MAX PLANCK INSTITUTE
OF MICROSTRUCTURE PHYSICS

FIROOZ AFLATOUNI
DEPT. OF ELECTRICAL AND SYSTEMS ENGINEERING,
UNIVERSITY OF PENNSYLVANIA

INTEGRATED PHOTONIC DEEP NETWORKS FOR IMAGE CLASSIFICATION

ABSTRACT

The typical hardware platform for neural networks operates based on clocked computation and consists of advanced parallel graphics processing units (GPU) and/or application specific integrated circuits (ASIC), which are reconfigurable, multi-purpose and robust. However, for such platforms the input data often needs to be converted to electrical domain, digitized, and stored. Furthermore, a clocked computation system typically has a high power consumption, suffers from a limited speed, and requires a large data storage device.

To address the ever-increasing demand for more sophisticated and complex AI based systems, deeper neural networks with a large number of layers and neurons are required, which result in even higher power consumption and longer computation time. Photonic deep networks could address some of these challenges by utilizing the large bandwidth available around the optical carrier and low propagation loss of CMOS-compatible photonic devices and blocks.

In this talk, a low-cost integrated highly-scalable photonic architecture for implementation of deep neural networks for image/video/signal classification is presented, where the input images are taken using an array of pixels and directly processed in the optical domain.

The implemented system performs computation by propagation and, as such, is several orders-of-magnitude faster than state-of-the-art clocked based systems and operates at a significantly lower power consumption. This system, which is scalable to a network with a large number of layers, performs in-domain processing (*i.e.* processing in the optical domain) and as a result, opto-electronic conversion, analog-to-digital conversion, an d requirement for a large memory module are eliminated.

SEPTEMBER 15 2023,

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LECTURE HALL