# IS&T International Symposium on Electronic Imaging Science and Technology 2020

## Image Quality and System Performance XVII

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**Editors:**

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# IMAGE QUALITY AND SYSTEM PERFORMANCE XVII

## Monday, January 27, 2020

### KEYNOTE: Automotive Camera Image Quality — JOINT SESSION

Session Chair: Luke Cui, Amazon (United States)

**8:45 – 9:30 am**
Regency B
*This session is jointly sponsored by: Autonomous Vehicles and Machines 2020, and Image Quality and System Performance XVII.*

**8:45**
**Conference Welcome**

**8:50**                                                              AVM-001
**LED flicker measurement: Challenges, considerations, and updates from IEEE P2020 working group,** *Brian Deegan, senior expert, Valeo Vision Systems (Ireland)*...N/A

### Automotive Camera Image Quality — JOINT SESSION

Session Chair: Luke Cui, Amazon (United States)

**9:30 – 10:10 am**
Regency B
*This session is jointly sponsored by: Autonomous Vehicles and Machines 2020, and Image Quality and System Performance XVII.*

**9:30**                                                              IQSP-018
**A new dimension in geometric camera calibration,** *Dietmar Wueller, Image Engineering GmbH & Co. KG (Germany)*...1

**9:50**                                                              AVM-019
**Automotive image quality concepts for the next SAE levels: Color separation probability and contrast detection probability,** *Marc Geese, Continental AG (Germany)*...N/A

10:10 – 10:50 am Coffee Break

### Predicting Camera Detection Performance — JOINT SESSION

Session Chair: Robin Jenkin, NVIDIA Corporation (United States)

**10:50 am – 12:30 pm**
Regency B
*This session is jointly sponsored by: Autonomous Vehicles and Machines 2020, Human Vision and Electronic Imaging 2020, and Image Quality and System Performance XVII.*

**10:50**                                                            AVM-038
**Describing and sampling the LED flicker signal,** *Robert Sumner, Imatest, LLC (United States)*...N/A

**11:10**                                                            IQSP-039
**Demonstration of a virtual reality driving simulation platform,** *Mingming Wang and Susan Farnand, Rochester Institute of Technology (United States)*...5

**11:30**                                                            AVM-040
**Prediction and fast estimation of contrast detection probability,** *Robin Jenkin, NVIDIA Corporation (United States)*...N/A

**11:50**                                                            AVM-041
**Object detection using an ideal observer model,** *Paul Kane and Orit Skorka, ON Semiconductor (United States)*...N/A

**12:10**                                                            AVM-042
**Comparison of detectability index and contrast detection probability (JIST-first),** *Robin Jenkin, NVIDIA Corporation (United States)*...N/A

12:30 – 2:00 pm Lunch

### PLENARY: Frontiers in Computational Imaging

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

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

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

3:10 – 3:30 pm Coffee Break

### Perceptual Image Quality — JOINT SESSION

Session Chairs: Mohamed Chaker Larabi, Université de Poitiers (France), and Jeffrey Mulligan, NASA Ames Research Center (United States)

**3:30 – 4:50 pm**
Grand Peninsula A
*This session is jointly sponsored by: Human Vision and Electronic Imaging 2020, and Image Quality and System Performance XVII.*

**3:30**                                                             IQSP-066
**Perceptual quality assessment of enhanced images using a crowd-sourcing framework,** *Muhammad Irshad[1], Alessandro Silva[1,2], Sana Alamgeer[1], and Mylène Farias[1]; [1]University of Brasilia and [2]IFG (Brazil)*...11

**3:50**                                                             IQSP-067
**Perceptual image quality assessment for various viewing conditions and display systems,** *Andrei Chubarau[1], Tara Akhavan[2], Hyunjin Yoo[2], Rafal Mantiuk[3], and James Clark[1]; [1]McGill University (Canada), [2]IRYStec Software Inc. (Canada), and [3]University of Cambridge (United Kingdom)*...19

**4:10**                                                             HVEI-068
**Improved temporal pooling for perceptual video quality assessment using VMAF,** *Sophia Batsi and Lisimachos Kondi, University of Ioannina (Greece)*...N/A

**4:30**                                                             HVEI-069
**Quality assessment protocols for omnidirectional video quality evaluation,** *Ashutosh Singla, Stephan Fremerey, Werner Robitza, and Alexander Raake, Technische Universität Ilmenau (Germany)*...N/A

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

# Tuesday, January 28, 2020

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

## Video Quality Experts Group I | JOINT SESSION

Session Chairs: Kjell Brunnström, RISE Acreo AB (Sweden), and Jeffrey Mulligan, NASA Ames Research Center (United States)

### 8:50 – 10:10 am
Grand Peninsula A

*This session is jointly sponsored by: Human Vision and Electronic Imaging 2020, and Image Quality and System Performance XVII.*

8:50 HVEI-090

**The Video Quality Experts Group - Current activities and research,** *Kjell Brunnström[1,2] and Margaret Pinson[3]; [1]RISE Acreo AB (Sweden), [2]Mid Sweden University (Sweden), and [3]National Telecommunications and Information Administration, Institute for Telecommunications Sciences (United States)*...N/A

9:10 HVEI-091

**Quality of experience assessment of 360-degree video,** *Anouk van Kasteren[1,2], Kjell Brunnström[1,3], John Hedlund[1], and Chris Snijders[2]; [1]RISE Research Institutes of Sweden AB (Sweden), [2]University of Technology Eindhoven (the Netherlands), and [3]Mid Sweden University (Sweden)*...N/A

9:30 HVEI-092

**Open software framework for collaborative development of no reference image and video quality metrics,** *Margaret Pinson[1], Philip Corriveau[2], Mikolaj Leszczuk[3], and Michael Colligan[4]; [1]US Department of Commerce (United States), [2]Intel Corporation (United States), [3]AGH University of Science and Technology (Poland), and [4]Spirent Communications (United States)*...N/A

9:50 HVEI-093

**Investigating prediction accuracy of full reference objective video quality measures through the ITS4S dataset,** *Antonio Servetti, Enrico Masala, and Lohic Fotio Tiotsop, Politecnico di Torino (Italy)*...N/A

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

10:10 – 10:50 am Coffee Break

## Video Quality Experts Group II | JOINT SESSION

Session Chair: Kjell Brunnström, RISE Acreo AB (Sweden)

### 10:50 am – 12:30 pm
Grand Peninsula A

*This session is jointly sponsored by: Human Vision and Electronic Imaging 2020, and Image Quality and System Performance XVII.*

10:50 HVEI-128

**Quality evaluation of 3D objects in mixed reality for different lighting conditions,** *Jesús Gutiérrez, Toinon Vigier, and Patrick Le Callet, Université de Nantes (France)*...N/A

11:10 HVEI-129

**A comparative study to demonstrate the growing divide between 2D and 3D gaze tracking quality,** *William Blakey[1,2], Navid Hajimirza[1], and Naeem Ramzan[2]; [1]Lumen Research Limited and [2]University of the West of Scotland (United Kingdom)*...N/A

11:30 HVEI-130

**Predicting single observer's votes from objective measures using neural networks,** *Lohic Fotio Tiotsop[1], Tomas Mizdos[2], Miroslav Uhrina[2], Peter Pocta[2], Marcus Barkowsky[3], and Enrico Masala[1]; [1]Politecnico di Torino (Italy), [2]Zilina University (Slovakia), and [3]Deggendorf Institute of Technology (DIT) (Germany)*...N/A

11:50 HVEI-131

**A simple model for test subject behavior in subjective experiments,** *Zhi Li[1], Ioannis Katsavounidis[2], Christos Bampis[1], and Lucjan Janowski[3]; [1]Netflix, Inc. (United States), [2]Facebook, Inc. (United States), and [3]AGH University of Science and Technology (Poland)*...N/A

12:10 HVEI-132

**Characterization of user generated content for perceptually-optimized video compression: Challenges, observations, and perspectives,** *Suiyi Ling[1,2], Yoann Baveye[1,2], Patrick Le Callet[2], Jim Skinner[3], and Ioannis Katsavounidis[3]; [1]CAPACITÉS (France), [2]Université de Nantes (France), and [3]Facebook, Inc. (United States)*...N/A

12:30 – 2:00 pm Lunch

## PLENARY: Automotive Imaging

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

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

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

3:10 – 3:30 pm Coffee Break

## Image Quality Metrics | JOINT SESSION

Session Chair: Jonathan Phillips, Google Inc. (United States)

### 3:30 – 5:10 pm
Grand Peninsula A

*This session is jointly sponsored by: Human Vision and Electronic Imaging 2020, and Image Quality and System Performance XVII.*

3:30 IQSP-166

**DXOMARK objective video quality measurements,** *Emilie Baudin, Laurent Chanas, and Frédéric Guichard, DXOMARK (France)*...27

3:50 IQSP-167

**Analyzing the performance of autoencoder-based objective quality metrics on audio-visual content,** *Helard Becerra[1], Mylène Farias[1], and Andrew Hines[2]; [1]University of Brasilia (Brazil) and [2]University College Dublin (Ireland)*...33

4:10 IQSP-168

**No reference video quality assessment with authentic distortions using 3-D deep convolutional neural network,** *Roger Nieto[1], Hernan Dario Benitez Restrepo[1], Roger Figueroa Quintero[1], and Alan Bovik[2]; [1]Pontificia University Javeriana, Cali (Colombia) and [2]The University of Texas at Austin (United States)*...38

4:30             IQSP-169

**Quality aware feature selection for video object tracking,** *Roger Nieto[1], Carlos Quiroga[2], Jose Ruiz-Munoz[3], and Hernan Benitez-Restrepo[1]; [1]Pontificia University Javeriana, Cali (Colombia), [2]Universidad del Valle (Colombia), and [3]University of Florida (United States)*...44

4:50             IQSP-170

**Studies on the effects of megapixel sensor resolution on displayed image quality and relevant metrics,** *Sophie Triantaphillidou[1], Jan Smejkal[1], Edward Fry[1], and Chuang Hsin Hung[2]; [1]University of Westminster (United Kingdom) and [2]Huawei (China)*...50

5:30 – 7:30 pm Symposium Demonstration Session

# Wednesday, January 29, 2020

### KEYNOTE: Image Capture

Session Chair: Nicolas Bonnier, Apple Inc. (United States)

**8:50 – 9:50 am**
Harbour A/B

IQSP-190

**Camera vs smartphone: How electronic imaging changed the game,** *Frédéric Guichard, DXOMARK (France)*...N/A

### Image Capture Performance I

Session Chair: Peter Burns, Burns Digital Imaging (United States)

**9:50 – 10:10 am**
Harbour A/B

IQSP-214

**Comparing common still image quality metrics in recent High Dynamic Range (HDR) and Wide Color Gamut (WCG) representations,** *Anustup Choudhury and Scott Daly, Dolby Laboratories (United States)*...59

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

10:10 – 10:50 am Coffee Break

### Image Capture Performance II

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

**10:50 am – 12:10 pm**
Harbour A/B

10:50             IQSP-239

**Validation of modulation transfer functions and noise power spectra from natural scenes (JIST-first),** *Edward Fry[1], Sophie Triantaphillidou[1], Robin Jenkin[2], and Ralph Jacobson[1]; [1]University of Westminster (United Kingdom) and [2]NVIDIA Corporation (United States)*...67

11:10             IQSP-240

**Application of ISO standard methods to optical design for image capture,** *Peter Burns[1], Don Williams[2], Heidi Hall[3], John Griffith[3], and Scott Cahall[3]; [1]Burns Digital Imaging, [2]Image Science Associates, and [3]Moondog Optics (United States)*...78

11:30             IQSP-241

**Camera system performance derived from natural scenes,** *Oliver van Zwanenberg[1], Sophie Triantaphillidou[1], Robin Jenkin[2], and Alexandra Psarrou[1]; [1]University of Westminster (United Kingdom) and [2]NVIDIA Corporation (United States)*...84

11:50             IQSP-242

**Correcting misleading image quality measurements,** *Norman Koren, Imatest LLC (United States)*...93

12:30 – 2:00 pm Lunch

### PLENARY: VR/AR Future Technology

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

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

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

3:10 – 3:30 pm Coffee Break

### Image Quality of Omnidirectional Environnement

Session Chair: Stuart Perry, University of Technology Sydney (Australia)

**3:30 – 5:10 pm**
Harbour A/B

3:30             IQSP-284

**Subjective and viewport-based objective quality assessment of 360-degree videos,** *Roberto Azevedo[1], Neil Birkbeck[2], Ivan Janatra[2], Balu Adsumilli[2], and Pascal Frossard[1]; [1]Ecole Polytechnique Fédérale de Lausanne (Switzerland) and [2]YouTube (United States)*...102

3:50             IQSP-285

**Statistical characterization of tile decoding time of HEVC-encoded 360° video,** *Henrique Garcia[1], Mylène Farias[1], Ravi Prakash[2], and Marcelo Carvalho[1]; [1]University of Brasilia (Brazil) and [2]The University of Texas at Dallas (United States)*...108

4:10             IQSP-286

**Complexity optimization for the upcoming versatile video coding standard,** *Mohamed Chaker Larabi, Université de Poitiers (France)*...114

4:30             IQSP-287

**On the improvement of 2D quality assessment metrics for omnidirectional images,** *Mohamed Chaker Larabi, Université de Poitiers (France)*...120

4:50             IQSP-288

**The cone model: Recognizing gaze uncertainty in virtual environments,** *Anjali Jogeshwar, Mingming Wang, Gabriel Diaz, Susan Farnand, and Jeff Pelz, Rochester Institute of Technology (United States)*...130

# Thursday, January 30, 2020

## Image Capture Performance III

Session Chair: Mylène Farias, University of Brasilia (Brazil)

### 8:50 – 10:10 am
Harbour A/B

8:50     IQSP-345

**Noise power spectrum scene-dependency in simulated image capture systems,** *Edward Fry[1], Sophie Triantaphillidou[1], Robin Jenkin[1,2], Ralph Jacobson[1], and John Jarvis[1]; [1]University of Westminster (United Kingdom) and [2]NVIDIA Corporation (United States)*...189

9:10     IQSP-346

**Verification of long-range MTF testing through intermediary optics,** *Alexander Schwartz, Sarthak Tandon, and Jackson Knappen, Imatest, LLC (United States)*...195

9:30     IQSP-347

**Measuring camera Shannon information capacity with a Siemens star image,** *Norman Koren[1] and Robin Jenkin[2]; [1]Imatest LLC and [2]NVIDIA Corporation (United States)*...201

9:50     IQSP-348

**Scene-and-process-dependent spatial image quality metrics (JIST-first),** *Edward Fry[1], Sophie Triantaphillidou[1], Robin Jenkin[2], and John Jarvis[1]; [1]University of Westminster (United Kingdom) and [2]NVIDIA Corporation (United States)*...210

10:10 – 10:50 am Coffee Break

## System Performance

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

### 10:50 am – 12:30 pm
Harbour A/B

10:50     IQSP-370

**Depth map quality evaluation for photographic applications,** *Eloi Zalczer[1], François-Xavier Thomas[1], Laurent Chanas[1], Gabriele Facciolo[2], and Frédéric Guichard[1]; [1]DXOMARK and [2]ENS Cachan (France)*...223

11:10     IQSP-371

**Prediction of Lee filter performance for Sentinel-1 SAR images,** *Oleksii Rubel[1], Vladimir Lukin[1], Andrii Rubel[1], and Karen Egiazarian[2]; [1]National Aerospace University (Ukraine) and [2]Tampere University (Finland)*...229

11:30     IQSP-372

**Evaluating whole-slide imaging viewers used in digital pathology,** *Wei-Chung Cheng[1], Samuel Lam[2], Qi Gong[1], and Paul Lemaillet[1]; [1]US Food and Drug Administration and [2]University of Maryland (United States)*...235

11:50     IQSP-373

**Inkjet quality ruler experiments and print uniformity predictor,** *Yi Yang[1], Utpal Sarkar[2], Isabel Borrell[2], and Jan Allebach[1]; [1]Purdue University (United States) and [2]HP Inc. (Spain)*...240