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Editors

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Introduction

The effects of the atmosphere on optical propagation can often be the limiting performance factor in many optical system applications. The primary factors in beam degradation are: absorption and scattering by molecules, aerosols and clouds; large-scale refractive effects; and optical turbulence. For many applications, it is necessary to understand how these factors can be predicted and modeled, and hence to describe the interactions and correlations between the factors. Specific environments remain difficult for beam propagation models: long horizontal propagation paths near the ocean surface or near the land surface can encounter large vertical gradients in turbulence intensity and in extinction. Inhomogeneous regions such as coastal areas, mountains, or urban islands are difficult to simulate.

For laser projection systems, atmospheric extinction induces irradiance reduction, while turbulence-induced temporal variation in irradiance can be manifest as either a fade or a surge. Temporary signal fades are detrimental to communication systems efficiency and reliability, but surges are also somewhat problematic since they may involve depositing more than the designed irradiance at a target or a receiver. Validated models and well-controlled field experiments are important to progress in system designs which can mitigate these effects.

For imaging systems, atmospheric effects may lead to serious degradation of image quality through contrast reduction, blurring and scintillation. Due to its chaotic nature and its high spatial and temporal frequencies, atmospheric turbulence is presently one of the most important factors determining image quality. For a reliable assessment of system performance, a description of turbulence intensity and its impact on imaging systems is crucial. There is thus a need for a description of turbulence in terms of environmental parameters, in terms of its impact on image quality, and in terms of image processing techniques to improve image quality by removing turbulence effects.

The "Atmospheric Optics: Turbulence and Propagation" conference is the 2011 contribution to a series of SPIE conferences addressing optical propagation through the atmosphere, which has been hosted over the years in the "Optical Engineering and Applications" symposium. Similar to its predecessors, the conference aims at stimulating interdisciplinary discussions of atmospheric turbulence and propagation phenomena and their impact on optical, radar and communication systems, by providing a venue to present papers on:

• measurement and modeling of the effects of turbulence on propagation and system performance

- measurement and modeling of the effects of aerosol (including dust), rain, and clouds on propagation and system performance
- nowcasting and forecasting of propagation effects
- critical analyses of the current state-of-the-art propagation and radiance codes
- inversion techniques, applying the sensor as a probe of the atmospheric state
- techniques for mitigation of atmospheric effects, and sensor fusion
- sensor signal (image) improvement techniques by removing atmospheric effects
- impact of atmospheric effects on sensor task performance (tracking, beam pointing, wavefront control).

The major focus of the conference is closely related to the "Free Space and Atmospheric Laser Communications" conference that is also part of the "Optical Engineering and Applications" symposium. This year, as well in previous years, this proximity has been underlined by a joint session in which papers from both conferences are presented. This approach has resulted in an improved intermingling of attendees of both conferences, and it is the intention of the chairmen of both conferences to continue and to improve the contacts between the two communities.

Continuing a trend that has been visible for a few years, this year's conference saw a further decline of papers dealing with transmission losses by aerosols and molecules and/or large-scale refractive effects. Instead, many papers addressed turbulence phenomena, from either a theoretical or experimental point of view. It is this mix between fundamental wave propagation theory, elegant laboratory-scale experiments to reveal elemental parameters governing turbulence phenomena, and field trials that identify the operational effects of turbulence on sensor systems that create the platform for a fruitful discussion and allow participants to refresh their point of view on this elusive topic.