



Image Quality and System Performance XIX

Conference Chairs

Mohamed-Chaker Larabi, University of Poitiers (France)

Mylène Farias, University of Brasilia (Brazil)

This document details the conference program, held as part of the 2022 IS&T International Symposium on Electronic Imaging, online 15–26 January 2022. Manuscripts of conference papers are reproduced from PDFs as submitted and approved by authors; no editorial changes were made.

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Image Quality and System Performance XIX

Conference overview

We live in a visual world. The perceived quality of images is of crucial importance in industrial, medical, and entertainment 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 and autonomous vehicles bring image processing into new aspects of society.

The power of imaging rests directly on the visual quality of the images and the performance of the systems that produce them. As the images are generally intended to be viewed by humans, a deep understanding of human visual perception is key 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 specify the requirements and assess the performance of modern imaging systems. It focuses on 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, virtual, mixed or augmented reality, LDR or HDR.

Conference Chairs: Mylène Farias, University of Brasilia (Brazil), and Mohamed-Chaker Larabi, University of Poitiers (France)

Program Committee: Nicolas Bonnier, Apple Inc. (United States); Alan Bovik, University of Texas at Austin (United States); Peter Burns, Burns Digital Imaging (United States); Anustup Choudhury, Dolby Laboratories (United States); Brian Cooper, Lexmark International, Inc. (United States); Luke Cui, Amazon (United States); Mylène Farias, University of Brasilia (Brazil); Susan Farnand, Rochester Institute of Technology (United States); Frans Gaykema, Océ Technologies B.V. (the Netherlands); Jukka Häkkinen, University of Helsinki (Finland); Dirk Hertel, E Ink Corporation (United States); Robin Jenkin, NVIDIA Corporation (United States); Elaine Jin, NVIDIA Corporation (United States); Göte Nyman, University of Helsinki (Finland); Stuart Perry, University of Technology Sydney (Australia); Jonathan Phillips, Imatest (United States); and Sophie Triantaphillidou, University of Westminster (United Kingdom)

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Image Quality and System Performance XIX

MONDAY 17 JANUARY 2022

PLENARY: Quanta Image Sensors: Counting Photons Is the New Game in Town

10:00 – 11:10

Eric R. Fossum, Dartmouth College (United States)

The Quanta Image Sensor (QIS) was conceived as a different image sensor—one that counts photoelectrons one at a time using millions or billions of specialized pixels read out at high frame rate with computation imaging used to create gray scale images. QIS devices have been implemented in a CMOS image sensor (CIS) baseline room-temperature technology without using avalanche multiplication, and also with SPAD arrays. This plenary details the QIS concept, how it has been implemented in CIS and in SPADs, and what the major differences are. Applications that can be disrupted or enabled by this technology are also discussed, including smartphone, where CIS-QIS technology could even be employed in just a few years.

Eric R. Fossum is best known for the invention of the CMOS image sensor “camera-on-a-chip” used in billions of cameras. He is a solid-state image sensor device physicist and engineer, and his career has included academic and government research, and entrepreneurial leadership. At Dartmouth he is a professor of engineering and vice provost for entrepreneurship and technology transfer. Fossum received the 2017 Queen Elizabeth Prize from HRH Prince Charles, considered by many as the Nobel Prize of Engineering “for the creation of digital imaging sensors,” along with three others. He was inducted into the National Inventors Hall of Fame, and elected to the National Academy of Engineering among other honors including a recent Emmy Award. He has published more than 300 technical papers and holds more than 175 US patents. He co-founded several startups and co-founded the International Image Sensor Society (IISS), serving as its first president. He is a Fellow of IEEE and OSA.

WEDNESDAY 19 JANUARY 2022

PLENARY: In situ Mobility for Planetary Exploration: Progress and Challenges

10:00 – 11:15

Larry Matthies, Jet Propulsion Laboratory (United States)

This year saw exciting milestones in planetary exploration with the successful landing of the Perseverance Mars rover, followed by its operation and the successful technology demonstration of the Ingenuity helicopter, the first heavier-than-air aircraft ever to fly on another planetary body. This plenary highlights new technologies used in this mission, including precision landing for Perseverance, a vision coprocessor, new algorithms for faster rover traverse, and the ingredients of the helicopter. It concludes with a survey of challenges for future planetary mobility systems, particularly for Mars, Earth’s moon, and Saturn’s moon, Titan.

Larry Matthies received his PhD in computer science from Carnegie Mellon University (1989), before joining JPL, where he has supervised the Computer Vision Group for 21 years, the past two coordinating internal technology investments in the Mars office. His research interests include 3-D perception, state estimation, terrain classification, and dynamic scene analysis for autonomous navigation of unmanned vehicles on Earth and in space. He has been a principal investigator in many programs involving robot vision and has initiated new technology developments that impacted every US Mars surface mission since 1997, including visual navigation algorithms for rovers, map matching algorithms for precision landers, and autonomous navigation hardware and software architectures for rotorcraft. He is a Fellow of the IEEE and was a joint winner in 2008 of the IEEE’s Robotics and Automation Award for his contributions to robotic space exploration.

Image Quality and System Performance XIX Posters

11:20 – 12:20

Poster interactive session for all conferences authors and attendees.

IQSP-195

P-12: Image quality performance of CMOS image sensor equipped with CMY color filter, Sungho Cha, Samsung Electronics Co, Ltd. (Republic of Korea)

P-13: Visualization for texture analysis of the Shitsukan Research Database based on luminance information, *Norifumi Kawabata, Hokkaido University (Japan)*

MONDAY 24 JANUARY 2022

High Dynamic Range Quality and Performance

Session Chair: Jonathan Phillips, Imatest, LLC (United States)

10:00 – 11:05

10:00

Conference Introduction

10:05

IQSP-312

Objective image quality evaluation of HDR videos captured by smartphones, *Cyril Lajarge, François-Xavier Thomas, Elodie Souksava, Laurent Chanas, Hoang-Phi Nguyen, and Frédéric Guichard, DXOMARK (France)*

10:25

IQSP-313

New visual noise measurement on a versatile laboratory setup in HDR conditions for smartphone camera testing, *Thomas Bourbon, Coraline S. Hillairet, Benoit Pochon, and Frédéric Guichard, DXOMARK (France)*

10:45

IQSP-314

Combined image flare and dynamic range measurement from two test chart images, *Norman Koren, Imatest LLC (United States)*

Application-Based Quality Assessment I

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

11:30 – 12:30

11:30

IQSP-317

Image enhancement dataset for evaluation of image quality metrics, *Altynay Kadyrova, Marius Pedersen, Bilal Ahmad, Dipendra J. Mandal, Mathieu Nguyen, and Pauline Hardeberg Zimmermann, Norwegian University of Science and Technology (Norway)*

11:50

IQSP-318

Image quality evaluation of video conferencing solutions with realistic laboratory scenes, *Rafael Falcon, Stanislas Brochard-Garnier, Gabriel P. Gouveia, Mauro Patti, Santiago T. Acevedo, Thelma Bergot, Rick Alarcon, Corentin Bomstein, Hervé Macudzinski, Pierre-Yves Maitre, Benoit Pochon, Laurent Chanas, Hoang-Phi Nguyen, and Frédéric Guichard, DXOMARK (France)*

12:10

IQSP-319

A continuous bitstream-based blind video quality assessment using multi-layer perceptron, *Hugo Merly, Alexandre Ninassi, and Christophe Charrier, University de Caen Basse-Normandie (France)*

Quality and Perception

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

13:00 – 14:00

IQSP-326

KEYNOTE: Towards neural representations of perceived visual quality, *Sebastian Bosse, Fraunhofer Heinrich Hertz Institute (Germany)*

Accurate computational estimation of visual quality as it is perceived by humans is crucial for any visual communication or computing system that has humans as the ultimate receivers. But most importantly besides the practical importance, there is a certain fascination to it: While it is so easy, almost effortless, to assess the visual quality of an image or a video, it is astonishingly difficult to predict it computationally. Consequently, the problem of quality estimation touches on a wide range of disciplines like engineering, psychology, neuroscience, statistics, computer vision, and, since a couple of years now, on machine learning. In this talk, Bosse gives an overview of recent advances in neural network-based approaches to perceptual quality prediction. He examines and compares different concepts of quality prediction with a special focus on the feature extraction and representation. Through this, Bosse revises the underlying principles and assumptions, the algorithmic details and some quantitative results. Based on a survey of the limitations of the

state of the art, Bosse discusses challenges, novel approaches and promising future research directions that might pave the way towards a general representation of visual quality.

Sebastian Bosse is head of the Interactive & Cognitive Systems group at Fraunhofer Heinrich Hertz Institute (HHI), Berlin, Germany. He studied electrical engineering and information technology at RWTH Aachen University, Germany, and Polytechnic University of Catalonia, Barcelona, Spain. Sebastian received the Dr.-Ing. in computer science (with highest distinction) from the Technical University Berlin (2018). During his studies he was a visiting researcher at Siemens Corporate Research, Princeton, (United States). In 2014, Sebastian was a guest scientist in the Stanford Vision and Neuro-Development Lab (SVNDL) at Stanford University, (United States). After 10 years as a research engineer working in the Image & Video Compression group and later in the Machine Learning group, he founded the research group on Interactive & Cognitive Systems at Fraunhofer HHI in 2020 that he has headed since. Sebastian is a lecturer at the German University in Cairo. He is on the board of the Video Quality Expert Group (VQEG) and on the advisory board of the International AIQT Foundation. Sebastian is an affiliate member of VISTA, York University, Toronto, and serves as an associate editor for the IEEE Transactions on Image Processing. Since 2021 he has been appointed a chair for the ITU focus group on Artificial Intelligence for Agriculture. His current research interests include the modelling of perception and cognition, machine learning, computer vision, and human-machine interaction over a wide field of applications ranging from multimedia and augmented reality, through medicine to agriculture and industrial production.

Application-Based Quality Assessment II

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

18:00 – 19:00

18:00

IQSP-332

Accuracy and precision of an edge-based modulation transfer function measurement method using a variable oversampling ratio, Kenichiro Masaoka, NHK Science & Technology Research Laboratories (Japan)

18:20

IQSP-333

Quality-based video bitrate control for WebRTC-based teleconference services, Masahiro Yokota and Kazuhisa Yamagishi, Nippon Telegraph and Telephone Corporation (Japan)

18:40

IQSP-334

Assessing the impact of image quality on object-detection algorithms, Abhinav K. Venkataramanan, Marius Facktor, Praful Gupta, and Alan C. Bovik, The University of Texas at Austin (United States)

Image Quality Assessment Tools

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

19:15 – 20:15

19:15

IQSP-341

Generation of reference images using filtered radon transform and truncated SVD for structural artifacts, Seungwan Jeon, Yukyung Lee, Kundong Kim, Daeil Yu, Sung-Su Kim, and Joonseo Yim, Samsung Electronics Co., Ltd. (Republic of Korea)

19:35

IQSP-342

Color image distortion assessment based on synthetic ground truth recovery, Jungmin Lee, Seunghyeok June, Jiyun Bang, Sung-Su Kim, and Joonseo Yim, Samsung Electronics Co., Ltd. (Republic of Korea)

19:55

IQSP-343

Image distortion inference based on correlation between line pattern and character, Sungho Gil, Ohyeong Kim, Eunji Yong, Sung-Su Kim, and Joonseo Yim, Samsung Electronics Co., Ltd. (Republic of Korea)

TUESDAY 25 JANUARY 2022

PLENARY: Physics-based Image Systems Simulation

10:00 – 11:00

Joyce Farrell, Stanford Center for Image Systems Engineering, Stanford University, CEO and Co-founder, ImagEval Consulting (United States)

Three quarters of a century ago, visionaries in academia and industry saw the need for a new field called photographic engineering and formed what would become the Society for Imaging Science and Technology (IS&T). Thirty-five years ago, IS&T recognized the massive transition from analog to digital imaging and created the Symposium on Electronic Imaging (EI). IS&T and EI continue to evolve by cross-pollinating electronic imaging in the fields of computer graphics, computer vision, machine learning, and visual perception, among others. This talk describes open-source software and applications that build on this vision. The software combines quantitative computer graphics with models of optics and image sensors to generate physically accurate synthetic image data for devices that are being prototyped. These simulations can be a powerful tool in the design and evaluation of novel imaging systems, as well as for the production of synthetic data for machine learning applications.

Joyce Farrell is a senior research associate and lecturer in the Stanford School of Engineering and the executive director of the Stanford Center for Image Systems Engineering (SCIEN). Joyce received her BS from the University of California at San Diego and her PhD from Stanford University. She was a postdoctoral fellow at NASA Ames Research Center, New York University, and Xerox PARC, before joining the research staff at Hewlett Packard in 1985. In 2000 Joyce joined Shutterfly, a startup company specializing in online digital photofinishing, and in 2001 she formed ImagEval Consulting, LLC, a company specializing in the development of software and design tools for image systems simulation. In 2003, Joyce returned to Stanford University to develop the SCIEN Industry Affiliates Program.

PANEL: The Brave New World of Virtual Reality

11:00 – 12:00

Advances in electronic imaging, computer graphics, and machine learning have made it possible to create photorealistic images and videos. In the future, one can imagine that it will be possible to create a virtual reality that is indistinguishable from real-world experiences. This panel discusses the benefits of this brave new world of virtual reality and how we can mitigate the risks that it poses. The goal of the panel discussion is to showcase state-of-the-art synthetic imagery, learn how this progress benefits society, and discuss how we can mitigate the risks that the technology also poses. After brief demos of the state-of-the-art, the panelists will discuss: creating photorealistic avatars, Project Shoah, and digital forensics.

Panel Moderator: Joyce Farrell, Stanford Center for Image Systems Engineering, Stanford University, CEO and Co-founder, ImagEval Consulting (United States)

Panelist: Matthias Neissner, Technical University of Munich (Germany)

Panelist: Paul Debevec, Netflix, Inc. (United States)

Panelist: Hany Farid, University of California, Berkeley (United States)

Image Capture Performance I

Session Chair: Peter Burns, Rochester Institute of Tech. (United States)

12:15 – 13:15

12:15

IQSP-347

Creation and evolution of ISO 12233, the international standard for measuring digital camera resolution, Ken Parulski¹, Dietmar Wueller², Peter Burns³, and Hideaki Yoshida⁴; ¹aKAP Innovation, LLC (United States), ²Image Engineering GmbH & Co. KG (Germany), ³Burns Digital Imaging (United States), and ⁴Digital Solutions (Japan)

12:35

IQSP-348

Estimation of ISO12233 edge spatial frequency response from natural scene derived step-edge data (JIST-first), Oliver van Zwanenberg¹, Sophie Triantaphillidou¹, Robin B. Jenkin², and Alexandra Psarrou¹; ¹University of Westminster (United Kingdom) and ²NVIDIA Corporation (United States)

12:55

IQSP-349

Analysis of natural scene derived spatial frequency responses for estimating camera ISO12233 slanted-edge performance (JIST-first), Oliver van Zwanenberg¹, Sophie Triantaphillidou¹, Alexandra Psarrou¹, and Robin B. Jenkin²; ¹University of Westminster (United Kingdom) and ²NVIDIA Corporation (United States)

Image Capture Performance II

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

13:45 – 14:45

13:45

IQSP-357

Updated camera spatial frequency response for ISO 12233, Peter Burns¹, Kenichiro Masaoka², Ken Parulski³, and Dietmar Wueller⁴; ¹Burns Digital Imaging (United States), ²NHK Science & Technology Research Laboratories (Japan), ³aKAP Innovation, LLC (United States), and ⁴Image Engineering GmbH & Co. KG (Germany)

14:05

IQSP-358

Temporal MTF evaluation of slow motion mode in mobile phones, Lin Luo, Celalettin Yurdakul, Kaijun Feng, and Bo Mu, OmniVision Technologies Inc. (United States)

14:25

IQSP-359

Optimizing modulation transfer function measurement method for video endoscopes, Chinh V. Tran^{1,2}, Josh Pfefer², Nader Namazi¹, and Quanzeng Wang²; ¹The Catholic University of America and ²U.S. Food and Drug Administration (United States)

WEDNESDAY 26 JANUARY 2022

Learning-Based Quality Assessment

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

10:00 – 11:00

10:00

IQSP-384

Multi-gene genetic programming based predictive models for full-reference image quality assessment (JIST-first), Naima Merzougui and Leila Djerou, University of Biskra (Algeria)

10:20

IQSP-385

Learning-based 3D point cloud quality assessment using a support vector regressor, Aladine Chetouani¹, Maurice Quach², Giuseppe Valenzise², and Frédéric Dufaux²; ¹Université d'Orléans and ²L2S, Centrale Supélec, Université Paris-Saclay (France)

10:40

IQSP-386

Image quality assessment: Learning to rank image distortion level, Shira Faigenbaum-Golovin¹ and Or Shimshi²; ¹Duke University (United States) and ²Consultant (Israel)

Immersive Quality of Experience

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

11:30 – 12:30

11:30

IQSP-393

Exploration of comfort factors for virtual reality environments, Thibault Lacharme, Mohamed Chaker Larabi, and Daniel Meneveaux, Université de Poitiers (France)

11:50

IQSP-394

Designing a user-centric framework for perceptually-efficient streaming of 360° edited videos, Lucas dos Santos Althoff, Myllena Prado, Henrique Garcia, Gabriel Araújo, Israel Nascimento, Dario D. Moraes, Sana Alamgeer, Mylène C. Farias, and Marcelo Carvalho, University of Brasilia (Brazil)

12:10

IQSP-395

Patch-based CNN model for 360 image quality assessment with adaptive pooling strategies, Abderrezzaq Sendjasni^{1,2}, Mohamed Chaker Larabi¹, and Faouzi Alaya Cheikh²; ¹Université de Poitiers (France) and ²Norwegian University of Science and Technology (Norway)