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Improving BER in a MIMO Free Space Optical Communication System in a Turbulent Channel with Spatial Arrangement of the Transceiver Arrays

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Abstract

Free space optical (FSO) communication offers a high speed, secure, unlicensed and low cost mode of communication and access. However, the efficacy of line-of-sight FSO communication in atmosphere is reduced by scintillation and scattering of the laser beam carrying the data signal. The use of multiple laser sources and multiple optical detectors, i.e., the MIMO technique, is popular for mitigating the adverse effects in a high data rate FSO system in a turbulence atmospheric channel with attenuation and fading. MIMO configurations take benefit from the spatial diversity and receive multiple independent copies of the same signal at the receiver, hence resulting in increased signal-to-noise ratio or BER. In a MIMO FSO system the variation of the overall SNR and BER with parameters such as the number and the spatial arrangement of multiple transmitters and receivers in the diversity system are difficult to determine. In this paper we first consider a SIMO system with a single transmitter and multiple receivers with small apertures. A statistical model is developed for an OOK system considering atmospheric fading and misalignment factors between the spatially distributed receivers. Using both deterministic methods and Monte Carlo simulations we show that the number and the spatial arrangement of the receivers can be chosen so as to maximize the overall performance of the diversity system. Then the results are extended to a MIMO system to improve the overall performance even in the presence of attenuation and scintillation in the atmosphere.

Biography

Dr. Anjan K Ghosh has 30 years of research and teaching experience in the areas of optical information processing, optical communications and photonic sensors. He obtained his PhD in Electrical Eng. in 1984 from Carnegie-Mellon Univ., Pittsburgh and his MS from the SUNY at Stony Brook. He is an alumnus of IIT Kharagpur, India. Dr. Ghosh was a member of technical staff in AT&T Bell Laboratories for 2 years. Then he served as a faculty member in the Univ. of Iowa, Iowa City, USA, IIT Kanpur, India, Nanyang Tech. Univ., Singapore, the University of Oklahoma, Tulsa, USA and DA-IICT, Gandhinagar, India. He was the Head of the Dept. of Electrical Eng., Adv. Center for Electronic Sciences, Laser Tech. Program and the Center for Laser Tech., all at IIT Kanpur. At present Dr. Ghosh is the Vice Chancellor of Tripura (Central) University near Agartala, India. He published over 150 papers in journals and conference proceedings and delivered several invited talks. He is a Senior Member of IEEE, a fellow of the IETE(India), IE (India) and Optical Society of India, and member of SPIE, and OSA.