Integrated Optical Tensor Processors

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In modern neural networks, most of the computational load comes from linear algebra operations such as matrix multiplication and matrix-vector multiplication. These operations can be efficiently implemented in linear optics, which gives rise to the idea of an optical tensor processor: a device in which matrix multiplication operations are carried out in an optical core. We will discuss the potential of such devices and consider the advantages and disadvantages of various approaches to implementing optical cores. We will discuss experimental implementation of multicore optical tensor processors utilizing the integrated micro-ring resonator based optical cores and discuss the challenges and limits of their scaling. Beyond straightforward matrix multiplication cores, it is tempting to use optical systems as specific physical layers in deep learning pipelines, however in practice that may result in non-differentiable black-box layers requiring special algorithmic tricks for training which we will also briefly discuss.