Computer Vision and Image Analysis of Art 2022

Conference Chairs
Kurt Heumiller, Museum of Modern Art (United States)
David G. Stork, consultant (United States)

PROGRAM AND PROCEEDINGS

Computer Vision and Image Analysis of Art 2022

Conference overview

This conference on computer image analysis in the study of art presents leading research in the application of image analysis, computer vision, and pattern recognition to problems of interest to art historians, curators and conservators.

A number of recent questions and controversies have highlighted the value of rigorous image analysis in the service of the analysis of art, particularly painting. Consider these examples: the fractal image analysis for the authentication of drip paintings possibly by Jackson Pollock; sophisticated perspective, shading and form analysis to address claims that early Renaissance masters such as Jan van Eyck or Baroque masters such as Georges de la Tour traced optically projected images; automatic multi-scale analysis of brushstrokes for the attribution of portraits within a painting by Perugino; and multi-spectral, x-ray and infra-red scanning and image analysis of the Mona Lisa to reveal the painting techniques of Leonardo. The value of image analysis to these and other questions strongly suggests that current and future computer methods will play an ever larger role in the scholarship of visual arts.

The conference chairs and program committee invite high-quality submissions of papers discussing new results in the following and related topics: image analysis of perspective, brush strokes, form color and multi-spectral images for attribution and dating; color modeling and manipulation for predicting the effects of conservation treatments; image de-warping to reveal undistorted images from anamorphic art or depictions of reflections in curved mirrors. This conference will focus on analysis, rather than on image acquisition or digital archiving of artistic works. A key goal of this conference is to foster dialog and collaboration between image scientists and humanists; as such, interdisciplinary teams of authors (scientists and art specialists) are especially encouraged to submit papers

Conference Chairs: **Kurt Heumiller,** Museum of Modern Art (United States), and **David G. Stork,** consultant (United States)

Program Committee: **Ahmed Elgamal,** Rutgers University (United States); **Nica Gutman Rieppi,** Art Analysis and Research, LLC (United States); **Emily L. Spratt, Columbia University** (United States); and **Christopher W. Tyler,** Smith Kettlewell Eye Institute and Columbia University (United States)

Paper authors listed as of 1 January 2022; refer to manuscript for final authors. Titles that are not listed with the proceedings files were presentation-only.

Computer Vision and Image Analysis of Art 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.

TUESDAY 18 JANUARY 2022

Computer Analysis of Fine Art
Session Chair: Kurt Heumiller, Museum of Modern Art (United States)
13:20 – 14:25

13:20
Conference Introduction

13:25   CVAA-169
Improving semantic segmentation of fine art images using photographs rendered in a style learned from artworks, *Thomas Heitzinger[1] and David G. Stork[2]; [1]TU Wien (Austria) and [2]Consultant (United States)*

13:45   CVAA-170
Extracting associations and meanings of objects depicted in artworks through bi-modal deep networks, *Gregory Kell[1], Ryan Rhys Griffiths[2], Anthony Bourached[3], and David G. Stork[4]; [1]King's College London (United Kingdom), [2]University of Cambridge (United Kingdom), [3]University College London (United Kingdom), and [4]Consultant (United States)*

14:05   CVAA-171
Improved identification of portraiture of the Julio-Claudian period with mobile apps (JIST-first), *Dmitri A. Gusev, Purdue University (United States)*

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.

Computer Vision and Image Analysis of Art 2022 Poster
11:20 – 12:20

Poster interactive session for all conferences authors and attendees.

CVAA-186

P-03: Artist-specific style transfer for semantic segmentation of paintings: The value of large corpora of surrogate artworks, *Matthias Wödlinger[1], Thomas Heitzinger[1], and David G. Stork[2]; [1]TU Wien (Austria) and [2]Consultant (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)