Compensation of Multimode Fiber Dispersion using Adaptive Optics via Convex Optimization

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We propose a provably optimal technique for minimizing inter-symbol interference (ISI) in multimode fiber (MMF) systems using adaptive optics via convex optimization. We use a spatial light modulator (SLM) to shape the spatial profile of light launched into an MMF. We derive an expression for the system impulse response in terms of the SLM reflectance and the field patterns of the MMF principal modes (PMs). Finding optimal SLM settings to minimize ISI, subject to physical constraints, is posed as an optimization problem. We observe that our problem can be cast as a second-order cone program (SOCP), which is a convex optimization problem. Its global solution can, therefore, be found with minimal computational complexity, and can be implemented using fast, low-complexity adaptive algorithms. We include simulation results, which show that this technique opens up an eye pattern originally closed due to ISI. We also see that, contrary to what one might expect, the optimal SLM settings do not completely suppress higher-order PMs.