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Strohbehn J W. Line-of-sight wave propagation through the turbulent atmosphere. *Proc. IEEE* 56:1301-18, 1968.
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A review of recent developments in the field of random fluctuations of an electromagnetic wave propagated over a line-of-sight path is presented. The major interest is in the optical to mm wavelength range where fluctuations in amplitude, phase, and angle-of-arrival are important system considerations. The review concentrates on the major approximations involved in the theoretical developments, and, in particular, attempts to put in perspective the arguments over Rytov's method. [The *SCI*® indicates that this paper has been cited in over 100 publications since 1968.]

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"During my doctoral work under Alan T. Waterman, Jr., at Stanford University in the area of beyond-the-horizon propagation of microwaves, I became interested in the remote sensing of atmospheric parameters using radio wave propagation experiments. Since the laser had recently been invented, it was natural to consider the question of the atmospheric effects on optical propagation and the inverse problem of remote sensing of atmospheric parameters by optical propagation experiments. Interest in the area of optical propagation through the turbulent atmosphere immediately led one to the works by V.I. Tatarski[1] and L.A. Chernov[2] in the Soviet Union, where interest in this topic had been pursued before the invention of the laser.

"Because of the Russian preeminence in this area, I applied for and was accepted as an exchange scientist to the Soviet Union under the National Academy of Sciences from January to March 1967.

"The problem with which I was primarily concerned before going to the Soviet Union was the validity of the Rytov approximation as applied to optical propagation, and its advantages with respect to the Born approximation, a topic which was being hotly debated in the US literature.

"From a scientific viewpoint, the most exciting result from the trip to the Soviet Union was to find that their concern was not with a comparison of these two approximations, but with the fact that neither theory was able to predict the results of some elegant experiments performed by Gracheva and Gurvich.[3]

"When an optical wave propagates through the atmosphere, variations in the refractive index, which result from the turbulence, lead to fluctuations in the intensity of the optical signals. This is precisely the effect that causes the twinkling of stars or the shimmering of heat over a hot pavement. Both the Born and Rytov approximations predict that as the path length through the turbulent atmosphere increases, the strength of the scintillations will also increase. The amazing result discovered by the Russian workers was that the variance of the logarithm of the intensity of the light only increases up to a certain point; this quantity then saturates and in actual fact decreases with increasing path length. This result had wide implications for many problems involved with optical propagation, e.g., optical communication links. In addition, there were data on such quantities as the spatial covariance function of intensity fluctuations.

"Because of the importance of this problem, and the fact that very few workers in the US were aware of the Russian work, when I returned to the US I wrote this review paper attempting to summarize both the theoretical and experimental work relating to the various aspects discussed above including the Born and Rytov approximations, the experimental work performed by the Russians, and new theoretical developments addressing the saturation problem. The most obvious reason for the number of citations to this paper is that it was the first paper in the English literature to review the new Russian developments in this area, and to include a number of results and figures from papers which had not been translated into English.

"Since that time, a great deal of effort has gone into this problem both theoretically and experimentally. The saturation effect has been explained theoretically by workers in both the Soviet Union and the US, primarily by Shishov and Gochelashvili and Fante. Equally important, Clifford and Yura have given heuristic theories which give a great deal of physical insight into the problem. Much of this work has been reviewed in a monograph which appeared in 1978.[4] Interest in this problem is still current with much of the recent work focusing on the form of the probability density function of the intensity fluctuations."

1. **Tatarski V I.** *Wave propagation in a turbulent medium*. New York: McGraw-Hill, 1961. 285 p.
2. **Chernov L A.** *Wave propagation in a random medium*. New York: McGraw-Hill, 1960. 168 p.
3. **Gracheva M E & Gurvich A S.** On strong fluctuations of the intensity of light when propagating in the lower layer of the atmosphere. *Izv. Vyssh. Uch. Zav. Radiof. SSSR* 8:717-24, 1965.
4. **Strohbehn J W,** ed. *Laser beam propagation in the atmosphere*. Berlin: Springer-Verlag, 1978. 325 p.