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The Most Robust Modes Through Atmospheric Turbulence

Long distance optical communication has been dominated by the use of single mode optical fibres. These fibres can only accept one mode of structured light thus limiting the rate and which information can be sent and received. Conversely, free space propagation can make use of multiple modes which open up additional degrees of freedom to store information thus making information transfer significantly faster. The downside of free space propagation is the effects of atmospheric turbulence. There are many fluctuations in our atmosphere due to temperature and pressure variations which in turn create random fluctuations in the refractive index. This turbulent behaviour can greatly alter the shape of structured light travelling through the atmosphere thus making its long range propagation difficult for encoding information. It has been shown that certain shapes of light can remain robust and maintain their shape while travelling through atmospheric turbulence (the so-called eigenmodes of turbulence). In this work we will show that it has also been observed that while there are a large number of theoretical eigenmodes for a given instance of turbulence, only some of these modes perform well in practice. We will also show that the eigenmodes that remain robust in practice share several useful and unique properties that make them easily identifiable and easy to find when presented with the many eigenmodes for a given turbulence operator. This work has many useful applications including uses in the fields of imaging and optical free space communications.

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

Yes

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

MSc

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