INVESTIGATION ON WAVEFRONT SENSING FOR PROPAGATION CHARACTERISTICS OF TURBULENCE IMPACTED LIGHT BEAMS

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by

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ABSTRACT

The effects of atmospheric turbulence on light beams and the turbulence induced higher order aberrations plays an important role for free space optical communication. In this thesis, the immunity of higher order Gaussian beams in maintaining its integrity during its propagation through atmospheric turbulence is experimentally investigated. The propagation analysis of laser Gaussian beam passing twice through a dynamic atmospheric turbulent mimicking Pseudo Random Phase Plate (PRPP) is carried out using variance matrix method. The characteristics like twist, symplectic Eigen values, asymmetry parameters, scintillation and beam wander are calculated for Gaussian and standard Laguerre Gaussian beams through rotating PRPP.

Further wavefront detection using a common path vectorial shearing interferometer based wavefront sensor has been carried out. Copies of input shearing beam is obtained using cascaded sagnac interferometer. The proof of principle of Vectorial shearing interferometer based wavefront sensor is carried out. Wavefront variation introduced due to change in position of collimating lens has been calculated and verified with simulated results. A comparative study on SHWFS and Vectorial interferometric wavefront sensor has been done.

For simulating the wavefront sensing using a natural light source or an artificially induced guide star, the proposed interferometer based wavefront sensor is tested with low coherent light source with finite spatial extent. The designs for maintaining the interference within temporal coherence domain and reviving the spatial coherence using diffraction effects ensured the sensing of wavefront. Wavefront of turbulent impacted (PRPP) low coherent wave has been detected using vectorial shearing interferometer based wavefront sensor.