LIGHT-BEAT MEASUREMENTS OF ATMOSPHERIC FLUCTUATIONS

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ABSTRACT

So far fluctuations of a laser light beam propagating through a turbulent atmosphere have been investigated to explore turbulent nature of the atmosphere. Experimental works have usually been done by a standard method[1] that makes measurements of the mean separation of two maxima in the spatial interference fringes. However, this method has the difficulty in getting a phase-difference angle above 2π between the two light beams to be interfered, often occurring in the open atmosphere. An alternative method[2] was further developed, which was able to reject the difficulty and made measurements of phase fluctuations in real-time, although the method was somewhat tedious.

In contrast to such methods the present work employs a light beat signal modulated by the atmospheric fluctuations[3]. When the signal and local oscillator light beams undergo fluctuations over their wave-fronts during passage through the atmosphere, the generated light beat should be randomely modulated in its amplitude and phase. As a consequence, this light beat can offer significant information about the state of the atmospheric fluctuations. Fortunately, such information can be processed in real-time, because the modulated beat signal has a carrier wave.

The main purpose of this paper is to present a technique to explore statistical properties of the turbulent atmosphere with the help of such a beat signal. Especially, with the use of an artificially generated turbulent atmosphere the phase structure function, probability density function, and temporal correlation function will be obtained as the most basic quantities of the atmospheric fluctuations.

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2) G. M. B. Bouricius and S. F. Clifford : Rev. Sci. Instrum. 41 (1970) 1800.
3) Y. Ohtsuka and I. Sasaki : Applied Physics 3 (1974) 15.