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Opportunities and challenges for structured light multiplexing in free-space optical links

Abstract: Free-space optical (FSO) communication systems have the potential to revolutionise the way we connect our cities by providing dynamic untethered connections that can be redistributed as cities needs evolve over time. Such systems can also play a vital role in the distribution of internet access in developing countries [Lavery et. al, Nature Photonics 12, 249–252 (2018)]. I will discuss our latest achievements in developing a “plug- and-play” FSO system suitable for deployment in urban environments.

Spatial modes of light such as orbital angular momentum, hermite-gaussian, vector modes and others have generated considerable excitement in the scientific community in recent years. Laboratory experiments have demonstrated layered approaches to combine many different multiplexing techniques that have reached speed beyond 100-Tbps. As the technologies for multiplexing and demultiplexing become more mature, demonstration of compact deployable systems are becoming the key next step in the development of free-space optical systems that employ novel space division multiplexing techniques. I will outline our latest link equipment comprising that has the ability to self set-up and present results for various urban use-cases between 15m and 200m.

In real world scenarios, a critical concern for an FSO system is the effects of atmospheric turbulence. Our compact FSO system is portable and can be tested in various deployment scenarios. Atmospheric turbulence induces aberrations to the wavefront of the transmitted beam that will result in channel crosstalk. An overview of our recent studies into the propagation of beam carrying OAM at ranges of 1 mile [Lavery et. al, Science Advances 3,10, e1700552, 2017], presenting future challenges and opportunities in the rapidly advancing research area of structured photonics.