# 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

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## INVENTORS

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## 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
- Adapting Existing Computer Networks to a Quantum-Based Internet Future

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