

# Wavefront shaping in multimode fibers by transmission matrix engineering

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## **Abstract**

Light that propagates through complex media is subject to scrambling due to multiple scattering and multi-path interference. The effect of scrambling can be accounted for by wavefront shaping, i.e. by manipulating the wavefront of the incident light, before it impinges on the complex media. We present a new technique for light modulation, where the light is manipulated throughout the course of its propagation in the complex media, and an experimental proof-of-concept with multimode optical fibers, where an array of actuators applies mechanical perturbations on small segments throughout the fiber. These perturbations change the fiber's geometry and manipulate its transmission matrix, resulting in changes to the speckle pattern at its distal end. Specifically, we demonstrate focusing at the distal end of a multimode fiber and mode conversion in a few-mode fiber, both achieved with an entirely fiber-based apparatus, making the technique attractive for applications such as microendoscopy and spatial division multiplexing in optical fiber communications.