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Field Experiments

Laser Beam Propagation In Maritime Environment

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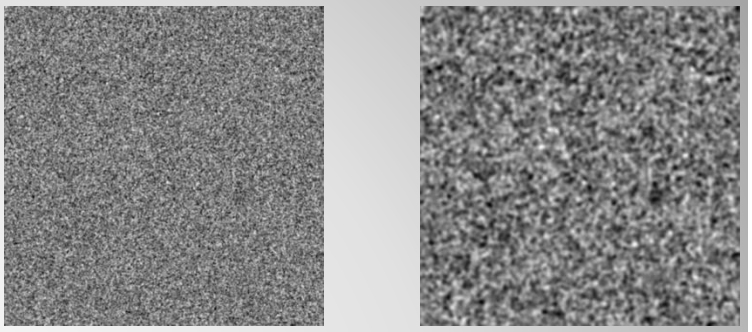
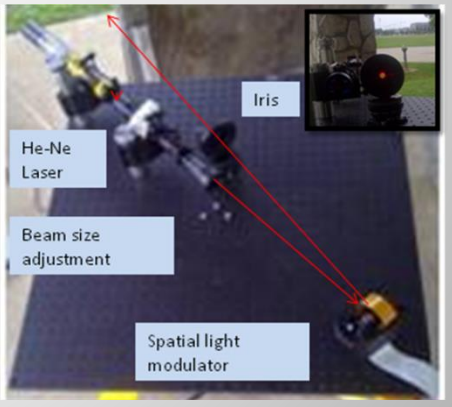
Revolutionary Research . . . Relevant Results

A 2 mW power He-Ne laser source with the rifle scope expander, generates Gaussian laser beam of about 0.5 mm diameter. SLM modulates the light phase to create a Gaussian Schell-model beam with tunable correlation properties. Light propagates over a grassy field for 500 m and over the water for 150 m. Target is a light sensor located on a concrete surface capturing intensity fluctuations at the rate of 1000 realizations per second during 3 minute intervals.



Phase screens generated for the SLM SLM =2, less coherent (left) and SLM = 16 more coherent (right) with corresponding source correlation widths of 0.021 mm, 0.06 mm respectively.

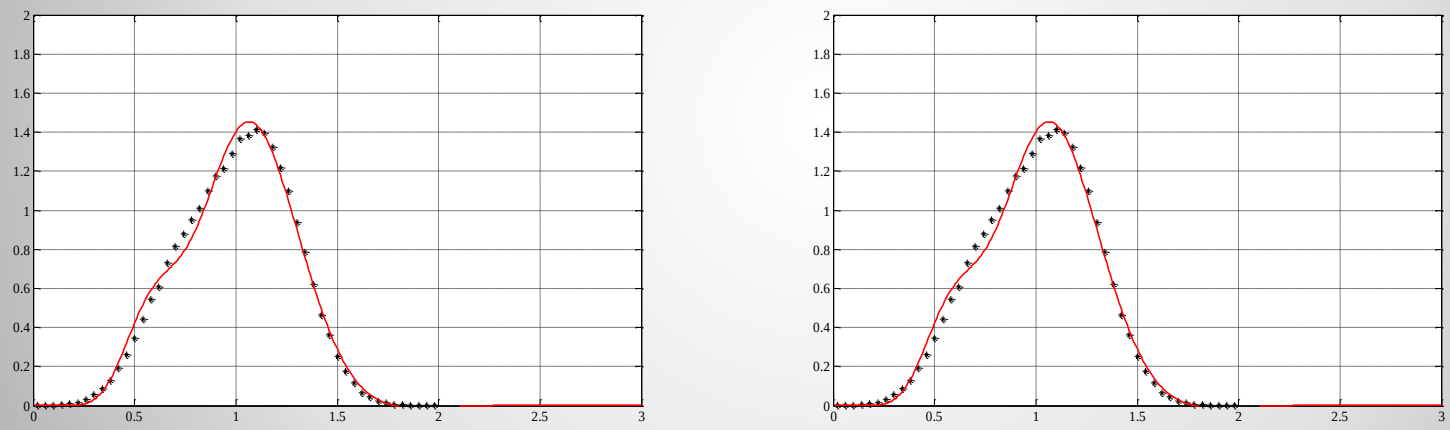


Source experimental setup

Experiment

SLM value	Number of realizations used for moment computation	Selected Pixel	2nd moment	3rd moment	4th moment	5th moment	6th moment
2	177946	#1 #2 #3	0.0743 0.0596 0.0486	0.2193 0.1761 0.144	0.4459 0.3562 0.2902	0.7776 0.6147 0.4975	1.2539 0.9764 0.782
16	175894	#1 #2 #3	0.1106 0.0926 0.1114	0.364 0.3029 0.3671	0.8377 0.6877 0.8461	1.6833 1.3543 1.7025	3.1871 2.4983 3.2285

Comparison of the first 6 statistical moments of the beam's intensity for three different pixel locations. The values of the moments show little variation from pixel to pixel within each SLM-correlation while have significant discrepancy for different source correlation widths.



Probability density functions of the beam's intensity for SLM 16 (top) and SLM 2 (bottom), normalized by the average intensity values. Stars are the binned data values, solid red curves are the Gamma-Laguerre reconstructed functions.

Results

- Measured and analytically reconstructed the PDF of the instantaneous intensity of a beam produced by a partially coherent source and passed through a turbulent atmospheric channel.
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- While for strongly phase-randomized laser light the resulting intensity PDF is robust, preserving its initial Gaussian profile, that of a weakly randomized light changes its intensity PDF from Gaussian to Gamma-like, more resembling that of a pure laser source.
- This result generalizes previous findings about coherent and partially coherent beams' resilience in terms of average spreading, directionality and scintillation index.
- While the overall results for the PDF reconstruction are novel the values of the second-order moment are in agreement with references in weak regime of atmospheric fluctuations, i.e. the smaller SLM correlation size must correspond to a lower second-order moment.

Conclusions