# INVESTIGATIONS ON WAVE PROPAGATION THROUGH PSEUDO-RANDOM-PHASE-PLATE USING He-Ne LASER AT 633 nm

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*by*

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# ABSTRACT

Turbulence mimicking media in experimental laboratories have proved to be very helpful for investigating the properties and effects of a realistic turbulent medium. Researchers have constantly attempted on improvising the existing turbulence mimicking capacities to create robust and repeatable turbulence models for laboratory purposes. In this thesis, Pseudo-Random-Phase-Plates (PRPPs) which belong to the class of aforesaid media have been investigated by using a 633 nm He-Ne laser wave-field.

In the first place, a collimated 633 nm laser wave-field is used in two classical interferometers namely the Mach-Zehnder and the Michelson's interferometer, to determine the nature of PRPPs, which amounts to revealing whether they behave like Kolmogorov or non-Kolmogorov turbulence simulators. It is found that the two PRPPs in question behave like non-Kolmogorov turbulence simulators at $633\,\mathrm{nm}$ wavelength, whether used individually or as a combination. It is also observed that the behavior of PRPPs tends to approach towards Kolmogorov turbulence regime on increasing the number of passages of wave-field through them. Also, to discuss one of the applications of the characterized PRPPs, a phase-sharing experiment involving a Mach-Zehnder interferometer using a PRPP as object in one of the interferometric arms is mentioned.

This is followed by wave-propagation analysis using the Variance matrix on the said PRPPs with a 633 nm laser wave-field. Variance matrix, along with some derivable physical quantities is calculated using the Shack-Hartmann-Wavefront-Sensor (SHWFS) data at different propagation distances. The estimated quantities for a wave-field subjected to a propagation through PRPP (either once or twice) are compared with those for a wave-field not subject to a propagation through the PRPP. The comparison though shows an increased fluctuation in all the quantities with a passage through the PRPP, but it also reveals a decreased wave-field asymmetry on an average.

Towards the end, an attempt on PRPP characterization is made using the standard statistical parameters usually used for characterizing surface roughness.