Implementing a complete neural network using multimode semiconductor lasers

D. Brunner

[1]Institut FEMTO-ST, Université Bourgogne Franche-Comté CNRS UMR 6174, Besançon, France.

Neural network (NN) concepts revolutionize computing by solving challenges previously thought to be reserved to the abstract intelligence of humans. However, the astonishing and substantial conceptual breakthroughs are so far not mirrored by advances in integrated hardware specialized in physically implementing NNs. For maximal efficiency, the largest fraction of a NN's hardware should be dedicated to the core computational task, while auxiliary infrastructure should be pushed into the background. I will demonstrate a fully autonomous photonic NN based on a high-dimensional semiconductor laser that implements a scalable photonic NN fully in parallel and with minimal support by a classical digital computer. We achieve this by employing exclusively black-box, evolutionary optimization algorithms, and I will show that for real-world analog neural networks these hold substantial promises while removing the most critical block to truly hardware based realtime learning.

Bio:

Daniel Brunner is a CNRS researcher with the FEMTO-ST, France. His interests include novel computing using quantum or nonlinear substrates with a focuses on photonic neural networks. He was received several University and the IOP's 2010 Roys prize, the IOP Journal Of Physics: Photonics emerging leader 2021 prize as well as the CNRS Bronze medal in 2022. He edited one Book and three special issues, has presented his results 60+ times upon invitation, has published 70+ scientific articles, has been awarded a prestigious ERC Consolidator grant and is a pilot of the French PEPR Electronique project of the France 2030 initiative.