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Editors

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Introduction

This is the third in a series of annual conferences on the combined topics of laser communication and propagation effects through the atmosphere and ocean. There are well-established technologies in free space optical (FSO) communication, yet many challenges remain in obtaining reliable link and network performance in the face of atmospheric conditions—especially turbulence.

Several papers presented at the conference discussed theoretical analysis and simulation of turbulence effects, such as anisotropic and non-Kolmogorov turbulence, and scintillation, especially in conditions of strong turbulence. Many of these papers described variants of phase screen analysis as a way to simulate wave propagation through turbulence. Beyond its effects on FSO, systems turbulence also affects imaging through the atmosphere, and there was an invited paper that described how the atmosphere is the limiting factor in the performance of electro-optic systems of all kinds. A number of papers discussed how meteorological measurements could enable the estimation of turbulence conditions that affect FSO and imaging systems.

The use of powerful tools from numerical weather prediction (NWP) provided an exciting new direction for the assessment of large-scale refractive effects. Several papers described the estimation and simulation of optical turbulence for different atmospheric layers. The capability for NWP to reconstruct three-dimensional optical refractivity was utilized in a fascinating paper describing the contributions of the meteorological and optical environment to the Titanic disaster.

The effect of the atmosphere on directed energy (laser) weapons was the subject of several papers. Paper topics included scintillation measurements in dynamic scenarios, and modeling for both beam effects as well as the detection of laser beams. Measurement research was described, including Shack-Hartmann wave-front sensors, and the use of modified plenoptic cameras for distortion characterization.

Several papers discussed the development of ways to improve the focusing of energy on a distant target, either by adaptive optics mitigation of laser beam distortion, or by using phase conjugation of a target illumination laser, or through the exploitation of enhanced back scatter (EBS). A new way for observing EBS in a single camera frame was described. Other high-energy laser effects discussed included plasma formation, filaments, and their applications. A number of papers discussed how different kinds of laser beams, such as the multi-Gaussian Schell beam, Bessel beams, and Airy beams propagate through turbulence, and whether these beams offer advantages over single Gaussian beams.

An invited paper discussed the effects of the atmosphere on millimeter precision lunar ranging and how such observations can provide deep insight into fundamental physics. A second invited paper discussed how multi-spectral modes can provide efficient data transport in terms of bits/photon and spectral efficiency in terms of bits/sec-Hz and how cross-talk in such applications is affected by turbulence. The continuing interest in visible light communication (VLC) using LED illumination sources was discussed in papers describing MIMO techniques, modulation schemes, and retro-reflectors.

Finally, the 'Oceans' part of the conference title was well represented, with papers concentrating on underwater communications, examining the best wavelengths to use in different water conditions, and effects at the air-water interface. The expansion of topics presented at the conference included non-line-of-sight UV communications, light propagation through ship exhaust plumes, and time transfer using picosecond lasers at the single photon level.

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