Metasurface-Based All-Optical Tensor Processing Unit

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Abstract: With the rapid growth of artificial intelligence (AI), the power demands for training and inference using large AI models are increasing exponentially. Therefore, there is a critical need for a scalable and energy-efficient method to perform the basic operations – matrix multiplication and tensor processing – in AI models. Metasurfaces, with their high flexibility in manipulating light waves through spatially arranged subwavelength meta-atoms, offer a promising solution for next-generation matrix computation at the speed of light. Here, we demonstrate the design and fabrication of an inch-scale metasurface-based tensor processing unit, showcasing an all-optical tensor processing approach using free-space meta-optics.