Multi-Channel Microring Weight Bank Control for Reconfigurable Analog Photonic Networks

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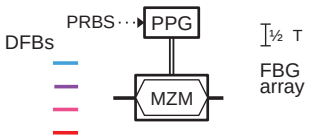
***Abstract*—W mon a 4-c ann l w ig a i ion in a ilicon mic o ing fil ban wi bi acc ac calabl calib a ion c ni a lo o mal c o - al an c o -gain a a ion ac ical w ig con ol i n ial o la g - cal o onic oc ing ba on mic o ing**

I. Introduction

The memory-processor bottleneck inherent in conventional computers has recently inflamed two global research thrusts: 1) integrated photonics manufacturing, in which the aim is to address this bottleneck's performance, and 2) unconventional computing architectures, in which the aim is to eliminate it altogether. Unconventional architectures in electronics are distributed, thereby relying heavily on multi-access networking strategies. Much recent work has focused on neuron-inspired models, in which network connections are represented by programmable real number "weights" [1]. The intersection of these two fields could yield cost-effective processors with unprecedented speed and complexity.

Optical approaches to the analog/neural interconnect problem have long been recognized, but so far none have been integrated. A silicon photonic analog networking approach called "broadcast-and-weight" (Fig. 1a) was proposed in [2]. Weighted connections are implemented by tunable microring resonator (MRR) weight banks (Fig. 1b). MRR circuits have the advantages of compactness, WDM capability, and ease of tuning. On the other hand, MRR sensitivity to fabrication variations, thermal fluctuations, and thermal cross-talk presents a control problem. The unique requirements of a MRR weight bank call for a feedforward control approach with offline pre-calibration performed at least once per fabricated device [3]. When weight interdependency is present, the dimensionality of the full tuning range increases with N, necessitating $O(2^N)$ calibration measurements in the naive case.

We show for the first time simultaneous multi-channel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