IS&T International Symposium on
Electronic Imaging
SCIENCE AND TECHNOLOGY
14–18 February 2016 • San Francisco, CA, USA

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

electronicimaging.org
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.
### Human Vision and Electronic Imaging (HVEI) 2016

**Monday, February 15, 2016**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
</table>
| 8:50 – 9:50 am | Continental Ballroom 4  
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)  
HVEI Conference Welcome  
Towards a rudimentary neural model of multisensory integration in human neocortex, John Foxe1 and Sophie Molholm2; 1University of Rochester Medical Center and 2Albert Einstein College of Medicine (USA) |
| 9:50 – 10:20 am | Continental Ballroom 4  
Multisensory development and plasticity: From neurons to the clinic (Invited), Mark Wallace, Vanderbilt University (USA) |
| 10:20 – 10:50 am | Continental Ballroom 4  
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  
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)  
Language processing in congenitally blind people (Invited), Krisi Sathian1, 2, Valeria Occelli1, Simon Lacey1, and Randall Stilla1; 1Emory University and 2Atlanta VAMC (USA)  
High-order multisensory mechanisms: Insights from Braile writing and reading (Invited), Lora Likova, Christopher Tyler, Kristya Minett, Laura Caciamani, and Spero Nicholas, Smith-Kettlewell Eye Research Institute (USA)  
Blind individuals represent the auditory space in egocentric rather than allocentric reference frame (Invited), Tiziana Vercillo1 and Monica Gori2; 1University of Nevada, Reno (USA) and 2Fondazione Istituto Italiano di Tecnologia (Italy) |
| 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 | Continental Ballroom 4  
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  
Beyond the predominance of the visual empire: A functional model on haptics & more (Invited), Claus-Christian Carbon1, 2, 3; 1University of Bamberg, 2Forschungsgruppe EPAEG, and 3Bamberg Graduate School of Affective and Cognitive Sciences (Germany)  
Visual-tactile integration during active touch (Invited), Cintia Martins and Qi Wang, Columbia University (USA)  
Evaluating the effectiveness of auditory and tactile surface graphs for the visually impaired, James Ferwerda1, Vladimir Bulatov2, and John Gardner3; 1Rochester Institute of Technology and 2ViewPlus 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  
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 RETINEX017 Retinexes algorithms: Many spatial processes used to solve many different problems (Invited), John McCann, McCann Imaging (USA)

9:30 RETINEX018 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 RETINEX019 The oriented difference of Gaussians model of brightness perception (Invited), Mark McCourt and Barbara Blakeslee, North Dakota State University (USA)

11:10 RETINEX020 A center-surround framework for spatial image processing, Vassilios Vonikakis, Advanced Digital Sciences Center (ADSC) (Singapore)

11:30 RETINEX021 Retinex-like computations in human lightness perception and their possible realization in visual cortex (Invited), Michael Rudd, University of Washington (USA)

11:50 RETINEX022 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 RETINEX023 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 Laparra1,2, Johannes Ballé2,3, Alexander Berardino2, and Eero Simoncelli2,3; 1Universitat de Valencia (Spain), 2New York University (USA), and 3Howard 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 Sagapud1, Samira Tavakoli2, Kjell Brunstrom2,4, and Narciso Garcia1; 1Technical University of Denmark (Denmark), 2Universidad Politecnica de Madrid (Spain), 3New York University (USA), and 4Howard Hughes Medical Institute (USA)

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

5:10 HVEI-107 Visual saliency in HEVC video stream, Marwa Ammar1, Mihai Mitrea1, Ismail Boujelbenn1, and Patrick le Callet2; 1Telecom Sud Paris and 2Polytech 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 Universität Delft (Netherlands)

**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

IQSP/HVEI: Joint Session
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 Martinez, and Erhardt Barth, University of Lübeck (Germany)

10:00 HVEI-111
Comparing object recognition from binary and bipolar edge features, Jae-Hyun Jung1, Tian Pu2, and Eliezer Peli1; 1Schepens Eye Research Institute/Mass. Eye and Ear, Harvard Medical School (USA) and 2University of Electronic Science and Technology of China (China)

10:20 – 10:50 am Coffee Break

Individual Differences in Perceptional 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 Palmer1, Karen Schloss2, and William Giniscom2; 1University of California, Berkeley, 2Brown University, and 1Microsoft 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, Nathaniel 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

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 Lebeton1, Alexander Raake2, and Marcus Barkowsky2; 1Technische Universität Ilmenau (Germany) and 2Université 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 Borghout, University of California, Berkeley (USA)
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
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
From vision science to data science: Applying perception to problems in big data (Invited), Remco Chang, Tufts University (USA)
10:10
A grounded theory study on the language of data visualization principles and guidelines, Eser Kandogan1 and Hanseung Lee2; 1IBM Research and 2Google (USA)

Perceptual Coding for Visualization (continued)
Session Chair: Ulrich Engelke, CSIRO (Australia)
11:00 am – 12:20 pm
Continental Ballroom 4
11:00
Why we use bad color maps and what you can do about it (Invited), Kenneth Moreland, Sandia National Laboratories (USA)
11:20
SwordPlots: Exploring neuron behavior within dynamic communities of brain networks (JIST-first), Chihua Ma1, Angus Forbes1, Daniel Llano1, Tanya Berger-Wolf1, and Robert Kenyon1; 1University of Illinois at Chicago and 2University of Illinois at Urbana-Champaign (USA)
11:40
Color visualization of the phase component of complex signals, Alfredo Restrepo, Universidad de los Andes (Colombia)
12:00
Visual performance in multidimensional data characterisation with scatterplots and parallel coordinates (Invited), Ulrich Engelke, Jenny Vuong, and Julian Heerich, CSIRO (Australia)
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 (continued)
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 Tyler1,2, 1Smith-Kettlewell Eye Research Institute (USA) and 2City 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 Lockyer1, Lyn Bartram1, Thecla Schiphorst1, and Karen Studd2; 1Simon Fraser University (Canada) and 2GMU 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 Ox1,2, 1University of Texas, Dallas and 2University 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 Jameson1, Keith Goldfarb2, and Vladimir Bochko3; 1University of California, Irvine (USA), 2Blackthorn Media LLC (USA), and 3University of Vaasa (Finland)

5:40 HVEI-146
Painting like old masters, creative algorithms for 2.5D reproduction (Invited), Camilla 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.