How Atmospheric Turbulence can be used to Improve Optical Systems Performance?

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There is a growing interest in development of optical systems capable for operation over long atmospheric distances (path lengths up to and over 100 km). Among these applications are long-range laser communications between a network of high-altitude airships and satellites, remote sensing of volcanic ash and pollution from airborne platforms, imaging and tracking of space debris, and laser weapon and high-power technological laser systems under development. Extended over long distance (deep or volume) atmospheric turbulence can result in significant change optical waves leading to strong degradation of optical system performance appearing as image blurring, laser beam intensity dancing and boiling, communication signal fading. Note that impact of deep turbulence on optical waves cannot always be considered as negative. As recently demonstrated, optical wave propagation in deep turbulence can lead to formation of high quality image regions (lucky regions) that can be utilized for imaging system performance enhancement. Another example is laser beam super-focusing effect that can result in dramatic increase of projected laser beam power density on a remote target (even beyond the diffraction limited value in vacuum). In this presentation we introduce turbulence effects and demonstrate how the traditional foul of turbulence can be transformed to a friendly force that play on our side helping to improve our capability to better see, communicate and defend ourselves.

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