6G-RIC
Research and
Innovation Cluster

GEFÖRDERT VOM
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A nonlinear signal equalizer based on optical neuromorphic computing networks

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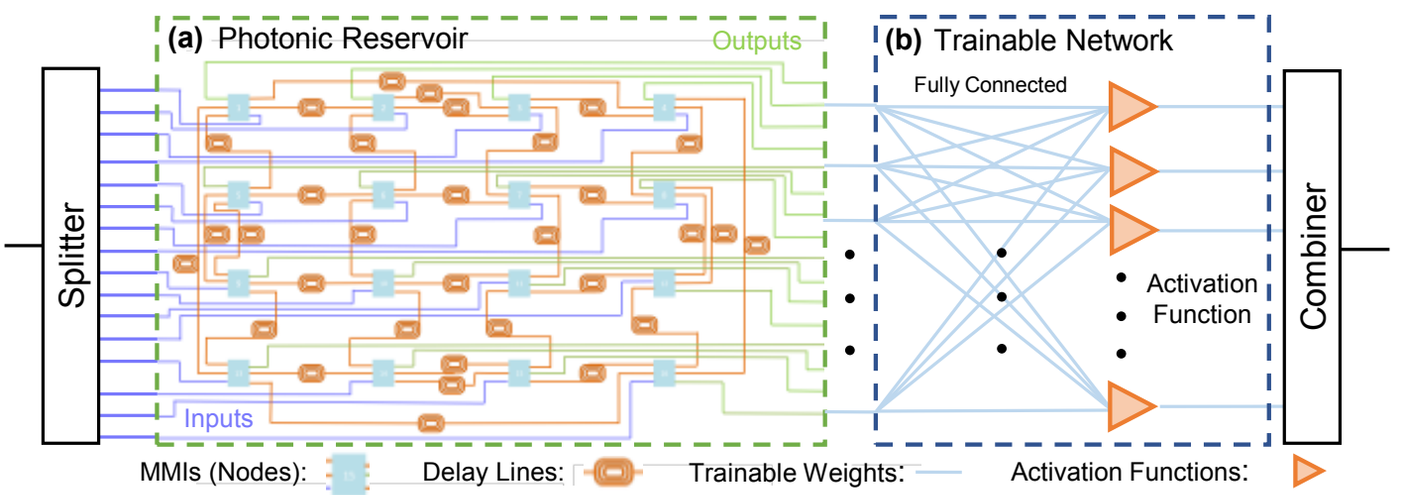
How to deal with demanding 6G-technologies as a solution for sustainable green photonics? How to cope with optical data-intensive transmission as an infrastructure for 6G-technologies to meet both energy-efficient and low-latency criteria? Is Optical Neuromorphic computing a viable solution for realization of these applications?



The schematics of the optical reservoir of a 4-port architecture following a 1-fully-connected layer of training network including complex weight functions and Indium Phosphide (InP) semiconductor optical amplifier (SOA) activation functions.

KEY FINDINGS

6G-technologies demand for chronically increasing and unavoidable Internet traffic. To meet challenging high-speed, -capacity, and long-haul data transmission requirements, optical neuromorphic computing architectures are a promising solution for an energy-efficient as well as low-latency applications. However, a long-haul optical implementation requires mitigating nonlinear distortion due to the Kerr effect of optical fibers at inevitable required high launch powers. In our study by taking advantage of optical neuromorphic computing based on reservoir computing (RC) architectures, we demonstrated a nonlinear signal equalizer, improving training times, and consequently, promising for energy-efficiency and low-latency performance. We numerically studied an optical reservoir of a 4-port architecture following a 1-fully-connected layer of Mach-Zehnder-Interferometer (MZI) weight functions and semiconductor optical amplifier (SOA) activation functions. Photontorch underlying calculations promises nonlinear mitigation of about 0.7 dB Q2-Factor when transmitting 32GBaud single polarization 16QAM optical signals over 800km. Physical demonstration of the architecture is yet under investigation to be achieved.

Guillermo von Hünefeld, Binoy Chacko, Gregor Ronniger, Mahdi Kaveh, Isaac Sackey, Mahtab Aghaeipour, Peter Bienstman, Colja Schubert, and Ronald Freund "Neuromorphic reservoir for nonlinear optical signal equalization", Proc. SPIE 12880, Physics and Simulation of Optoelectronic Devices XXXII, 128800H (11 March 2024);