Reservoir Computing with Silicon Integrated Photonics for Time Series Processing

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We will discuss how integrated photonic reservoir computing is a promising approach for solving a number of problems in telecommunications, *e.g.* non-linear dispersion compensation. We have shown experimentally that using a reservoir consisting of only 20 nodes can achieve sub-FEC error performance on on-off keying (OOK) signals at 32 Gbaud/s. Such a neuromorphic approach has the potential for being a high-speed low-power alternative for traditional electronic DSP.

We also showed in simulations that the scheme can be extended from simple modulation formats like OOK to complex coherent formats like 64QAM. We used the Kramers-Kronig (KK) detector configuration to achieve below-FEC-error-limit communications at 64 Gbaud/s, by including the nonlinear KK receiver in the training procedure.

Additionally, we have shown experimentally a completely new self-learning paradigm of optimising the weights inside a recurrent neural network, without relying on an offline algorithm or on a generated error feedback signal. Our network consists of ring resonators covered by a phase change material. By feeding the network with different binary sequences to be recognised, at powers above the plasticity threshold for the phase change material, we have shown that the network self-organises to better identify these sequences, without external intervention.