INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Thesis Title:

Investigation of propagation effect on laser beams carrying user defined phase profiles and turbulence resilient sensing scheme

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SHORT ABSTRACT

The phase profile or the wavefront of a laser beam is the most important parameter so far as the information content in the beam is concerned. How propagation affects a laser beam carrying different phase profiles is important in a number of applications involving short to long range propagation of the laser beam. In this thesis we first carry out numerical simulation to understand how a laser beam diverges, by considering the diffraction induced divergence on the Zernike modes present in the beam. We come up with a functional form that can predict the effective size of a laser beam propagating a given distance and carrying a given phase profile. We also carry out numerical simulations to investigate the propagation effect on the phase profile in terms of the same on the constituent Zernike modes. We then develop an experimental arrangement to demonstrate the propagation of a laser beam carrying user defined phase profile and validate the important findings of the numerical simulations. Long distance propagation of a laser beam may also be affected by atmospheric turbulence, which may degrade the performance of a wavefront sensor. In this thesis we also carry out experiments to generate the effect of atmospheric turbulence on a laser beam and to investigate how various wavefront sensors perform in the presence of atmospheric turbulence. From our results, we come up with sensing schemes which are more resilient to the presence of atmospheric turbulence.