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Achieving reliable and robust optical communication through a change of basis

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Free space optical communication has proven to be an effective form of transmitting information over large distances. Structured light has proven to be a valuable tool in improving such channels but is quickly reaching its limits due to the distortions induced by atmospheric turbulence. It has been shown that certain shapes of light, the eigenmodes of turbulence, remain invariant to these effects and can pass through the atmosphere unaffected. However, current methods produce eigenmodes that are not always viable to generate for real world use, lack an analytical description and are ineffective in practical applications. In this work we put forward a new method for calculating these eigenmodes by using an operator in the OAM basis. This basis is chosen because it is complete, meaning any light field can be decomposed into a superposition of OAM modes, and because these modes show low divergence in the paraxial regime. The new operator is found by first defining the transformations in the position basis and then decomposing this operator into the OAM basis. This has numerous benefits over previous approaches as it provides an analytical description of these eigenmodes, gives us insight to their propagation dynamics and relationship to the channel distortions and most importantly outputs modes that are reliably robust through turbulence. These results are not only of interest to the field of communications, but will also have applications to imaging, sensing and quantum optics.

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

Yes

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

MSc

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