

PROCEEDINGS OF SPIE

AI and Optical Data Sciences IV

Bahram Jalali
Ken-ichi Kitayama
Editors

30 January – 2 February 2023
San Francisco, California, United States

Sponsored and Published by
SPIE

Volume 12438

Proceedings of SPIE 0277-786X, V. 12438

SPIE is an international society advancing an interdisciplinary approach to the science and application of light.

AI and Optical Data Sciences IV, edited by Bahram Jalali, Ken-ichi Kitayama,
Proc. of SPIE Vol. 12438, 1243801 · © 2023 SPIE
0277-786X · doi: 10.1117/12.2675528

Proc. of SPIE Vol. 12438 1243801-1

The papers in this volume were part of the technical conference cited on the cover and title page. Papers were selected and subject to review by the editors and conference program committee. Some conference presentations may not be available for publication. Additional papers and presentation recordings may be available online in the SPIE Digital Library at SPIDigitalLibrary.org.

The papers reflect the work and thoughts of the authors and are published herein as submitted. The publisher is not responsible for the validity of the information or for any outcomes resulting from reliance thereon.

Please use the following format to cite material from these proceedings:

Author(s), "Title of Paper," in *AI and Optical Data Sciences IV*, edited by Bahram Jalali, Ken-ichi Kitayama, Proc. of SPIE 12438, Seven-digit Article CID Number (DD/MM/YYYY); (DOI URL).

ISSN: 0277-786X
ISSN: 1996-756X (electronic)

ISBN: 9781510659810
ISBN: 9781510659827 (electronic)

Published by

SPIE

P.O. Box 10, Bellingham, Washington 98227-0010 USA

Telephone +1 360 676 3290 (Pacific Time)

SPIE.org

Copyright © 2023 Society of Photo-Optical Instrumentation Engineers (SPIE).

Copying of material in this book for internal or personal use, or for the internal or personal use of specific clients, beyond the fair use provisions granted by the U.S. Copyright Law is authorized by SPIE subject to payment of fees. To obtain permission to use and share articles in this volume, visit Copyright Clearance Center at copyright.com. Other copying for republication, resale, advertising or promotion, or any form of systematic or multiple reproduction of any material in this book is prohibited except with permission in writing from the publisher.

Printed in the United States of America by Curran Associates, Inc., under license from SPIE.

Publication of record for individual papers is online in the SPIE Digital Library.

**SPIE. DIGITAL
LIBRARY**

SPIDigitalLibrary.org

Paper Numbering: A unique citation identifier (CID) number is assigned to each article in the Proceedings of SPIE at the time of publication. Utilization of CIDs allows articles to be fully citable as soon as they are published online, and connects the same identifier to all online and print versions of the publication. SPIE uses a seven-digit CID article numbering system structured as follows:

- The first five digits correspond to the SPIE volume number.
- The last two digits indicate publication order within the volume using a Base 36 numbering system employing both numerals and letters. These two-number sets start with 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B ... 0Z, followed by 10-1Z, 20-2Z, etc. The CID Number appears on each page of the manuscript.

Contents

vii *Conference Committee*

COMPUTATIONAL IMAGING/ONN: JOINT SESSION WITH CONFERENCES 12435 AND 12438

- 12438 02 **Multiplexing methods for scaling up photonic logic (Invited Paper)** [12438-2]
12438 03 **Michelson interferometric methods for full optical complex convolution** [12438-3]

PHOTONIC HARDWARE ACCELERATORS I

- 12438 04 **Ultrahigh bandwidth applications of optical microcombs (Invited Paper)** [12438-7]
12438 05 **Energy-efficient on-chip learning for a fully connected neural network using domain wall device** [12438-12]

REALTIME INFERENCE

- 12438 06 **Exploring the potential of high-speed 2D and 3D materials in silicon photonics** [12438-14]
12438 07 **Training on the optical system: local search method** [12438-15]
12438 08 **Metasurface optics enabled computational sensing (Invited Paper)** [12438-16]
12438 09 **Coherent VCSEL homodyne neural networks (Artificial Intelligence and Machine Learning Best Paper Award in OPTO)** [12438-18]

ANALOG OPTICAL COMPUTING

- 12438 0A **Deep optics: learning cameras and optical computing systems (Invited Paper)** [12438-23]
12438 0B **Parallel and deep reservoir computing based on frequency multiplexing** [12438-25]

PHOTONIC HARDWARE ACCELERATORS II

12438 OC **Integrated optical output layer for a reservoir computer based on frequency multiplexing** [12438-26]

12438 OD **Photonic tensor core machine learning accelerator** [12438-30]

INVERSE DESIGN

12438 OE **Machine learning for design optimizations and prediction of optical chip performance (Invited Paper)** [12438-34]

12438 OF **Decentralized power grid control scheme utilizing photonic sensing and computing** [12438-35]

PHYSICS-AI SYMBIOSIS I

12438 OG **Circuits that train themselves: decentralized, physics-driven learning (Invited Paper)** [12438-38]

MACHINE LEARNING FOR OPTICAL SENSING AND METROLOGY

12438 OH **Optical ranging and localization at beyond the coherence length of lasers (Invited Paper)** [12438-41]

12438 OI **Deep learning super resolution for high-speed excitation emission matrix measurements** [12438-42]

12438 OJ **Depth video super-resolution using a high-speed time-of-flight sensor** [12438-43]

12438 OK **Low-power actuators for programmable photonic processors (Invited Paper)** [12438-44]

12438 OL **Infrared image-based remote target detection for maritime rescue utilizing a deep learning network and data augmentation** [12438-45]

IMAGING AND SPECTROSCOPY

12438 OM **Design and analysis of high-performance real-time image dehazing using convolutional neural and generative adversarial networks** [12438-48]

12438 ON **Path-integrated concentration and multi-gas detection in FTIR spectroscopy with deep learning methods** [12438-49]

- 12438 OO **Understanding the learning mechanism of convolutional neural networks applied to fluorescence spectra** [12438-50]
- 12438 OP **Camera calibration as machine learning problem using dense phase shifting pattern, checkerboards, and different cameras** [12438-51]
- 12438 OQ **Column IV sensors for 2D and 3D infrared imaging (Invited Paper)** [12438-52]
- 12438 OR **Identifying the advantageous latent space dimensionality for StyleGANs used in industrial machine vision applications** [12438-54]
- 12438 OS **AI-based analysis of extremely low-resolved spectrogram fingerprints for the calculation of surface profiles in low-coherence interferometry** [12438-56]

OPTICAL DATA SCIENCES I

- 12438 OT **Simultaneous license plate recognition and face detection application at the edge** [12438-58]
- 12438 OU **Data assimilation-based internal structure modeling for waveguide devices (Invited Paper)** [12438-60]
- 12438 OV **Intelligent multispectral vision system for contactless water quality monitoring for wastewater** [12438-61]
- 12438 OW **High-performance optoelectronics for integrated photonic neural networks (Invited Paper)** [12438-62]

OPTICAL DATA SCIENCES II

- 12438 OX **Integrated optical phased arrays: augmented reality, LiDAR, and beyond (Invited Paper)** [12438-64]
- 12438 OY **SeidelNet: an aberration-informed deep learning model for spatially varying deblurring** [12438-65]
- 12438 OZ **Hardware-efficient, large-scale reconfigurable optical neural network (ONN) with backpropagation** [12438-8]
- 12438 10 **Speckle-based optical cryptosystem for face recognition** [12438-68]
- 12438 11 **Global phase insensitive loss function for deep learning in holographic imaging and projection applications** [12438-69]
- 12438 12 **LSTM-based autoencoder for the inverse design of achromatic metalenses** [12438-70]

PHYSICS-AI SYMBIOSIS II

12438 13 **Towards imaging through side-scattering in a multi-mode optical fiber** [12438-73]

POSTER SESSION

12438 14 **Direct face pose estimation using multiple camera views and deep learning** [12438-53]

12438 15 **Image reconstruction for the artificial compound eye based on deep learning** [12438-78]

12438 16 **Automatic 2D material detection in optical images using deep-learning-based computer vision** [12438-80]

DIGITAL POSTER SESSION

12438 17 **Interpolated template subtraction method for stimulation artifact removal** [12438-81]

12438 18 **Deep deconvolution of object information transformed by a lens** [12438-66]

Conference Committee

Symposium Chairs

Sonia M. García-Blanco, Universiteit Twente (Netherlands)
Bernd Witzigmann, Friedrich-Alexander-Universität Erlangen-Nürnberg
(Germany)

Symposium Co-chairs

Ulrich T. Schwarz, Technische Universität Chemnitz (Germany)
Karin Hinzer, University of Ottawa (Canada)

Program Track Chair

David L. Andrews, University of East Anglia (United Kingdom)

Conference Chairs

Bahram Jalali, UCLA Samueli School of Engineering (United States)
Ken-ichi Kitayama, National Institute of Information and
Communications Technology (Japan) and Hamamatsu Photonics
(Japan)

Conference Program Committee

Christopher Barsi, BRELYON, Inc. (United States)
Goëry Genty, Tampere University (Finland)
Don Lahiru Nirmal M. Hettiarachchi, University of Dayton
(United States)
Ryoichi Horisaki, The University of Tokyo (Japan)
Yunshan Jiang, Waymo, LLC (United States)
Koichiro Kishima, Pinpoint Photonics, Inc. (Japan)
Cejo K. Lonappan, UCLA Samueli School of Engineering
(United States)
Arka Majumdar, University of Washington (United States)
Peter L. McMahon, Cornell University (United States)
Masaya Notomi, NTT Basic Research Laboratories (Japan)
Aydogan Ozcan, UCLA Samueli School of Engineering (United States)
Natan T. Shaked, Tel Aviv University (Israel)
Volker J. Sorger, The George Washington University (United States)
Madhuri Suthar, UCLA Samueli School of Engineering (United States)
Haruyoshi Toyoda, Hamamatsu Photonics K.K. (Japan)
George C. Valley, The Aerospace Corporation (United States)
Tingyi Zhou, UCLA Samueli School of Engineering (United States)

