



Society for Imaging Science and Technology

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IS&T International Symposium on
Electronic Imaging 2019
 SCIENCE AND TECHNOLOGY

13 - 17 January, 2019 • Burlingame, California USA

COMPUTATIONAL IMAGING XVII

Conference Keywords: *Inverse Problems, Image Reconstruction, Image Analysis, Denoising, Model-based Imaging*

Related EI Short Courses:

- SC03 [Advanced Image Enhancement and Deblurring](#)
- SC07 [Visualization Tools and Techniques](#)
- SC20 [Fundamentals of Deep Learning](#)
- SC21 [Using Cognitive & Behavioral Sciences and the Arts in Artificial Intelligence Research & Design](#)
- SC23 [Introduction to TensorFlow](#)
- SC24 [Introduction to Probabilistic Models for Inference & Estimation](#)

Program

Overview

Topics

Monday January 14, 2019

AI for Reconstruction and Sensing I

Session Chair: Gregery Buzzard, Purdue University (United States)

9:10 – 10:10 AM

Post

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Important Dates

- Call for Papers Announced**
- Journal-first Submissions Due**
- Abstract Submission Site Opens**
- Review Abstracts Due (*refer to For A*)
 - Early Decision Ends
 - Regular Submission Ends
 - Extended Submission Ends
- Final Manuscript Deadlines**
 - Fast Track Manuscripts Due
 - Final Manuscripts Due
- Registration Opens**
- Early Registration Ends**
- Hotel Reservation Deadline**
- Conference Begins**

View

2019 Proceedings

View

2018 Proceedings

View

2017 Proceedings

Events
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COIMG-125

KEYNOTE: Learning to make images, W. Clem Karl, Boston University (United States)

W. Clem Karl received his PhD in electrical engineering and computer science (in 1991) from the Massachusetts Institute of Technology, Cambridge, where he also received the SM, EE, and S degrees. He held the position of staff research scientist with the Brown-Harvard-MIT Center for Intelligent Control Systems and the MIT Laboratory for Information and Decision Systems from 1992 to 1994. He joined the faculty of Boston University in 1995, where he is currently professor of electrical and computer engineering and biomedical engineering. Prof. Karl is currently the Editor-in-Chief of the IEEE Transactions on Image Processing. He is a member of the Board of Governors of the IEEE Signal Processing Society, the Signal Processing Society Conference Board, the IEEE Transactions on Medical Imaging Steering Committee, and the Technical Committee Review Board. He co-organized two special sessions of the 2012 IEEE Statistical Signal Processing Workshop, one on Challenges in High-Dimensional Learning and one on Statistical Signal Processing and the Engineering of Materials. In 2011 he was a co-organizer of a workshop on Large Data Sets in Medical Informatics as part of the Institute for Mathematics and Its Applications Thematic Year on the Mathematics of Information. He served as an Associate Editor of the IEEE Transactions on Image Processing and was the General Chair of the 2009 IEEE International Symposium on Biomedical Imaging. He is a past member of the IEEE Image, Video, and Multidimensional Signal Processing Technical Committee and is a current member of the IEEE Biomedical Image and Signal Processing Technical Committee. Prof. Karl's research interests are in the areas of multidimensional statistical signal and image processing, estimation, inverse problems, geometric estimation, and applications to problems ranging from biomedical signal and image processing to synthetic aperture radar.

10:10 – 11:00 AM Coffee Break

AI for Reconstruction and Sensing II

Session Chair: Gregery Buzzard, Purdue University (United States)

[View](#)
[2016 Proceedings](#)

Conference Chairs

Charles A. Bouman, Purdue University (United States); **Gregery T. Buzzard**, Purdue University (United States); **Robert L. Stevenson**, University of Notre Dame (United States)

Program Committee

Ken D. Sauer, University of Notre Dame (United States)

11:10 AM – 12:30 PM

Harbour AB

11:10

COIMG-127

Multi-target tracking with an event-based vision sensor and the GMPHD filter (Invited), Benjamin Foster¹, Dong Hye Ye², and Charles Bouman³; ¹Lockheed Martin, ²Marquette University, and ³Purdue University (United States)

11:30

COIMG-128

4D reconstruction using consensus equilibrium (Invited), Soumendu Majee¹, Thilo Balke¹, Craig Kemp², Gregery Buzzard¹, and Charles Bouman¹; ¹Purdue University and ²Eli Lilly and Company (United States)

11:50

COIMG-129

Joint direct deep learning for one-sided ultrasonic non-destructive evaluation (Invited), Hani Almansouri¹, Singanallur Venkatakrisnan², Charles Bouman¹, and Hector Santos-Villalobos²; ¹Purdue University and ²Oak Ridge National Laboratory (United States)

12:10

COIMG-130

Modeling long range features from serial section imagery of continuous fiber reinforced composites (Invited), Sam Sherman¹, Jeffrey Simmons², and Craig Przybyla²; ¹Air Force Life Cycle Management Center and ²Air Force Research Laboratory (United States)

12:30 – 2:00 PM Lunch

Monday Plenary

2:00 – 3:00 PM

Grand Peninsula Ballroom D

Autonomous Driving Technology and the OrCam MyEye, *Amnon Shashua, President & CEO, Mobileye, an Intel Company, and Senior Vice President of Intel Corporation (United States)*

The field of transportation is undergoing a seismic change with the coming introduction of autonomous driving. The technologies required to enable computer driven cars involves the latest cutting edge artificial intelligence algorithms along three major thrusts: Sensing, Planning and Mapping. Prof. Shashua will describe the challenges and the kind of computer vision and machine learning algorithms involved, but will do that through the perspective of Mobileye's activity in this domain. He will then describe how OrCam leverages computer vision, situation awareness and language processing to enable Blind and Visually impaired to interact with the world through a miniature wearable device.

Prof. Amnon Shashua holds the Sachs chair in computer science at the Hebrew University of Jerusalem. His field of expertise is computer vision and machine learning. For his academic achievements he received the MARR prize Honorable Mention in 2001, the Kaye innovation award in 2004, and the Landau award in exact sciences in 2005.

In 1999 Prof. Shashua co-founded Mobileye, an Israeli company developing a system-on-chip and computer vision algorithms for a driving assistance system, providing a full range of active safety features using a single camera. Today, approximately 24 million cars rely on Mobileye technology to make their vehicles safer to drive. In August 2014, Mobileye claimed the title for largest Israeli IPO ever, by raising \$1B at a market cap of \$5.3B. In addition, Mobileye is developing autonomous driving technology with more than a dozen car manufacturers. The introduction of autonomous driving capabilities is of a transformative nature and has the potential of changing the way cars are built, driven and own in the future. In August 2017, Mobileye became an Intel company in the largest Israeli acquisition deal ever of \$15.3B. Today, Prof. Shashua is the President and CEO of Mobileye and a Senior Vice President of Intel Corporation leading Intel's Autonomous Driving Group.

In 2010 Prof. Shashua co-founded OrCam which harnesses computer vision and artificial intelligence to assist people who are visually impaired or blind. The OrCam MyEye device is unique in its ability to provide visual aid to hundreds of millions of people, through a discreet wearable platform. Within its wide-ranging scope of capabilities, OrCam's device can read most texts (both indoors and outdoors) and learn to recognize thousands of new items and faces.

3:00 – 3:30 PM Coffee Break

Panel: Sensing and Perceiving for Autonomous Driving

Joint Session

Panelists: Boyd Fowler, OmniVision Technologies (United States); Jun Pei, Cepton Technologies Inc. (United States); Christoph Schroeder, Mercedes-Benz R&D Development North America, Inc. (United States); and Amnon Shashua, Mobileye, An Intel Company (Israel)

Panel Moderator: Wende Zhang, General Motors (United States)

3:30 – 5:30 PM

Grand Peninsula Ballroom D

This session is jointly sponsored by the EI Steering Committee.

Driver assistance and autonomous driving rely on perceptual systems that combine data from many different sensors, including camera, ultrasound, radar and lidar. This panel will discuss the strengths and limitations of different types of sensors and how the data from these sensors can be effectively combined to enable autonomous driving.

Moderator: Dr. Wende Zhang Technical Fellow at General Motors

Panelist: Dr. Boyd Fowler CTO, Omnivision Technologies

Panelist: Dr. Jun Pei CEO and Co-Founder, Cepton Technologies Inc.

Panelist: Dr. Amnon Shashua Professor of Computer Science at Hebrew University, President and CEO, Mobileye, an Intel Company, and Senior Vice President, Intel Corporation

Panelist: Dr. Christoph Schroeder Head of Autonomous Driving N.A. Mercedes-Benz R&D Development North America, Inc.

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

Tuesday January 15, 2019

7:30 – 8:45 AM Women in Electronic Imaging Breakfast

Medical and Scientific Imaging

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

8:50 – 10:10 AM

Harbour AB

8:50**COIMG-131**

Simultaneous denoising and deblurring for full-field tomography,
Daniel Ching and Doğa Gürsoy, Argonne National Laboratory (United States)

9:10**COIMG-132**

Autocorrelation-based, passive, non-contact, photoplethysmography: Computationally-efficient, noise-tolerant, extraction of heart rates from video,
Chadwick Parrish, Kevin Donohue, and Henry Dietz, University of Kentucky (United States)

9:30**COIMG-133**

Joint density map and continuous angular refinement in Cryo-EM,
Mona Zehni¹, Laurène Donati², Emmanuel Soubies², Zhizhen Zhao¹, Minh Do¹, and Michael Unser^{2,1}; University of Illinois at Urbana-Champaign (United States) and ²École Polytechnique Fédérale de Lausanne (EPFL) (Switzerland)

9:50**COIMG-134**

Point source localization from projection lines using rotation invariant features,
Mona Zehni, Shuai Huang, Ivan Dokmanic, and Zhizhen Zhao, University of Illinois at Urbana-Champaign (United States)

10:00 AM – 7:30 PM Industry Exhibition

10:10 – 10:40 AM Coffee Break

Image Enhancement via Neural Network

Session Chair: Sabine Süsstrunk, EPFL-IC-IVRL (Switzerland)

10:40 – 11:20 AM

Harbour AB

10:40**COIMG-135**

A comparative study on wavelets and residuals in deep super resolution, *Ruofan Zhou, Fayez Lahoud, Majed El Helou, and Sabine Süssstrunk, École Polytechnique Fédérale de Lausanne (EPFL) (Switzerland)*

11:00**COIMG-136**

GAN based image deblurring using dark channel prior, *Shuang Zhang, Ada Zhen, and Robert Stevenson, University of Notre Dame (United States)*

In Situ 3D/4D Image Capture and Analysis

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

11:20 AM – 12:40 PM**Harbour AB****11:20****COIMG-137**

Height estimation of biomass sorghum in the field using LiDAR, *Matthew Waliman and Avideh Zakhor, University of California, Berkeley (United States)*

11:40**COIMG-138**

In situ width estimation of biofuel plant stems, *Arda Sahiner, Franklin Heng, Adith Balamurugan, and Avideh Zakhor, University of California, Berkeley (United States)*

12:00**COIMG-139**

Vision guided, hyperspectral imaging for standoff trace chemical detection (Invited), *Raiyan Ishmam¹, Ashish Neupane¹, Shuchin Aeron¹, Eric Miller¹, Mark Witinski², Christian Pfluegl², Brandt Pein², and Romain Blanchard²; ¹Tufts University and ²Pendar Technologies (United States)*

12:20**COIMG-140**

Through the windshield driver recognition (Invited), *David Cornett*

Ill, Grace Nayola, Diane Montez, Alec Yen, Christi Johnson, Seth Baird, Hector Santos-Villalobos, and David Bolme, Oak Ridge National Laboratory (United States)

12:40 – 2:00 PM Lunch

Tuesday Plenary

2:00 – 3:00 PM

Grand Peninsula Ballroom D

The Quest for Vision Comfort: Head-Mounted Light Field Displays for Virtual and Augmented Reality, *Hong Hua, Professor of Optical Sciences, University of Arizona (United States)*

Hong Hua will discuss the high promises and the tremendous progress made recently toward the development of head-mounted displays (HMD) for both virtual and augmented reality displays, developing HMDs that offer uncompromised optical pathways to both digital and physical worlds without encumbrance and discomfort confronts many grand challenges, both from technological perspectives and human factors. She will particularly focus on the recent progress, challenges and opportunities for developing head-mounted light field displays (LF-HMD), which are capable of rendering true 3D synthetic scenes with proper focus cues to stimulate natural eye accommodation responses and address the well-known vergence-accommodation conflict in conventional stereoscopic displays.

Dr. Hong Hua is a Professor of Optical Sciences at the University of Arizona. With over 25 years of experience, Dr. Hua is widely recognized through academia and industry as an expert in wearable display technologies and optical imaging and engineering in general. Dr. Hua's current research focuses on optical technologies enabling advanced 3D displays, especially head-mounted display technologies for virtual reality and

augmented reality applications, and microscopic and endoscopic imaging systems for medicine. Dr. Hua has published over 200 technical papers and filed a total of 23 patent applications in her specialty fields, and delivered numerous keynote addresses and invited talks at major conferences and events worldwide. She is an SPIE Fellow and OSA senior member. She was a recipient of NSF Career Award in 2006 and honored as UA Researchers @ Lead Edge in 2010. Dr. Hua and her students shared a total of 8 “Best Paper” awards in various IEEE, SPIE and SID conferences. Dr. Hua received her Ph.D. degree in Optical Engineering from the Beijing Institute of Technology in China in 1999. Prior to joining the UA faculty in 2003, Dr. Hua was an Assistant Professor with the University of Hawaii at Manoa in 2003, was a Beckman Research Fellow at the Beckman Institute of University of Illinois at Urbana-Champaign between 1999 and 2002, and was a post-doc at the University of Central Florida in 1999.

3:00 – 3:30 PM Coffee Break

5:30 – 7:30 PM Symposium Demonstration Session

Wednesday January 16, 2019

10:00 AM – 3:30 PM Industry Exhibition

10:10 – 11:00 AM Coffee Break

12:30 – 2:00 PM Lunch

Wednesday Plenary

2:00 – 3:00 PM

Grand Peninsula Ballroom D

Light Fields and Light Stages for Photoreal Movies, Games, and

Virtual Reality, *Paul Debevec, Senior Scientist, Google (United States)*

Paul Debevec will discuss the technology and production processes behind "Welcome to Light Fields", the first downloadable virtual reality experience based on light field capture techniques which allow the visual appearance of an explorable volume of space to be recorded and reprojected photorealistically in VR enabling full 6DOF head movement. The lightfields technique differs from conventional approaches such as 3D modelling and photogrammetry. Debevec will discuss the theory and application of the technique. Debevec will also discuss the Light Stage computational illumination and facial scanning systems which use geodesic spheres of inward-pointing LED lights as have been used to create digital actor effects in movies such as Avatar, Benjamin Button, and Gravity, and have recently been used to create photoreal digital actors based on real people in movies such as Furious 7, Blade Runner: 2049, and Ready Player One. The lighting reproduction process of light stages allows omnidirectional lighting environments captured from the real world to be accurately reproduced in a studio, and has recently been extended with multispectral capabilities to enable LED lighting to accurately mimic the color rendition properties of daylight, incandescent, and mixed lighting environments. They have also recently used their full-body light stage in conjunction with natural language processing and automultiscopic video projection to record and project interactive conversations with survivors of the World War II Holocaust.

Paul Debevec is a Senior Scientist at Google VR, a member of GoogleVR's Daydream team, and Adjunct Research Professor of Computer Science in the Viterbi School of Engineering at the University of Southern California, working within the Vision and Graphics Laboratory at the USC Institute for Creative Technologies. Debevec's computer graphics research has been recognized with ACM SIGGRAPH's first Significant New Researcher Award in 2001 for "Creative and Innovative Work in the Field of Image-Based Modeling and Rendering", a Scientific and Engineering Academy Award in 2010 for "the design and engineering of the Light Stage

capture devices and the image-based facial rendering system developed for character relighting in motion pictures" with Tim Hawkins, John Monos, and Mark Sagar, and the SMPTE Progress Medal in 2017 in recognition of his achievements and ongoing work in pioneering techniques for illuminating computer-generated objects based on measurement of real-world illumination and their effective commercial application in numerous Hollywood films. In 2014, he was profiled in The New Yorker magazine's "Pixel Perfect: The Scientist Behind the Digital Cloning of Actors" article by Margaret Talbot.

3:00 – 3:30 PM Coffee Break

Light Field Imaging and Display Joint Session

Session Chair: Gordon Wetzstein, Stanford University (United States)

3:30 – 5:30 PM

Grand Peninsula Ballroom D

This session is jointly sponsored by the EI Steering Committee.

3:30

EISS-706

Light fields - From shape recovery to sparse reconstruction

(Invited), Ravi Ramamoorthi, University of California, San Diego (United States)

Prof. Ravi Ramamoorthi is the Ronald L. Graham Professor of Computer Science, and Director of the Center for Visual Computing, at the University of California, San Diego. Ramamoorthi received his PhD in computer science in 2002 from Stanford University. Prior to joining UC San Diego, Ramamoorthi was associate professor of EECS at the University of California, Berkeley, where he developed the complete graphics curricula. His research centers on the theoretical foundations, mathematical representations, and computational algorithms for understanding and rendering the visual appearance of objects, exploring topics in frequency analysis and sparse sampling and reconstruction of visual appearance datasets a digital data-driven visual appearance pipeline; light-field cameras and 3D photography; and physics-based computer vision. Ramamoorthi is an ACM Fellow for contributions to computer

graphics rendering and physics-based computer vision, awarded on Dec 2017, and an IEEE Fellow for contributions to foundations of computer graphics and computer vision, awarded Jan 2017.

4:10

EISS-707

The beauty of light fields (Invited), David Fattal, LEIA Inc. (United States)

Dr. David Fattal is co-founder and CEO at LEIA Inc., where he is in charge of bringing their mobile holographic display technology to market. Fattal received his PhD in physics from Stanford University in 2005. Prior to founding LEIA Inc., Fattal was a research scientist with HP Labs, HP Inc. At LEIA Inc., the focus is on immersive mobile, with screens that come alive in richer, deeper, more beautiful ways. Flipping seamlessly between 2D and lightfields, mobile experiences become truly immersive: no glasses, no tracking, no fuss. Alongside new display technology LEIA Inc. is developing Leia Loft™ — a whole new canvas.

4:30

EISS-708

Light field insights from my time at Lytro (Invited), Kurt Akeley, Google Inc. (United States)

Dr. Kurt Akeley is a Distinguished Engineer at Google Inc. Akeley received his PhD in stereoscopic display technology from Stanford University in 2004, where he implemented and evaluated a stereoscopic display that passively (e.g., without eye tracking) produces nearly correct focus cues. After Stanford, Dr. Akeley worked with OpenGL at NVIDIA Incorporated, was a principal researcher at Microsoft Corporation, and a consulting professor at Stanford University. In 2010, he joined Lytro Inc. as CTO. During his seven-year tenure as Lytro's CTO, he guided and directly contributed to the development of two consumer light-field cameras and their related display systems, and also to a cinematic capture and processing service that supported immersive, six-degree-of-freedom virtual reality playback.

4:50

EISS-709

Quest for immersion (Invited), Kari Pulli, Stealth Startup (United States)

Dr. Kari Pulli has spent two decades in computer imaging and AR at companies such as Intel, NVIDIA and Nokia. Before joining a stealth startup, he was the CTO of Meta, an augmented reality company in San Mateo, heading up computer vision, software, displays, and hardware, as well as the overall architecture of the system. Before joining Meta, he worked as the CTO of the Imaging and Camera Technologies Group at Intel, influencing the architecture of future IPU's in hardware and software. Prior, he was vice president of

computational imaging at Light, where he developed algorithms for combining images from a heterogeneous camera array into a single high-quality image. He previously led research teams as a senior director at NVIDIA Research and as a Nokia Fellow at Nokia Research, where he focused on computational photography, computer vision, and AR. Kari holds computer science degrees from the University of Minnesota (BSc), University of Oulu (MSc, Lic. Tech), and University of Washington (PhD), as well as an MBA from the University of Oulu. He has taught and worked as a researcher at Stanford, University of Oulu, and MIT.

5:10**EISS-710**

Industrial scale light field printing (Invited), *Matthew Hirsch, Lumii Inc. (United States)*

Dr. Matthew Hirsch is a co-founder and Chief Technical Officer of Lumii. He worked with Henry Holtzman's Information Ecology Group and Ramesh Raskar's Camera Culture Group at the MIT Media Lab, making the next generation of interactive and glasses-free 3D displays. Matthew received his bachelors from Tufts University in Computer Engineering, and his Masters and Doctorate from the MIT Media Lab. Between degrees, he worked at Analogic Corp. as an Imaging Engineer, where he advanced algorithms for image reconstruction and understanding in volumetric x-ray scanners. His work has been funded by the NSF and the Media Lab consortia, and has appeared in SIGGRAPH, CHI, and ICCP. Matthew has also taught courses at SIGGRAPH on a range of subjects in computational imaging and display, with a focus on DIY.

Computational Imaging XVII Interactive Posters Session

5:30 – 7:00 PM

The Grove

The following works will be presented at the EI 2019 Symposium Interactive Papers Session.

COIMG-141

Adaptive loss regression for flexible graph-based semi-supervised embedding, *Fadi Dornaika and Yousof El Traboulsi, University of the Basque Country (Spain)*

COIMG-142

An efficient motion correction method for frequency-domain

images based on Fast Robust Correlation, Yuan Bian¹, Stanley Reeves¹, and Ronald Beyers^{2,1}; Auburn University and ²Auburn University MRI Research Center (United States)

COIMG-143

Compton camera imaging with spherical movement, Kiwoon Kwon¹ and Sungwhan Moon^{2,1}; Dongguk University and ²Kyungpook National University (Republic of Korea)

Thursday January 17, 2019

Medical Imaging - Computational Joint Session

Session Chair: David Castañón, Boston University (United States)

8:50 – 10:10 AM

Grand Peninsula Ballroom A

This medical imaging session is jointly sponsored by: Computational Imaging XVII, Human Vision and Electronic Imaging 2019, and Imaging and Multimedia Analytics in a Web and Mobile World 2019.

8:50

IMAWM-145

Smart fetal care, Jane You¹, Qin Li², Qiaozhu Chen³, Zhenhua Guo⁴, and Hongbo Yang^{5,1}; The Hong Kong Polytechnic University (Hong Kong), ²Shenzhen Institute of Information Technology (China), ³Guangzhou Women and Children Medical Center (China), ⁴Tsinghua University (China), and ⁵Suzhou Institute of Biomedical Engineering and Technology, Chinese Academy of Sciences (China)

9:10

COIMG-146

Self-contained, passive, non-contact, photoplethysmography: Real-time extraction of heart rates from live view within a Canon Powershot, Henry Dietz, Chadwick Parrish, and Kevin Donohue, University of Kentucky (United States)

9:30

COIMG-147

Edge-preserving total variation regularization for dual-energy CT

images, Sandamali Devadithya and David Castañón, Boston University (United States)

9:50

COIMG-148

Fully automated dental panoramic radiograph by using internal mandible curves of dental volumetric CT, Sanghun Lee¹, Seongyoun Woo¹, Joonwoo Lee², Jaejun Seo², and Chulhee Lee¹; Yonsei University and ²Dio Implant (Republic of Korea)

10:10 – 11:00 AM Coffee Break



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