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The varying and invariant properties of vectorial light for robust communication through a 270m free space optical link with no pre- or post-correction

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Vectorial structured light has found numerous applications due to its unique properties and has many advantages over scalar light fields. However, there has been a lot of debate regarding the robustness of these modes to certain aberrations and distortions which has significant implications for the uses of these forms of light, including for communications, imaging and sensing. In this work examine the behaviour of vectorial light through the dynamic and highly aberrated medium of atmospheric turbulence using a real-world 270m free space optical link. We definitively show the amplitude, phase and polarisation distortions induced by the medium. We present the first ever experimental demonstration of the invariance of the concurrence (a quantity that measures the non-separability and variations in the beam's polarisation structure) through real-world atmospheric turbulence. Such a quantity allows for the encoding of information without the need for a shared basis and requires no error correction and thus holds many advantages over alternative means of communication. The invariance holds for multiple beam types over long periods of time through the dynamically changing medium and through various degrees of distortions induced by the atmosphere. The results of this work are therefore highly interesting for the use of vectorial light through various, complex media and for both classical and quantum communications and imaging.

Apply to be considered for a student ; award (Yes / No)?

Yes

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

MSc

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