Image Processing: Algorithms and Systems XXI

Conference Chairs
Sos S. Agaian, The City University of New York (CUNY) College of Staten Island and CUNY Graduate Center (US)
Karen O. Egiazarian, Tampere Univ. of Technology (Finland)
Atanas P. Gotchev, Tampere Univ. of Technology (Finland)

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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Image Processing: Algorithms and Systems XXI

Conference overview

Image Processing: Algorithms and Systems continues the tradition of the past conference Nonlinear Image Processing and Pattern Analysis in exploring new image processing algorithms.

Specifically, the conference aims at highlighting the importance of the interaction between transform-, model-, and learning-based approaches for creating effective algorithms and building modern imaging systems for new and emerging applications. It also reverberates the growing call for integrating theoretical research on image processing algorithms with the more applied research on image processing systems.

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.

Image Processing: Algorithms and Systems XXI

MONDAY 16 JANUARY 2023

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.

KEYNOTE: Systematic Data Labeling (W3.1)
Session Chairs: Karen Egiazarian, Tampere University (Finland) and Atanas Gotchev, Tampere University (Finland)
3:30 – 4:15 PM
Cyril Magnin III

3:30
Conference Welcome

3:35 IPAS-284
KEYNOTE: Systematic data labeling at the point of ingestion in enterprise systems, *Gevorg Karapetyan, Zero Cognitive Systems (United States)*

Gevorg Karapetyan is co-founder and Chief Technology Officer with Zero Cognitive Systems. In this role Karapetyan leads long-term technology vision and is responsible for the direction, coordination, and delivery of technology. Founded in 2015 in Los Gatos, California, Zero is dedicated to applying artificial intelligence and smart automation to the most pressing operational challenges of the professional services industry. Karapetyan previously worked at Imagenomic as a Senior Software Engineer and attended National Polytechnic University of Armenia. Karapetyan holds a PhD in Computer Science and has more than 10 years of experience in developing intelligent automation systems.

Machine Learning for Image Processing (W3.2)
Session Chairs: Karen Egiazarian, Tampere University (Finland) and Atanas Gotchev, Tampere University (Finland)
4:15 – 5:35 PM
Cyril Magnin III

4:15 IPAS-285
ORCA: An end-to-end video object removal framework with cropping interested region and quality assessment, *Minseong Son, Hansol Lee, Sungkeun Kwak, and Jihwan Woo, CJOliveNetworks (Republic of Korea)*

4:35 IPAS-286
Detection of object throwing behavior in surveillance videos, *Ivo P.C. Kersten, Erkut Akdag, Egor Bondarev, and Peter H. de With, Eindhoven University of Technology (the Netherlands)*

4:55 IPAS-287
Hybrid diffractive optics (DOE & refractive lens) for broadband EDoF imaging, *SeyyedReza MiriRostami, Samuel Pinilla, Igor Shevkunov, Vladimir Katkovnik, and Karen Egiazarian, Tampere University (Finland)*

5:15 IPAS-288
Evaluating active learning for blind imbalanced domains, *Hiroshi Kuwajima[1], Masayuki Tanaka[2], and Masatoshi Okutomi[2]; [1]DENSO Corporation and [2]Tokyo Institute of Technology (Japan)*

Image Processing: Algorithms and Systems XXI Interactive (Poster) Paper Session (W4)
5:35 – 7:00 PM
Cyril Magnin Foyer

The following work will be presented at the EI 2023 Symposium Interactive (Poster) Paper Session.

IPAS-290
MLExchange: An integrated platform for scientific machine learning, *Guanhua Hao[1], Tanny Chavez[1], Zhuowen Zhao[1], Elizabeth Holman[1], Eric Roberts[1], Howard Yanxon[2], Adam Green[1], Harinarayan Krishnan[1], Dylan McReynolds[1], Nicholas Schwarz[2], Petrus Zwart[1], Alexander Hexemer[1], and Dilworth Parkinson[1]; [1]Lawrence Berkeley National Laboratory and [2]Argonne National Laboratory (United States)*

THURSDAY 19 JANUARY 2023

Face and Facial Image Processing (R1)
Session Chairs: Karen Egiazarian, Tampere University (Finland) and Atanas Gotchev, Tampere University (Finland)
8:50 – 9:50 AM
Cyril Magnin III

8:50 IPAS-291
Facial expression recognition using visual transformer with histogram of oriented gradients, *Jieun Kim, Ju o Kim, Seungwan Je, and Deokwoo Lee, Keimyung University (Republic of Korea)*

9:10 IPAS-292
Face expressions understanding by geometrical characterization of deep human faces representation, *Adrien Raison, Theo Biardeau, Pascal Bourdon, and David Helbert, University de Poitiers (France)*

9:30 IPAS-293
Crowd counting using deep learning based head detection, *Maryam Hassan[1], Farhan Hussain[1], Sultan D. Khan[2], Mohib Ullah[3], Mudassar Yamin[3], and Habib Ullah[4]; [1]NUST College of Electrical & Mechanical Engineering (Norway), [2]National University of Technology (Pakistan), [3]Norwegian University of Science and Technology (Norway), and [4]Norwegian University of Life Sciences (NMBU) (Norway)*

KEYNOTE: Vulnerability of Neural Networks (R2.1)
Session Chairs: Karen Egiazarian, Tampere University (Finland) and Atanas Gotchev, Tampere University (Finland)
10:50 – 11:30 AM
Cyril Magnin III

IPAS-294
KEYNOTE: Surprising vulnerability of neural networks: Recovering training and input data in federated learning and split computing, *Pavlo Molchanov, NVIDIA Corporation (United States)*

Pavlo Molchanov obtained his PhD (2014) from Tampere University of Technology, Finland, in the area of signal processing. His dissertation focused on designing automatic target recognition systems for radars. Since 2015 he has been with the Learning and Perception Research team at NVIDIA, currently holding a senior research scientist position. His research is focused on methods for neural network acceleration, and designing novel human-computer interaction systems and human understanding. On network acceleration, he is interested in neural network pruning methods and conditional inference. For human understanding he is working on landmark estimation, gesture recognition, hand pose estimation.

Segmentation, Classification, and Tracking (R2.2)

Session Chairs: Karen Egiazarian, Tampere University (Finland) and Atanas Gotchev, Tampere University (Finland)
11:30 AM – 12:30 PM
Cyril Magnin III

11:30 IPAS-295
Exploring effects of colour and image quality in semantic segmentation (JIST-first), *Kanjar De, Luleå University of Technology (Sweden)*

11:50 IPAS-296
ILIAC: Efficient classification of degraded images using knowledge distillation with cutout data augmentation, *Dinesh Daultani[1], Masayuki Tanaka[1], Masatoshi Okutomi[1], and Kazuki Endo[2]; [1]Tokyo Institute of Technology and [2]Teikyo Heisei University (Japan)*

12:10 IPAS-297
AInBody: Are you in shape? - An integrated deep learning model that tracks your body measurement, *Nakyung Lee, Youngsun Cho, Minseong Son, Sungkeun Kwak, and Jihwan Woo, CJ OliveNetworks (Republic of Korea)*

Biomedical Image Processing (R3)

Session Chairs: Karen Egiazarian, Tampere University (Finland) and Atanas Gotchev, Tampere University (Finland)
2:00 – 3:00 PM
Cyril Magnin III

2:00 IPAS-298
Deep learning based speech emotion recognition for Parkinson patient, *Habib Khan[1], Mohib Ullah[2], Fadi Al-Machot[3], Faouzi Alaya Cheikh[2], and Muhammad Sajjad[2]; [1]Islamia College University Peshawar (Pakistan), [2]Norwegian University of Science and Technology (Norway), and [3]Norwegian University of Life Sciences (Norway)*

2:20 IPAS-299
Blind denoising of dental X-ray images, *Mykola Ponomarenko[1], Oleksandr Miroshnichenko[2], Vladimir Lukin[2], Sergey Krivenko[2], and Karen Egiazarian[1]; [1]Tampere University (Finland) and [2]National Aerospace University (Ukraine)*

2:40 IPAS-300
Automatic estimation of mucosal waves lateral peak sharpness – Modern approach, *Ales Zita[1], Simon Gresko[1], Adam Novozamsky[1], Michal Sorel[1], Barbara Zitova[1], Jan Svec[2], and Jitka Vydrova[3]; [1]Institute of Information Theory and Automation, [2]Palacky University, and [3]Voice Centre Prague, Medical Healthcom, Ltd (Czechia)*