Resonant Programmable Photonic Circuits

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In achieving machine learning and quantum computing using optical signals, photonic integrated platforms offer several advantages, including reduced footprint, efficient electro-optic modulation, and seamless integration with electronic platforms [1]. Furthermore, in terms of light-matter interactions, the application of resonant platforms with stored light, which exploit the manipulation of optical states through temporal dynamics of optical systems, can provide advanced design strategies beyond waveguide-based propagating mode approaches.
In this talk, I will present our recent studies on the use of resonant photonic circuits and their programmable modulation to achieve universal unitary operations [2], Hamiltonian emulation [3], and enhanced nonlinear expressivity [4]. I will introduce the concept of photonic time gates and their integration into programmable circuits, highlighting the fidelity of circuit-level operations [2]. I will also discuss the emulation of hyperbolic lattices using these resonant platforms [3], focusing on the scalability with respect to lattice size. As a foundational element for photonic machine learning, I will also cover the concept of nonlinear unitary operations and their applications to neural network architectures, including an analysis of the network's exponentially increasing nonlinear expressivity [4].

References

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