## PROCEEDINGS OF SPIE

# AI and Optical Data Sciences VI

Masaya Notomi Tingyi Zhou Editors

27–31 January 2025 San Francisco, California, United States

Sponsored and Published by SPIE

Volume 13375

Proceedings of SPIE 0277-786X, V. 13375

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

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 SPIEDigitalLibrary.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 VI*, edited by Masaya Notomi, Tingyi Zhou, Proc. of SPIE 13375, Seven-digit Article CID Number (DD/MM/YYYY); (DOI URL).

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

ISBN: 9781510684980 ISBN: 9781510684997 (electronic)

Published by **SPIE** P.O. Box 10, Bellingham, Washington 98227-0010 USA Telephone +1 360 676 3290 (Pacific Time) SPIE.org Copyright © 2025 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.



**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 I**

13375 02	Differentiable imaging: bridging physics and computing (Invited Paper) [13375-1]
13375 03	Waveguide-integrated eye tracking system [13375-3]
13375 04	Adjoint multiple scattering for differentiable 3D holographic imaging (Invited Paper) [13375-4]
13375 05	LiGO: LLM-enhanced iterative graphic optimization for large field-of-view underwater 3D reconstruction [13375-6]
	COMPUTATIONAL IMAGING II
13375 06	Deep-learning-enabled imaging of abdominal organs through multimode fibers [13375-11]
13375 07	Enhancing computer vision with a hyperspectral video imager using coded aperture technology [13375-10]
	PHOTONIC RESERVOIR COMPUTING
13375 08	Optical next generation reservoir computing with complex media (Invited Paper) [13375-13]
13375 09	Comparison of digital, photonic, and memristor-based reservoir computing [13375-14]
13375 0A	Reservoir computer using a photorefractive nonlinear medium [13375-16]
13375 OB	Leveraging nonlinear dynamics in silicon microring resonator arrays for image classification via reservoir computing [13375-17]
	NOVEL PIC AND DEVICE TECHNOLOGIES FOR OPTICAL NN I

13375 OC Engineering photonics for efficient and scalable machine learning systems (Invited Paper) [13375-20]

- 13375 0D Heterogeneous integration of nonvolatile phase-change photonics (Invited Paper) [13375-22]
- 13375 OE Quantum tomography and intracavity dynamics with a biased optical parametric oscillator (Invited Paper) [13375-23]

#### NOVEL PIC AND DEVICE TECHNOLOGIES FOR OPTICAL NN II

13375 0F Comprehensive thermal crosstalk model of meshed MZI topologies for neuromorphic computing [13375-29]

#### PHOTONIC HARDWARE ACCELERATOR I

13375 0G Hyperspectral compute-in-memory architecture and key optical components [13375-32]

#### PHOTONIC HARDWARE ACCELERATOR II

- 13375 OH Fully non-linear neuromorphic computing with linear wave scattering (Invited Paper) [13375-36]
- 13375 01 Spatiotemporal chaos-based photonic neural networks [13375-37]

#### PHOTONIC COMPUTING ON PIC I

- 13375 0J Towards ultra-efficient photonic computer system from a computer architecture perspective (Invited Paper) [13375-40]
- 13375 0K Mitigation of distortions in fiber-optic communication systems using optical-neuralnetwork-based equalizer [13375-41]

#### PHOTONIC COMPUTING ON PIC II

- 13375 0M Enhancement of data reuploading for photonic neural computing without nonlinear optical components [13375-44]
- 13375 0N Stochastic computing with biased optical parametric oscillators (Invited Paper, AI/ML Best Paper Award in OPTO) [13375-45]
- 13375 00 Reconfigurable time-wavelength integrated convolutional accelerator [13375-47]

#### **INVERSE DESIGN FOR PHOTONICS I**

- 13375 OP Al-based model for reducing the computational effort for optical meta-surfaces [13375-63]
- 13375 0Q Applications of machine learning to fiber laser optimization (Invited Paper) [13375-64]

#### **INVERSE DESIGN FOR PHOTONICS II**

- 13375 05 Fiber-optic link tomography enabled by optics-informed machine learning (Invited Paper) [13375-68]
- 13375 0T Exploration of observation space extensions for reinforcement learning in automated optics design [13375-72]

#### NOVEL AI TECHNOLOGIES WITH PHOTONICS II

13375 0U Innovative integration of visible light communication and artificial intelligence to enhance urban traffic management [13375-80]

#### POSTER SESSION

13375 OV	A large-field-of-view singlet camera with curved image sensor and deblurring model [13375-83]
13375 OW	Optical content-addressable memories for tree-based machine learning [13375-85]
13375 OX	PCM-based silicon photonic neural networks under fabrication nonuniformity [13375-86]
13375 OY	Multi-class object detection by an optical neural network implementation [13375-87]
13375 OZ	Advancements in precision optics polishing through AI-driven predictive models [13375-88]
13375 10	Unpaired virtual histological staining of tissue from autofluorescence using regularized cycle-consistent adversarial networks [13375-91]
13375 11	Single-pixel imaging with optical phase arrays: a machine-learning-assisted approach [13375-94]
13375 12	Research on improving the teaching effectiveness of LED courses [13375-95]
13375 13	Physics-informed neural networks for etaloning correction in Raman spectra using inverse modeling [13375-96]