Tensorized Optical Neural Network Architecture

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ABSTRACT

Researchers at the University of California, Davis have developed a large-scale, energy-efficient, high-throughput, and compact tensorized optical neural network (TONN) exploiting the tensor-train decomposition architecture on an integrated III–V-on-silicon metal–oxide–semiconductor capacitor (MOSCAP) platform.

FULL DESCRIPTION

The technology provides a solution of using a TONN architecture to address and mitigate challenges of optical neural networks. The TONN architecture is scalable to 1024×1024 synapses and beyond, which is extremely difficult for conventional integrated ONN architectures, by using cascaded multi-wavelength small-radix (e.g., 8 × 8) tensor cores.

APPLICATIONS

- Computer vision
- Speech recognition
- Machine translations
- Medical diagnoses
- Advanced gaming
- Large-volume and cost-effective EPIC manufacturing

FEATURES/BENEFITS

- Scalable synapses
- Utilizes fewer Mach–Zehnder interferometers (MZIs) and fewer cascaded stages of MZIs than conventional ONNs
- Maintains a training accuracy for Modified National Institute of Standards and Technology handwritten digit classification tasks
- Reduces the footprint-energy compared with digital electronics ANN hardware
- Steps ahead compared with silicon photonic and phase-change material technologies
- Overcomes the limited scalability of conventional ONNs
- Reduces the dependency on the type of task, unlike CNNs
- Does away with the need for alignment of III–V diode laser chips to Silicon Photonics chips, thereby eliminating related losses and packaging complexity

PATENT STATUS

Patent Pending

CONTACT

Michael M. Mueller
mmmueller@ucdavis.edu
tel: .

INVENTORS

- Xiao, Xian
- Yoo, S.J. Ben

OTHER INFORMATION

KEYWORDS

neural networks, optical computing, photonic neural networks, tensor core decomposition

CATEGORIZED AS

- **Optics and Photonics**
  - All Optics and Photonics
- **Communications**
  - Optical
- **Computer**
  - Hardware
- **Imaging**
  - Medical
- **Semiconductors**
  - Design and Fabrication
- **Sensors & Instrumentation**
  - Scientific/Research

RELATED CASES

2023-531-0

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Higher-Speed and More Energy-Efficient Signal Processing Platform for Neural Networks
- Crystal Orientation Optimized Optical Frequency Shifter
- Hyperspectral Compressive Imaging
- Multi-Wavelength, Nanophotonic, Neural Computing System
- Athermal Nanophotonic Lasers
- Ultra-High Resolution Multi-Platform Heterodyne Optical Imaging
- Multi-Wavelength, Laser Array
- Optical Interposers for Embedded Photonics Integration
- Ultrahigh-Bandwidth Low-Latency Reconfigurable Memory Interconnects by Wavelength Routing
- Development of a CMOS-Compatible, Nano-photonic, Laser
- Energy Efficient and Scalable Reconfigurable All-to-All Switching Architecture
- Compressive High-Speed Optical Transceiver
- All-Optical Regenerators
- Silicon Based Chirped Grating Emitter for Uniform Power Emission
- Energy-Efficient All-Optical Nanophotonic Computing
- 3D Photonic and Electronic Neuromorphic Artificial Intelligence

University of California, Davis
Technology Transfer Office
1850 Research Park Drive, Suite 100, ,
Davis,CA 95618

Tel: 530.754.8649
techtransfer@ucdavis.edu
https://research.ucdavis.edu/technology-transfer/
Fax: 530.754.7620