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A Method to Arbitrarily Transform the Polarization of Light Variably Across a Beam

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Light fields with spatially varying polarization have a wide range of potential uses in the areas of telecommunication, imaging, lithography, and quantum information. A spatial light modulator (SLM) is a two dimensional array of liquid crystal cells that can control phase, polarization, and intensity of light point by point across a beam's spatial profile. We have developed methods to implement general polarization transformations using SLMs. That is, we can apply arbitrary polarization rotations that vary controllably across a beam. In quantum information, our methods in principle could enable the parallel processing of millions of optical modes, one for each cell. As an experimental example of the power of these methods, we take a beam with a non-uniform polarization across its spatial profile and convert it to be uniform. Such a correction could be useful for astronomy or microscopy imaging systems that suffer from polarization aberrations. In order to demonstrate the procedure's effectiveness we present point by point measurements of the polarization before and after the correction.

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