A-10-05 (Invited)
Extended Abstracts of the 2022 International Conference on Solid State Devices and Materials, Makuhari, 2022, pp69-70

Analog Photonic Computing for Deep Neural Network Applications

Nikos Pleros, George Giamougiannis, Apostolos Tsakyridis, Miltiadis Moralis-Pegios

Aristotle University of Thessaloniki
Center for Interdisciplinary Research and Innovation
54124, Thessaloniki, Greece
E-mail: npleros@csd.auth.gr

Abstract

Reprogrammable optical meshes comprise a subject of heightened interest for the execution of linear transformations, having a significant impact in numerous applications that extend from the implementation of optical switches up to neuromorphic computing. Herein, we review the state-of-the-art approaches for the realization of unitary transformations and universal linear operators in the photonic domain and present our recent work in the field, introducing and validating a new interferometric architecture that allows for fidelity restorable and low loss optical circuitry with single-step programmability. These advantages unlock a new framework for matrix-vector multiplications required by neuromorphic silicon photonic circuits, supporting i) high speed and high accuracy neural network (NN) inference, ii) high-speed tiled matrix multiplication, and iii) programmable photonic NNs. This new potential is initially validated through recent experimental results using SiGe EAM technology and static weights and, subsequently, utilized for demonstrating experimentally the first Deep NN (DNN) where optical tiled matrix multiplication up to 50GHz is realized, allowing optics to execute DNNs with large number of trainable parameters over a limited photonic hardware. Finally, the new performance framework is benchmarked against state of the-art NN processors and photonic NN roadmap projections, highlighting its perspectives to turn the energy and area efficiency promise of neuromorphic silicon photonics into a tangible reality.