Axial Displacement of Focus Resulting From Atmospheric Turbulence: Implications for Army Vision Systems

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ABSTRACT:

Turbulence resulting from the effects of wind and convection in the Earth's atmosphere gives rise to microscopic fluctuations in the air temperature. These random temperature fluctuations in turn induce random fluctuations in the local refractive index of the air, whose cumulative effect on a laser beam propagating long distances through the atmosphere is to gradually destroy the spatial coherence of the beam. Wave front distortions in the beam induced by atmospheric turbulence manifest themselves in several ways, in particular, in a decrease in the beam mean wave front radius of curvature from that of a spherical wave. When the beam is brought to a focus, this alteration wave front curvature results in an axial displacement of the focal plane relative to its position in the absence of turbulence, and this focal shift can dramatically reduce the level of light intensity at the original focus. What are the implications of this effect for Army vision systems? I will describe some of my recent work in this area and discuss future efforts that may be appropriate for collaborative ventures with USMA researchers.

KEY WORDS: atmospheric turbulence, wave front curvature

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