

STRATOSPHERIC LASER PROPAGATION

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Final Report

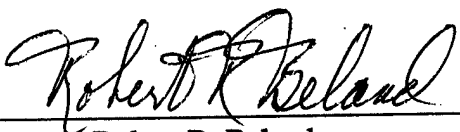
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HANSCOM AIR FORCE BASE MA 01731-3010**

"This technical report has been reviewed and is approved for publication"



Robert R. Beland
Contract Manager



Robert R. Beland, Chief
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14. ABSTRACT The University of Colorado simulated the evolution of the two-point coherence function of a plane wave propagating through globally intermittent turbulence. The specific parameters of the probability-density function used were taken from stratospheric experiments. The contractor found that including the large-scale variability of the inner scale requires to carefully define the non-intermittent case. The results show that the coherence of propagation through intermittency, which is known to be strictly larger than the coherence through a medium with the average of the structure function, becomes practically smaller than the coherence through the medium described by a structure function with average parameters. The phenomenon was explained theoretically.					
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STRATOSPHERIC LASER PROPAGATION – FINAL REPORT

The original contract called for a three year effort and had three Tasks: (1) Correlation and Spectrum of Intensity Through Intermittent Media; (2) Coherence and Intensity Correlation Through Anisotropic and Intermittent Random Medium; and (3) Two-Frequency Correlations of Field and Intensity Propagating in Intermittent and Anisotropic Random Medium. The work began on 19 Sep 1995 and was intended to end on 19 Sep 1998, however, only 68% of the funding was achieved and the contract was descope on 11 Feb 1998. The contractor fulfilled his Final Report requirement by submitting a Journal Article entitled, "Clarifying the Concepts of Wave Propagation Through Intermittent Media", as the Final Report. However, a mis-communication between the contractor (University of Colorado) and the government occurred and the report was published as Scientific Report No. 4. A Final Report is required to retire an R&D case file and, since the contractor already satisfied their reporting requirements by delivering four reports, this summary is being produced to satisfy the Final Report requirements.

ACCOMPLISHMENTS

From the contract SOW, the following research was accomplished:

TASK 1. Correlation and Spectrum of Intensity Through Intermittent Media.

SUBTASK 1.1. 100% completed.

Derive expressions and partial differential equations for propagation through intermittently random, layered media. Obtain analytical simplifications of the offerer's exact theory according to the anticipated scales of the medium.

SUBTASK 1.2. 100% completed.

Compute the full coverage of intensity correlation, spectrum, and scintillation index of spherical wave propagation in intermittently random medium. Obtain a numerical solution of the governing equations and integral evaluations associated with perturbation theory. Idealized models for the medium will be used for validations.

SUBTASK 1.3. 100% completed.

Parameterize in-situ balloon and aircraft data to obtain a model for the statistics of the average, variance, and scales of the refractive index. The techniques are: Conditional sampling for local stationarity, matching higher order structure functions, compound-Poisson model, and wavelet transforms.

TASK 2. Coherence and Intensity Correlation Through An-isotropic and Intermittent Random Medium.

SUBTASK 2.1. 80% Completed.

Formulate the propagation of the coherence function through an-isotropic, intermittent, random medium. Imaging and adaptive optics are second-moment (coherence) problems. Derive integral-differential equations for the propagation through an-isotropic media, and perturbation solutions for weak or strong anisotropy. Special attention will be given to the imaging configuration and for statistics that can be provided reliably by the ABLEX/ACE data. Inversion algorithms to find the parameters of the medium will also be considered.