Computer Vision and Image Analysis of Art 2023

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

PROGRAM AND PROCEEDINGS

This document details the conference program, held as part of the 2023 IS&T International Symposium on Electronic Imaging, 15-19 January 2023. Manuscripts of conference papers are reproduced from PDFs as submitted and approved by authors; no editorial changes were made.

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Computer Vision and Image Analysis of Art 2023

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

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

Conference overview

This conference is the descendent of the world's first conference specifically devoted to the application of rigorous computer vision, image analysis, machine learning, and artificial intelligence to problems in the history and interpretation of fine art. The work will be of interest to art historians, curators, and conservators, as well as researchers in fundamental AI and computer vision.

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

Paper authors listed as of 1 January 2023; 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 2023

MONDAY 16 JANUARY 2023

Computer Vision and Image Analysis of Art 2023 (M1)
Session Chair: Kurt Heumiller, National Gallery of Art (United States)
8:45 – 10:10 AM
Mission II/III

8:45
Conference Welcome

8:50 CVAA-209
Style transfer for improved visualization of underdrawings and ghost paintings: An application to a work by Vincent van Gogh, *Anthony Bourached[1], George Cann[1], Ryan Rhys Griffiths[1], David G. Stork[2], and Jesper Eriksson[1]; [1]Oxia Palus (United Kingdom) and [2]consultant (United States)*

9:10 CVAA-210
Recovering lost artworks by deep neural networks: Motivations, methodology, and proof-of-concept simulations, *Jesper Eriksson[1], Anthony Bourached[1], George Cann[1], and David G. Stork[2]; [1]Oxia Palus (United Kingdom) and [2]consultant (United States)*

9:30 CVAA-211
Computational tracking of head pose through 500 years of fine-art portraiture, *Jean-Peic Chou[1] and David G. Stork[2]; [1]Stanford University and [2]consultant (United States)*

9:50 CVAA-212
A computer vision-aided analysis of facial similarities in Song dynasty imperial portraits, *Grace Zhong, Stanford University (United States)*

Monday 16 January PLENARY: Neural Operators for Solving PDEs
Session Chair: Robin Jenkin, NVIDIA Corporation (United States)
2:00 PM – 3:00 PM
Cyril Magnin I/II/III

Deep learning surrogate models have shown promise in modeling complex physical phenomena such as fluid flows, molecular dynamics, and material properties. However, standard neural networks assume finite-dimensional inputs and outputs, and hence, cannot withstand a change in resolution or discretization between training and testing. We introduce Fourier neural operators that can learn operators, which are mappings between infinite dimensional spaces. They are independent of the resolution or grid of training data and allow for zero-shot generalization to higher resolution evaluations. When applied to weather forecasting, neural operators capture fine-scale phenomena and have similar skill as gold-standard numerical weather models for predictions up to a week or longer, while being 4-5 orders of magnitude faster.

Anima Anandkumar, Bren professor, California Institute of Technology, and senior director of AI Research, NVIDIA Corporation (United States)

Anima Anandkumar is a Bren Professor at Caltech and Senior Director of AI Research at NVIDIA. She is passionate about designing principled AI algorithms and applying them to interdisciplinary domains. She has received several honors such as the IEEE fellowship, Alfred. P. Sloan Fellowship, NSF Career Award, and Faculty Fellowships from Microsoft, Google, Facebook, and Adobe. She is part of the World Economic Forum's Expert Network. Anandkumar received her BTech from Indian Institute of Technology Madras, her PhD from Cornell University, and did her postdoctoral research at MIT and assistant professorship at University of California Irvine.

EI 2023 Highlights Session
Session Chair: Robin Jenkin, NVIDIA Corporation (United States)
3:30 – 5:00 PM
Cyril Magnin II

Join us for a session that celebrates the breadth of what EI has to offer with short papers selected from EI conferences.

NOTE: The EI-wide "EI 2023 Highlights" session is concurrent with Monday afternoon COIMG, COLOR, IMAGE, and IQSP conference sessions.

IQSP-309
Evaluation of image quality metrics designed for DRI tasks with automotive cameras, *Valentine Klein, Yiqi LI, Claudio Greco, Laurent Chanas, and Frédéric Guichard, DXOMARK (France)*

SD&A-224
Human performance using stereo 3D in a helmet mounted display and association with individual stereo acuity, *Bonnie Posselt, RAF Centre of Aviation Medicine (United Kingdom)*

IMAGE-281
Smartphone-enabled point-of-care blood hemoglobin testing with color accuracy-assisted spectral learning, *Sang Mok Park[1], Yuhyun Ji[1], Semin Kwon[1], Andrew R. O'Brien[2], Ying Wang[2], and Young L. Kim[1]; [1]Purdue University and [2]Indiana University School of Medicine (United States)*

AVM-118
Designing scenes to quantify the performance of automotive perception systems, *Zhenyi Liu[1], Devesh Shah[2], Alireza Rahimpour[2], Joyce Farrell[1], and Brian Wandell[1]; [1]Stanford University and [2]Ford Motor Company (United States)*

VDA-403
Visualizing and monitoring the process of injection molding, *Christian A. Steinparz[1], Thomas Mitterlehner[2], Bernhard Praher[2], Klaus Straka[1,2], Holger Stitz[1,3], and Marc Streit[1,3]; [1]Johannes Kepler University, [2]Moldsonics GmbH, and [3]datavisyn GmbH (Austria)*

COIMG-155

Commissioning the James Webb Space Telescope, *Joseph M. Howard, NASA Goddard Space Flight Center (United States)*

HVEI-223

Critical flicker frequency (CFF) at high luminance levels, *Alexandre Chapiro[1], Nathan Matsuda[1], Maliha Ashraf[2], and Rafal Mantiuk[3]; [1]Meta (United States), [2]University of Liverpool (United Kingdom), and [3]University of Cambridge (United Kingdom)*

HPCI-228

Physics guided machine learning for image-based material decomposition of tissues from simulated breast models with calcifications, *Muralikrishnan Gopalakrishnan Meena[1], Amir K. Ziabari[1], Singanallur Venkatakrishnan[1], Isaac R. Lyngaas[1], Matthew R. Norman[1], Balint Joo[1], Thomas L. Beck[1], Charles A. Bouman[2], Anuj Kapadia[1], and Xiao Wang[1]; [1]Oak Ridge National Laboratory and [2]Purdue University (United States)*

3DIA-104

Layered view synthesis for general images, *Loïc Dehan, Wiebe Van Ranst, and Patrick Vandewalle, Katholieke University Leuven (Belgium)*

ISS-329

A self-powered asynchronous image sensor with independent in-pixel harvesting and sensing operations, *Ruben Gomez-Merchan, Juan Antonio Leñero-Bardallo, and Ángel Rodríguez-Vázquez, University of Seville (Spain)*

COLOR-184

Color blindness and modern board games, *Alessandro Rizzi[1] and Matteo Sassi[2]; [1]Università degli Studi di Milano and [2]consultant (Italy)*

TUESDAY 17 JANUARY 2023

Tuesday 17 January PLENARY: Embedded Gain Maps for Adaptive Display of High Dynamic Range Images
Session Chair: Robin Jenkin, NVIDIA Corporation (United States)
2:00 PM – 3:00 PM
Cyril Magnin I/II/III

Images optimized for High Dynamic Range (HDR) displays have brighter highlights and more detailed shadows, resulting in an increased sense of realism and greater impact. However, a major issue with HDR content is the lack of consistency in appearance across different devices and viewing environments. There are several reasons, including varying capabilities of HDR displays and

the different tone mapping methods implemented across software and platforms. Consequently, HDR content authors can neither control nor predict how their images will appear in other apps.

We present a flexible system that provides consistent and adaptive display of HDR images. Conceptually, the method combines both SDR and HDR renditions within a single image and interpolates between the two dynamically at display time. We compute a Gain Map that represents the difference between the two renditions. In the file, we store a Base rendition (either SDR or HDR), the Gain Map, and some associated metadata. At display time, we combine the Base image with a scaled version of the Gain Map, where the scale factor depends on the image metadata, the HDR capacity of the display, and the viewing environment.

Eric Chan, Fellow, Adobe Inc. (United States)

Eric Chan is a Fellow at Adobe, where he develops software for editing photographs. Current projects include Photoshop, Lightroom, Camera Raw, and Digital Negative (DNG). When not writing software, Chan enjoys spending time at his other keyboard, the piano. He is an enthusiastic nature photographer and often combines his photo activities with travel and hiking.

Paul M. Hubel, director of Image Quality in Software Engineering, Apple Inc. (United States)

Paul M. Hubel is director of Image Quality in Software Engineering at Apple. He has worked on computational photography and image quality of photographic systems for many years on all aspects of the imaging chain, particularly for iPhone. He trained in optical engineering at University of Rochester, Oxford University, and MIT, and has more than 50 patents on color imaging and camera technology. Hubel is active on the ISO-TC42 committee Digital Photography, where this work is under discussion, and is currently a VP on the IS&T Board. Outside work he enjoys photography, travel, cycling, coffee roasting, and plays trumpet in several bay area ensembles.

WEDNESDAY 18 JANUARY 2023

Wednesday 18 January PLENARY: Bringing Vision Science to Electronic Imaging: The Pyramid of Visibility
Session Chair: Andreas Savakis, Rochester Institute of Technology (United States)
2:00 PM – 3:00 PM
Cyril Magnin I/II/III

Electronic imaging depends fundamentally on the capabilities and limitations of human vision. The challenge for the vision scientist is to describe these limitations to the engineer in a comprehensive, computable, and elegant formulation. Primary among these limitations are visibility of variations in light intensity over space and time, of variations in color over space and time, and of all of these patterns with position in the visual field. Lastly, we must describe how all these sensitivities vary with adapting light level. We have recently developed a structural description of human visual sensitivity that we call the Pyramid of Visibility, that accomplishes this synthesis. This talk shows how this structure accommodates all the dimensions described above, and how it can be used to solve a wide variety of problems in display engineering.

Andrew B. Watson, chief vision scientist, Apple Inc. (United States)

Andrew Watson is Chief Vision Scientist at Apple, where he leads the application of vision science to technologies, applications, and displays. His research focuses on computational models of early vision. He is the author of more than 100 scientific papers and 8 patents. He has 21,180 citations and an h-index of 63. Watson founded the Journal of Vision, and served as editor-in-chief 2001-2013 and 2018-2022. Watson has received numerous awards including the Presidential Rank Award from the President of the United States.