Microring Weight Banks for

not merely reconfigurable, but programmable. For example, a simulated continuous-time recurrent neural network with modulator-class neurons can be programmed to solve nonlinear differential equations with a 294 speedup compared to a CPU baseline [11].

MRR weight banks are the seat of reconfigurability in integrated analog photonic networks. Their performance is therefore closely tied to the potential of these overall systems. In a MRR weight bank, the transmission seen by a WDM channel is configured by thermally tuning that filter on and off resonance [12]. A bank of these filters coupled to two bus waveguides independently weights all WDM channels. A complementary –1 to +1 weight range is achieved by balanced photodetection of the multiplexed bus WGs. Techniques for extracting weight vectors from time-domain WDM measurements and for precise control of MRR weights were introduced in Ref. [13]. The demonstrated weight resolution of 4.1 bits plus a sign bit (i.e. 34 distinguishable levels) is on par with the weight resolution of digital neuromorphic electronics.

In a MRR-based WDM device, the channel count limit is determined by the finesse of the resonators and the channel spacing normalized to the filter linewidth. In MRR demultiplexers, this channel density parameter trades off with inter-channel crosstalk. In a weight bank, all WDM signals exit the same pair of waveguides, so the concept of inter-channel crosstalk breaks down. Instead, the channel density is limited by the ability to weight neighboring signals independently [14]. A unique property of the weight bank is the presence of two bus waveguides between filters that act upon neighboring WDM channels. Coherent paths can be formed for wavelengths that partially couple through the neighboring filter.

The nature of inter-filter interference is fundmentally different for MRR filters that are odd-pole vs. even-pole. In a odd-pole bank, a channel partially coupled through a neighboring filter returns through the opposite bus WG to complete a resonator-like feedback path; in an even-pole bank, the partially dropped channel continues in the same direction to instead complete an interferometer-like feedforward path. Interferometer-like interference depends on

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