UNIVERSITÀ DEGLI STUDI DI TRENTO
Dipartimento di Fisica

Dott.ssa Elena Goi

University of Shanghai for Science and Technology, Shanghai, China

Friday, 16th December 2022 - 11:00 a.m.
Room 7

Integrated high-neuron-density diffractive neural networks performing near-infrared inference

Abstract:

Optical machine learning has emerged as an important research area that, by leveraging the advantages inherent to optical signals such as parallelism and high speed, paves the way for a future where optical hardware can process data at the speed of light. In this work, such optical devices for data processing in the form of multi-layer nanoscale diffractive neural networks trained to perform optical inference tasks are presented. We show the functionality of these passive optical devices on the example of decryptors trained to perform optical inference through symmetric and asymmetric decryption and multi-layer diffractive neural networks for direct phase retrieval. The perceptrons, designed for operation in the near-infrared region, are nanoprinted on complementary metal-oxide–semiconductor chips by galvo-dithered two-photon nanolithography with axial nanostepping of 10 nm, achieving a neuron density of 108 neurons / mm3. The compact form factor of the resulting optical neural networks and the lithographic fabrication technology that allow for directly integration on opto-electronic sensors, enable the co-integration of the optical perceptrons with additional layers of electronic neural networks, or the use of the sensor's nonlinear response as nonlinear activation function, in this way forming deep neural networks. This power-efficient commixture of machine learning and on-chip integration may have a transformative impact on optical decryption, sensing, microscopy, high-precision laser nanolithography, medical diagnostics, and computing.

Contacts:
Department of Physics
Via Sommarive, 14
38123 Povo, Trento
df.supportstaff@unitn.it

Scientific Coordinator:
prof. Pavesi Lorenzo