broad understanding of 3D video processing techniques. Prior familiarity with basics of signal and image processing, in particular digital image representations, is helpful although not essential for an intuitive understanding.

Yo-Sung Ho received BS and MS in electronic engineering from Seoul National University, Seoul, Korea, in 1981 and 1983, respectively, and a PhD in electrical and computer engineering from the University of California, Santa Barbara (1990). He joined ETRI (Electronics and Telecommunications Research Institute), Korea, in 1983. From 1990 to 1993, he was with North America Philips Laboratories, New York, where he was involved in development of the Advanced Digital High-Definition Television (AD-HDTV) system. In 1993, he rejoined the technical staff of ETRI and was involved in development of the Korean DBS Digital Television and High-Definition Television systems. Since 1995, he has been with Gwangju Institute of Science and Technology (GIST), where he is currently Professor of Information and Communications Department. Since August 2003, he has been Director of Realistic Broadcasting Research Center at GIST in Korea. He has been serving as an Associate Editor of IEEE Transactions on Multimedia *(T-MM) and an Associate Editor of* IEEE Transactions on Circuits and Systems Video Technology *(T-CSVT). His research interests include digital image and video coding, image analysis and image restoration, three-dimensional image modeling and representation, advanced source coding techniques, three-dimensional television (3DTV) and realistic broadcasting technologies.*

NEW for 2016 EI05: Advanced Image Enhancement and Deblurring

Instructor: Majid Rabbani, Eastman Kodak Company (United States)

8:00 am – 12:15 pm

Course Level: Advanced

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 more than 30 years of experience in digital imaging. He is a Kodak Fellow at Eastman Kodak Research Labs and an adjunct Associate Professor at the Rochester Institute of Technology (RIT) and the University of Rochester. 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 in 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.*

NEW for 2016 EI06: Introduction to the EMVA1288 Standard

Instructor: Arnaud Darmont, APHESA SPRL (Belgium)

10:15 am – 12:15 pm

Course Level: Intermediate

Image sensor and camera datasheets usually do not provide complete and directly comparable technical information. Sometimes the information is also provided in a confusing way or in a way that makes the product look better than it actually is. The goal of the EMVA1288 standard, defined by the European Machine Vision Association and approved by all major international associations, including the American Imaging Association, is to define measurement methods and reporting templates and units in order to make the comparison of image sensor and camera datasheets easier. The provided data can also be used to simulate the performance of a device. The course is based on EMVA1288 version 3.1rc2 but also introduces some preliminary concepts of version 3.2.

Benefits

- Understand the principles behind the EMVA1288 standard.
- Be able to compare products based on EMVA1288 measurement results.
- Be able to estimate product performance based on datasheets.

Intended Audience: The short course is intended for image sensor, camera and characterization engineers, scientists, students, and managers who are not yet familiar with the EMVA1288 standard, now used worldwide.

Arnaud Darmont is owner and CEO of Aphesa, a company founded in 2008 specializing in image sensor consulting, custom camera design, the EMVA1288 standard, and camera benchmarking. He holds a degree in electronic engineering from the University of Liège (Belgium). Prior to founding Aphesa, he worked for more than seven years in the field of CMOS image sensors and high dynamic range imaging. He is a member of the EMVA1288 working group since 2006.

EI07: 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

Course Level: to Intermediate

High-dynamic range (HDR) imaging records and displays more information than conventional imaging. Non-uniform 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.
- Discover relationships between HDR range and scene dependency; the effect of glare.

- Discuss the limits of RAW scene capture in LDR and normal scenes.
- Learn about techniques to verify reciprocity and linearity limits.
- Learn about scene dependent glare in RAW image capture.
- Explore the limits of our vision system on HDR.
- Calculate retinal luminance.
- Identify tone-rendering problems and spatial methods.

Intended Audience: Students, color scientists, imaging researchers, medical imagers, software and hardware engineers, photographers, cinematographers, and production specialists, interested in using HDR in imaging applications.

Alessandro Rizzi has studied the field of digital imaging and vision since 1990. His main research topic is the use of color information in digital images with particular attention to color perception mechanisms. He is associate professor at the Dept. of Information Science and Communication at University of Milano teaching fundamentals of digital imaging, multimedia video, and human-computer interactions. He is one of the founders of the Italian Color Group and member of several program committees of conferences related to color and digital imaging.

John McCann received a degree in biology from Harvard College (1964). He worked in, and managed, the Vision Research Laboratory at Polaroid from 1961 to 1996. He has studied human color vision, digital image processing, large format instant photography, and the reproduction of fine art. His publications and patents have studied Retinex theory, color constancy, color from rod/cone interactions at low light levels, appearance with scattered light, and HDR imaging. He is a Fellow of IS&T and the Optical Society of America (OSA). He is a past President of IS&T and the Artists Foundation, Boston. He is the IS&T/OSA 2002 Edwin H. Land Medalist, and IS&T 2005 Honorary Member.

NEW for 2016 EI08: Concepts, Procedures, and Practical Aspects of Measuring Resolution in Mobile and Compact Imaging Devices and the Impact of Image Processing

Instructors: Uwe Artmann, Image Engineering GmbH & Co KG (Germany) and Kevin Matherson, Microsoft Corporation (United States)

10:15 am – 12:15 pm

Course Level: Introductory/Intermediate

Imaging devices and the impact of image processing resolution is often used to describe the 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.
- Appreciate 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 set up.
- 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: 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 principal optical engineer 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 the 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.

NEW for 2016 EI09: Hardware and Its Calibration for Mobile Imaging Devices

Instructors: Uwe Artmann, Image Engineering GmbH & Co KG (Germany) and Kevin Matherson, Microsoft Corporation (United States)

1:30 – 5:30 pm

Course Level: Intermediate

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

- Be able to 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.

- Learn how to perform the various calibrations typically done in compact camera modules (relative illumination, color shading, spectral calibrations, gain, actuator variability, etc.).
- Understand the equipment required for performing calibrations.
- Compare hardware tradeoffs, its impact on calibration, and overall influence on final image quality.

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 principal optical engineer 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 the 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.

EI10: Introduction to Digital Color Imaging

Instructor: Gaurav Sharma, University of Rochester (United States)

1:30 – 5:30 pm

Course Level: Introductory

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 co-design 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 has more than two decades of experience in the design and optimization of color imaging systems and algorithms that spans employment at the Xerox Innovation Group and his current position as a professor at the University of Rochester in the departments of Electrical and Computer Engineering and Computer Science. Additionally, he has consulted for several companies on the development of new imaging systems and algorithms. He holds 49 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 currently serves as the Editor-in-Chief for the SPIE/IS&T* Journal of Electronic Imaging. *Sharma is a fellow of IEEE, SPIE, and IS&T.*

NEW for 2016 EI11: OpenVX: A Framework for Accelerating Computer Vision

Instructors: Radha Giduthuri, AMD (United States) and Kari Pulli, LIght (United States)

1:30 – 5:30 pm

Course Level: Introductory (OpenVX architecture and its relation to other related APIs) to intermediate (the practical programming aspects, requiring familiarity with C++).

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 real-time 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 mapped to the graph API will be discussed. Also covered is the relationship between OpenVX and OpenCV, as well as OpenCL. The tutorial 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 real-time image processing and computer vision tasks.

Intended Audience: Students, color scientists, imaging researchers, software and hardware engineers, interested in computer vision applications. Prior familiarity with the practical programming aspects, familiarity with C++, will be helpful.

Kari Pulli is VP of Computational Imaging at Light. Earlier, he was Sr. 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. Kari 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. Kari 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 PMTS 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 OpenVX working group representing AMD. In the past he was a member of SMPTE video compression standardizing committee for several years. He is also chair of IEEE Signal Processing Society Chapter of Santa Clara Valley.

EI12: 3D Imaging

Instructor: Gady Agam, Illinois Institute of Technology (United States)

1:30 – 5:30 pm

Course Level: Introductory

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 also 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.

NEW for 2016 EI13: Introduction to CMOS Image Sensor Technology

Instructor: Arnaud Darmont, APHESA SPRL (Belgium)

1:30 – 5:30 pm

Course Level: Beginner/Intermediate

This short course is a good refresher for image sensor and camera design engineers but is primarily targeted for newcomers to the technology or to less technical people who need to have a better understanding of the CMOS imaging technology. The course starts from the light and light sources and follows the natural path through the imaging system until an image is available out of a camera. Lenses, microlenses, color filters, photodiodes, pixel circuits, pixel arrays, readout circuits, and analog-to-digital conversion will be described in details. The description includes an analysis of the noise sources, signal-to-noise, dynamic range, and the most important formulas are provided.

Benefits

- Understand the general principles of imaging (lighting, optics, sensor, and camera).
- Learn CMOS image sensor architecture.
- Understand CMOS image sensor noise sources and performance figures (signal-to-noise ratio, dynamic range).
- Understand and compare rolling and global shutters.
- Understand the key design tradeoffs.
- Learn the basics of color imaging.
- Learn the basics of photography.

Intended Audience: The short course is intended for engineers, scientists, students and managers who need to acquire a beginner or intermediate level of technical knowledge about CMOS image sensor principles, architecture, and performance.

Arnaud Darmont is owner and CEO of Aphesa, a company founded in 2008 specializing in image sensor consulting, custom camera design, the EMVA1288 standard, and camera benchmarking. He holds a degree in electronic engineering from the University of Liège (Belgium). Prior to founding Aphesa, he worked for more than seven years in the field of CMOS image sensors and high dynamic range imaging. He is a member of the EMVA1288 working group since 2006.

Monday, February 15, 2016

NEW for 2016 EI14: 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)

8:30 – 10:30 am

Course Level: Introductory to Intermediate

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 principal optical engineer 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 the 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.

EI15: Joint Design of Optics and Image Processing for Imaging Systems

Instructor: David Stork, Rambus (United States)

8:30 am – 12:30 pm

Course Level: Introductory to intermediate

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 will describe the theoretical and algorithmic foundations of new methods of jointly designing the optics and image processing of electro-optical imaging systems. The course will focus 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.*

Tuesday, February 16, 2016

EI16: Perceptual Metrics for Image and Video Quality in a Broader Context: From Perceptual Transparency to Structural Equivalence

Instructors: Sheila Hemami, Northeastern University (United States) and Thrasyvoulos Pappas, Northwestern University (United States)

8:30 am – 12:30 pm

Course Level: Intermediate (Prerequisites: Basic understanding of image compression algorithms; background in digital signal processing and basic statistics: frequency-based representations, filtering, distributions.)

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 supra-threshold 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 also 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 supra-threshold 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 (2004–06), chair of the* IEEE Image and Multidimensional Signal Processing *(now IVMSP) Technical Committee, and technical program co-chair of ICIP-01 and ICIP-09.*

Sheila S. Hemami received a BSEE from the University of Michigan (1990), and MSEE and PhD from Stanford University (1992 and 1994). She was with Hewlett-Packard Laboratories in Palo Alto, California in 1994 and was with the School of Electrical Engineering at Cornell University from 1995–2013. She is currently Professor and Chair of the Department of Electrical & Computer Engineering at Northeastern University in Boston, 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, including Eta 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.*

EI17: Understanding and Interpreting Images

Instructor: Majid Rabbani, Eastman Kodak Company (United States)

8:30 am – 12:30 pm

Course Level: to Intermediate

A key problem in computer vision is image and video understanding, which can be defined as the task of recognizing objects in the scene and their corresponding relationships and semantics, in addition to identifying the scene category itself. Image understanding technology has numerous applications among which are smart capture devices, visual mobile search, intelligent image processing, semantic image search and retrieval, image/video utilization (e.g., ratings on quality, usefulness, etc.), security and surveillance, intelligent asset selection and targeted advertising. This short course provides an introduction to the theory and practice of image understanding algorithms by studying the various technologies that serve the three major components of a generalized IU system, namely, feature extraction and selection, machine learning tools used for classification, and datasets and ground truth used for training the classifiers. Realtime demos including face detection and recognition, CBIR, and SIFT image matching are also provided.

Benefits

- Learn the various applications of IU and the scope of its consumer and commercial uses.
- Explain the various technologies used in image feature extraction such as global, block-based or region-based color histograms and moments, the "tiny" image, GIST, histogram of oriented gradients (HOG), scale-invariant feature transform (SIFT), speeded-up robust features (SURF), etc.
- Explain the various machine learning paradigms and the fundamental techniques used for classification such as Bayesian classifiers, linear support vector machines (SVM) and nonlinear kernels, boosting techniques (e.g., AdaBoost), k-nearest neighbors, .etc.
- Explain the concepts used for classifier evaluation such as false positives and negatives, true positives and negatives, confusion matrix, precision and recall, and receiver operating characteristics (ROC).
- Explain the fundamental ideas employed in the IU algorithms used for face detection, material detection, image orientation, and a few others.
- Learn the importance of using context in IU tasks.

Intended Audience: Scientists, engineers, and managers who need to familiarize themselves with IU technology and understand its performance limitations in a diverse set of products and applications. No specific prior knowledge is required except familiarity with general mathematical concepts such as the dot product of two vectors and basic image processing concepts such as histograms, filtering, gradients, etc.

Majid Rabbani has more than 30 years of experience in digital imaging. He is a Kodak Fellow at Eastman Kodak Research Labs and an adjunct Associate Professor at the Rochester Institute of Technology (RIT) and the University of Rochester. 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 in 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.*

NOTES

General Information

Registration

Onsite Registration and Badge Pick-Up Hours

Sunday 14 February ..... 7:00 am to 8:00 pm
Monday 15 February..... 7:00 am to 5:00 pm
Tuesday 16 February ..... 8:00 am to 5:00 pm
Wednesday 18 February..... 8:00 am to 5:00 pm
Thursday 18 February ..... 8:30 am to noon

Conference Registration

Conference Registration Includes: Admission to all technical sessions, coffee breaks, the Conference 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. Course prices include applicable taxes. Courses will take place in various meeting rooms at the Hilton San Francisco Union Square. 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 8 February 2016. 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 5 March 2016.

Author/Presenter Information

Speaker AV Preparation

California Room

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.

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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,

About IS&T

The Society for Imaging Science and Technology (IS&T)—the organizer of the Electronic Imaging Symposium—is an international non-profit dedicated to keeping members and other imaging professionals apprised of the latest developments in the field through conferences, educational programs, publications, and its website. IS&T encompasses all aspects of imaging, with particular emphasis on digital printing, electronic imaging, color science, sensors, virtual reality, photofinishing, image preservation, and hybrid imaging systems.

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- Reduced registration fees at all IS&T sponsored conferences—a value equal to the difference between member and nonmember rates alone—and short courses
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- Subscription to The Reporter, a quarterly newsletter
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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.

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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, 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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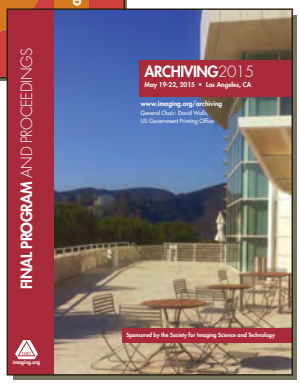

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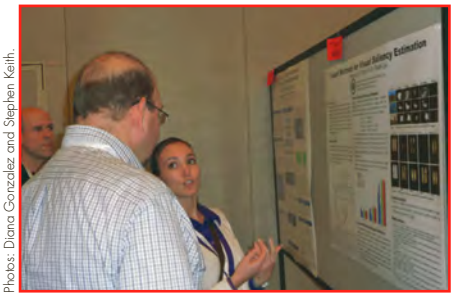
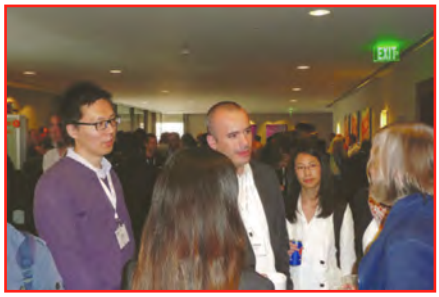

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