Karlsruhe Institute of Technology

KSOP
Karlsruhe School of Optics & Photonics

Speaker Karlsruhe Days of Optics & Photonics 2023

Abstract: Photonic computing

Prof. Dr. Wolfram Pernice

Conventional computers are organized around a centralized processing architecture, which is well suited to running sequential, procedure-based programs. Such an architecture is inefficient for computational models that are distributed, massively parallel and adaptive, most notably those used for neural networks in artificial intelligence. In these application domains demand for high throughput, low latency and low energy consumption is driving the development of not only new architectures, but also new platforms for information processing.

Photonic circuits are emerging as one promising candidate platform and allow for realizing the underlying computing architectures, which process optical signals in analogy to electronic integrated circuits. Therein electrical connections are replaced with photonic waveguides which guide light to desired locations on chip. Through heterogeneous integration, photonic circuits, which are normally passive in their response, are able to display active functionality and thus provide the means to build neuromorphic systems capable of learning and adaptation. In reconfigurable photonic architectures in-memory computing allows for overcoming separation between memory and central processing unit as a route for designing artificial neural networks, which operate entirely in the optical domain.

I will provide an overview of recent progress in photonic computing for applications in machine learning and will describe our process on building photonic processors. I will focus on incoherent photonic engines which deliver high throughput and promise low latency in hybrid architectures.

Karlsruhe Institute of Technology

KSOP
Karlsruhe School of Optics & Photonics

Speaker Karlsruhe Days of Optics & Photonics 2023

Biography:

In 2002, Pernice completed his studies of computer science at Indiana University, Bloomington in the USA. In 2004, he received his diploma in Microsystems Technology from University of Freiburg and in 2007, he obtained a DPhil in Electrical Engineering from University of Oxford in Great Britian.

From 2008-2011, Pernice was a Feodor-Lynen Fellow of the Alexander von Humboldt Foundation, Department of Electrical Engineering at Yale University in the USA. Then from 2011-2015, he was a Emmy-Noether Research Group Leader at Karlsruhe Institute of Technology (KIT). After, he was a Professor for the Physics Institute at WWU Münster. Since October 2021, Pernice is a Professor for the Kirchhoff-Institute for Physics at Heidelberg University.

In 2016, Pernice received the ERC Consolidator Grant. His research interests and scientific focuses are in nanophotonics, integrated optics, single photon detection and nanofabrication.