

PROCEEDINGS OF SPIE

Emerging Topics in Artificial Intelligence (ETAI) 2025

**Giovanni Volpe
Joana B. Pereira
Daniel Brunner
Aydogan Ozcan**
Editors

**3–7 August 2025
San Diego, California, United States**

Sponsored and Published by
SPIE

Volume 13585

Proceedings of SPIE 0277-786X, V. 13585

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 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 *Emerging Topics in Artificial Intelligence (ETAI) 2025*, edited by Giovanni Volpe, Joana B. Pereira, Daniel Brunner, Aydogan Ozcan, Proc. of SPIE 13585, Seven-digit Article CID Number (DD/MM/YYYY); (DOI URL).

ISSN: 0277-786X

ISSN: 1996-756X (electronic)

ISBN: 9781510690783

ISBN: 9781510690790 (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.

**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*

PHOTONIC AND NEUROMORPHIC COMPUTING III

- 13585 02 **Super-resolution focusing spots generation using diffractive neural networks** [13585-10]
- 13585 03 **3D two-photon nanolithography for fibre-integrated optical diffractive neural networks** [13585-12]

PHOTONIC AND NEUROMORPHIC COMPUTING IV

- 13585 04 **Tackling hard optimization problems with opto-electronic Ising machines (Invited Paper)** [13585-14]
- 13585 05 **Quantum reservoir computing with nonlinear optics: experimental continuous variable memory control (Invited Paper, Best Presentation Award)** [13585-15]

OPTICAL TRAPPING AND AI: JOINT SESSION WITH CONFERENCES 13580 AND 13585

- 13585 06 **Structure and dynamics of biomolecular condensates revealed by deep-learning-enhanced interferometric microscopy** [13585-29]

BIOMEDICAL APPLICATIONS I

- 13585 07 **Graph neural networks and cortical column modeling for AI-based brain age prediction in Alzheimer's disease risk (Invited Paper)** [13585-30]
- 13585 08 **Utilizing ocular imaging data and deep learning to diagnose open angle glaucoma and diabetic retinopathy** [13585-34]

BIOMEDICAL APPLICATIONS III

- 13585 09 **Mueller matrix polarimetry for automated assessment of dewaxed pancreatic tissue using deep learning** [13585-40]
- 13585 0A **Quantitative analysis of dynamic biofilm structures via time-resolved droplet microfluidics and artificial intelligence** [13585-43]

**PANEL DISCUSSION: LARGE-SCALE ARTIFICIAL INTELLIGENCE DEPLOYMENT AND EVALUATION
IN CLINICAL PRACTICE**

- 13585 0B **Multimodal graph attention networks for predicting brain age and stratifying Alzheimer's disease risk in clinical populations (Invited Paper)** [13585-82]

BIOMEDICAL APPLICATIONS IV

- 13585 0C **Uncertainty quantification and out-of-distribution detection in skin and breast lesion diagnostics using conformal prediction** [13585-45]
- 13585 0D **Masked autoencoders for early neurological outcome prediction in post-cardiac arrest patients using brain CT scan** [13585-48]

PHYSICS-INFORMED AND INTERPRETABLE AI I

- 13585 0E **Exploiting feature-rich image locations for adversarial attacks on image classifiers without network access** [13585-55]
- 13585 0F **A spherical manifold learning technique to enhance machine learning and explainable artificial intelligence systems** [13585-56]
- 13585 0G **Using confounders to model uncertainty in occluded scenarios** [13585-58]
- 13585 0H **Digital design of mode decomposition systems for multimode fibers using physics-informed neural network** [13585-59]

PHYSICS-INFORMED AND INTERPRETABLE AI II

- 13585 0I **Generalized training for neural network learnability: a spectral methods approach** [13585-66]
- 13585 0J **Datasets validation: should we trust publicly available datasets for research?** [13585-67]

POSTER SESSION

- 13585 0K **Medical-informed foundation model for GBM segmentation** [13585-68]

DIGITAL POSTER SESSION

- 13585 OL **Optimizing silicon slot waveguide design through parametric optimization** [13585-65]
- 13585 OM **Universal memory, construing, thinking, and intelligence pathways: the inertial reference system for direct and inverse universal thinking and learning framework mechanisms as self-embedded processes** [13585-75]