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Imaging and Multimedia Analytics at the Edge 2022

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Imaging and Multimedia Analytics at the Edge 2022

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.

Virtual Reality
Session Chairs: Jan Allebach, Purdue University (United States); Raja Bala, Amazon (United States); and Qian Lin, HP Labs, HP Inc. (United States)
19:15 – 20:15

19:15 N/A
Cognitive load inference within a multitasking paradigm in virtual reality (Invited), *Jishang Wei, HP Labs (United States)*

19:55 IMAGE-255
VR facial expression tracking via action unit intensity regression model, *Xiaoyu Ji[1], Jishang Wei[2], Yvonne Huang[3], Qian Lin[3], Jan P. Allebach[1], and Fengqing Zhu[1]; [1]Purdue University, [2]HP Labs, and [3]HP Inc. (United States)*

THURSDAY 20 JANUARY 2022

Photography

Session Chairs: Jan Allebach, Purdue University (United States); Raja Bala, Amazon (United States); and Qian Lin, HP Labs, HP Inc. (United States)
10:00 – 11:05

10:00 N/A

KEYNOTE: Analogue – Digital – Mobile – Social: How photography has changed in the last 25 years, *Reiner Fageth, CEWE Stiftung & Co. KGAA (Germany)*

This paper will describe how digital photography has evolved from being a niche product for digital experts and IT freaks, to total domination of the mass-market and the disruption of analogue photography. This rapid, industry-altering process will be put into relationship to conferences and presentations given at Electronic Imaging in the last three decades. Developments and influence on quality were driven by imaging sensors and printing technologies. A review of the battle for attainting the high quality of silver-halide prints from negatives will be presented. The development of image enhancement technologies and printing technologies will be analyzed. The classical one-hour in-store photo order process in North America and Asia based on mini labs, and the logistics systems in Europe (collecting the film from the points of sale in the evening and returning the prints, processed by huge photofinishing plants, the next day) were substituted by digital kiosk systems in stores, and software applications in the browser or downloadable software. The development of the technologies involved will also be presented, as well as the efforts in supporting the selection process of the most suitable images. New digital printers based on liquid ink and toner offered new products, personalized photobooks and calendars allowed for story-telling and emotionalized gifting via tangible photo products and raised the value of every printed image. A review will be provided of the improvements there, as well as classical silver-halide based printing systems. The introduction of smartphones disrupted the new digital imaging ecosystems once more. The camera was now a constant companion in nearly everybody's pocket. The resulting increase in the number of images taken complicated the selection process (convenience photos, images "only" for social communication, ...) and the image quality discussion was once more raised and addressed in these conference. All of these challenges are addressed by actual imaging eco-systems. They include ordering possibilities over all devices (classical digital cameras and smartphones) and retail locations, as well as providing home delivery options. Selling these products became more of a marketing than a technological challenge. These systems utilize AI based solutions (on device and utilizing edge computing) combined with experience/heuristics gathered in the last 25 years. Some very good approaches will be presented at the end.

Reiner Fageth occupies the position of Head-Technology, Research & Development at CEWE Stiftung & Co. KGaA and Chairman-Supervisory Board of CEWE Color as (a subsidiary of CEWE Stiftung & Co. KGaA). Dr. Fageth is also on the board of CeWe Color, Inc. and Member-Management Board at Neumüller CEWE COLOR Stiftung. Reiner Fageth studied electronic engineering at the Fachhochschule Heilbronn, Germany. He received a PhD from the University of Northumbria at Newcastle, UK in split research with Telefunken Microelectronic and the Steinbeis Transferzentrum Image Processing in 1994. The major research topics there and also for the following years were industrial image processing systems based on classification using fuzzy logic and neural networks. In 1998 he joined CeWe Color with the charge to drive the analogue photo business into digital. First he was responsible for R&D and the production of consumers digital files on silver halide paper. CeWe Color is Europe largest wholesale photofinisher producing more than 3 billion prints a year. He is a member of the German DIN Normenausschuss Bild und Film NA 049-00-04 AA and has published over 30 technical papers.

10:40 IMAGE-263

Efficient real-time portrait video segmentation with temporal guidance, *Weichen Xu[1], Yezhi Shen[1], Qian Lin[2], Jan P. Allebach[1], and Fengqing Zhu[1]; [1]Purdue University (United States) and [2]HP Inc. (United States)*

Machine / Deep Learning

Session Chairs: Jan Allebach, Purdue University (United States); Raja Bala, Amazon (United States); and Qian Lin, HP Labs, HP Inc. (United States)
11:30 – 12:30

11:30 N/A

Generating high-resolution atmospheric gas concentration imagery with multiple remote sensing data using a geography-informed machine learning approach (Invited), *Kalai Ramea, Palo Alto Research Center (United States)*

12:10 IMAGE-273

Cultural assets identification using transfer learning, *Huajian Liu, Simon Bugert, Waldemar Berchtold, and Martin Steinebach, Fraunhofer Institute for Secure Information Technology (Germany)*

Image / Video Analysis

Session Chairs: Jan Allebach, Purdue University (United States); Raja Bala, Amazon (United States); and Qian Lin, HP Labs, HP Inc. (United States)
13:00 – 14:00

13:00 IMAGE-287

Correspondences for image and video reconstruction (Invited), *Xiaoyu Xiang, Facebook Inc. (United States)*

13:40 IMAGE-301

Towards the creation of a nutrition and food group based image database, *Zeman Shao, Jiangpeng He, Ya-Yuan Yu, Luotao Lin, Alexandra E. Cowan, Heather A. Eicher-Miller, and Fengqing Zhu, Purdue University (United States)*

Applications

Session Chairs: Jan Allebach, Purdue University (United States); Raja Bala, Amazon (United States); and Qian Lin, HP Labs, HP Inc. (United States)
18:00 – 19:00

18:00 IMAGE-300

Automatic facial skin feature detection for everyone, *Qian Zheng[1], Ankur Purwar[2], Heng Zhao[1], Guang Liang Lim[1], Ling Li[1], Debasish Behera[2], Qian Wang[1], Min Tan[1], Rizhao Cai[1], Jennifer Werner[2], Dennis Sng[1], Maurice van Steensel[1], Weisi Lin[1], and Alex C. Kot[1]; [1]Nanyang Technological University and [2]Procter & Gamble (Singapore)*

18:20 IMAGE-288

Mix-loss trained bias-removed blind image denoising network, *Yi Yang[1], Chih-Hsien Chou[2], and Jan P. Allebach[1]; [1]Purdue University and [2]Futurewei Technologies, Inc (United States)*

18:40 N/A

Billion-scale pretrained unified visual embedding and its applications in Pinterest, *Josh Beal[1], Rex Wu[1], Seth Park[1,2], Kofi Boakye[1], Bin Shen[1], Andrew Zhai[1], and Chuck Rosenberg[1]; [1]Pinterest and [2]University of California, Berkeley (United States)*

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-their-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)