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Tailoring Noise Invariant Light for Robust Optical Communication

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Long distance optical communication has long relied on the use of single mode optical fibres to transport information. This method is limited because only one mode may be used thus restricting the rate at which data can be transferred. Conversely, free space propagation can make use of multiple modes, allowing for a much greater rate of data transfer. The main obstacle to overcome in free space optical communication is atmospheric turbulence. The atmosphere undergoes many fluctuations in temperature and pressure which in turn create random fluctuations in the refractive index. This turbulent behaviour can greatly alter any shape of structured light travelling through the atmosphere thus making long range propagation of structured light very difficult for encoding information. Several methods have been put forward to compensate for this including the use of machine learning, adaptive optics for pre-and post-correction and iterative routines. In our approach, we aim to find shapes of light that will remain robust through atmospheric turbulence by treating the atmosphere as a single unitary operator and then calculating the eigenstates (also called eigenmodes) of the operator. The effectiveness of this technique was demonstrated by using a structured light modulator to simulate the effects of atmospheric turbulence. We then compare these effects on both our calculated eigenmode and an eigenmode of free space. Our results show that the calculated eigenmode remains significantly more robust through turbulence than the eigenmode of free space. These results and the ability to calculate the eigenmodes of complex media will be very useful in many fields such as imaging and free space optical communication.

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Yes

Level for award;(Hons, MSc, PhD, N/A)?

MSc

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