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Autonomous Vehicles and Machines 2023

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Autonomous Vehicles and Machines 2023

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.

N/A

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)

N/A
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)*

N/A
Smartphone-enabled point-of-care blood hemoglobin testing with color accuracy-assisted spectral learning, *Sang Mok Park¹, Yuhyun Ji¹, Semin Kwon¹, Andrew R. O'Brien², Ying Wang², and Young L. Kim¹; ¹Purdue University and ²Indiana University School of Medicine (United States)*

N/A
Designing scenes to quantify the performance of automotive perception systems, *Zhenyi Liu¹, Devesh Shah², Alireza Rahimpour², Joyce Farrell¹, and Brian Wandell¹; ¹Stanford University and ²Ford Motor Company (United States)*

N/A
Visualizing and monitoring the process of injection molding, *Christian A. Steinparz¹, Thomas Mitterlehner², Bernhard Praher², Klaus Straka^{1,2}, Holger Stitz^{1,3}, and Marc Streit^{1,3}; ¹Johannes Kepler University, ²Moldsonics GmbH, and ³datavisyn GmbH (Austria)*

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

N/A
Critical flicker frequency (CFF) at high luminance levels, *Alexandre Chapiro¹, Nathan Matsuda¹, Maliha Ashraf², and Rafal Mantiuk³; ¹Meta (United States), ²University of Liverpool (United Kingdom), and ³University of Cambridge (United Kingdom)*

N/A
Physics guided machine learning for image-based material decomposition of tissues from simulated breast models with calcifications, *Muralikrishnan Gopalakrishnan Meena¹, Amir K. Ziabari¹, Singanallur Venkatakrishnan¹, Isaac R. Lyngaas¹, Matthew R. Norman¹, Balint Joo¹, Thomas L. Beck¹, Charles A. Bouman², Anuj Kapadia¹, and Xiao Wang¹; ¹Oak Ridge National Laboratory and ²Purdue University (United States)*

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

N/A

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)*

N/A

Color blindness and modern board games, *Alessandro Rizzi¹ and Matteo Sassi²; ¹Università degli Studi di Milano and ²consultant (Italy)*

TUESDAY 17 JANUARY 2023

Sensors (T1)

Session Chair: Brian Deegan, National University of Ireland, Galway (Ireland)

9:05 – 9:50 AM

Cyril Magnin I

9:05

Conference Welcome

9:30

AVM-122

How much depth information can radar contribute to a depth estimation model?, *Chen-Chou Lo and Patrick Vandewalle, Katholieke University Leuven (Belgium)*

Camera Performance Evaluation (T2)

Session Chair: Patrick Denny, University of Limerick (Ireland)

10:40 AM – 12:40 PM

Cyril Magnin I

10:40

N/A

Update on progress of IEEE P2020 Automotive Image Quality Working Group, *The IEEE P2020 Working Group¹, Uwe Artmann², and Darryl Perks³; ¹IEEE Standards Association - P2020 Automotive Image Quality Working Group (United States), ²presenter (Image Engineering GmbH & Co KG) (Germany), and ³presenter (onsemi) (United Kingdom)*

11:00

N/A

An investigation into the impact of image compression on image quality prior to image signal processing, *Jordan Cahill¹, Brian Deegan², Patrick Denny³, Enda Ward⁴, Martin Glavin¹, and Edward Jones¹; ¹University of Galway, ²National University of Ireland, Galway, ³University of Limerick, and ⁴Valeo Vision Systems (Ireland)*

11:20

N/A

Modulation-transfer function as performance indicator for AI algorithms?, *Patrick Müller¹ and Alexander Braun²; ¹Hochschule Düsseldorf, University of Applied Sciences Düsseldorf and ²Düsseldorf University of Applied Sciences (Germany)*

11:40

N/A

The influence of image capture and processing on MTF for end of line test and validation, *Brian Deegan, Martin Glavin, and Edward Jones, University of Galway (Ireland)*

12:00

N/A

Comprehensive stray light (flare) testing: Lessons learned, Jackson S. Knappen, Imatest LLC (United States)

12:20

N/A

Optical flow for autonomous driving: applications, challenges and improvements, Shihao Shen¹, Louis Kerofsky², and Senthil Yogamani³; ¹Carnegie Mellon University (United States), ²Qualcomm Technologies Inc. (United States), and ³QT Technologies Ireland Limited (Ireland)

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

End-to-end Systems (W2)

Session Chair: Patrick Denny, University of Limerick (Ireland)

11:10 AM – 12:30 PM

Cyril Magnin I

11:10

AVM-110

tRANSAC: Dynamic feature accumulation across time for stable online RANSAC model estimation in automotive applications, Shimiao Li¹, Yang Song², Ruijiang Luo¹, Zhongyang Huang¹, and Chengming Liu¹; ¹OmniVision Technologies (Singapore) and ²OmniVision Technologies Inc. (United States)

11:30

AVM-111

End-to-end evaluation of practical video analytics systems for face detection and recognition, Praneet Singh, Edward J. Delp, and Amy R. Reibman, Purdue University (United States)

11:50

AVM-112

Orchestration of co-operative and adaptive multi-core deep learning engines, Mihir Mody¹, Kumar Desappan¹, Pramod Swami¹, David Smith¹, Shyam Jagannathan¹, Kevin Lavery¹, Gregory Shultz¹, Jason Jones¹, and Jesse Villarreal²; ¹Texas Instruments India Ltd (India) and ²Texas Instruments (United States)

12:10

AVM-113

optIFlow – An optimized end-to-end dataflow for accelerating deep learning workloads on heterogeneous SoCs, Shyam Jagannathan¹, Vijay Pothukuchi², Jesse Villarreal², Kumar Desappan¹, Manu Mathew¹, Rahul Ravikumar¹, Aniket Limaye¹, Mihir Mody¹, Pramod Swami¹, Piyali Goswami^{1,3}, Carlos Rodriguez³, Emmanuel Madrigal³, and Marco Herrera³; ¹Texas Instruments India Ltd (India), ²Texas Instruments (United States), and ³RidgeRun (United States)

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.

Simulation Methods (W3)

Session Chair: Alexander Braun, Düsseldorf University of Applied Sciences (Germany)

3:30 – 5:10 PM

Cyril Magnin I

3:30

N/A

Simulation standards and their impact on the quantification of simulation quality, *Marius Dupuis, ASAM e.V. (Germany)*

3:50

AVM-116

Design and validation of a rain model for a realistic automotive simulation environment, *Tim Brophy¹, Brian Deegan¹, Martin Glavin¹, Javier Salado², Ángel Tena², Patrick Denny³, Enda Ward⁴, Jonathan Horgan⁴, and Edward Jones¹; ¹University of Galway (Ireland), ²Anyverse (Spain), ³University of Limerick (Ireland), and ⁴Valeo (Ireland)*

4:10

AVM-117

Simulating motion blur and exposure time and evaluating its effect on image quality and object detection performance., *Hao Lin, University of Galway (Ireland)*

4:30

AVM-118

Designing scenes to quantify the performance of automotive perception systems, *Zhenyi Liu¹, Devesh Shah², Alireza Rahimpour², Joyce Farrell¹, and Brian Wandell¹; ¹Stanford University and ²Ford Motor Company (United States)*

4:50

AVM-119

Design of an automotive platform for computer vision research, *Dominik Schörkhuber¹, Roman Popp², Oleksandr Chistov³, Fabian Windbacher⁴, Michael Hödlmoser⁴, and Margrit Gelautz¹; ¹Vienna University of Technology, ²ZKW Lichtsysteme, ³ZKW Group GmbH, and ⁴emotion3d (Austria) [[view abstract](#)]*