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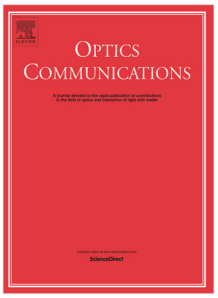

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A Rapid Hybrid Wave Front Correction Algorithm for Sensor-less Adaptive Optics in Free Space Optical Communication

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Abstract: In free-space optical communication (FSOC) system, wave front sensor-less adaptive optics (AO) technology is widely used to compensate wave front distortions caused by atmospheric turbulences. There are different kinds of compensation methods with both advantages and disadvantages. The conventional and often considered model-free algorithm, stochastic parallel gradient descent (SPGD) algorithm, requires a lot of iterations to obtain optimal solution, which may lead to a poor real-time performance. The newly developed model based algorithms have certain constraints and difficulties for the construction of the models. Therefore, in order to develop a rapid wave front distortion compensation algorithm with better performance, we present a hybrid method by a suitable combination of SPGD algorithm and a model-based algorithm presented by Martin J. Booth. Simulations under our built experiment platform show that this hybrid method can compensate wave front aberrations fitted by the Zernike polynomials in higher speed than that of SPGD algorithm at higher SR and lower RMS with strong turbulence, which means it can improve communication quality.

Keywords: Free space optical communication, wave front correction, hybrid method, adaptive optics

Section 1 Introduction

Free-space optical communication (FSOC) is an optical communication technology using laser as information carrier to transmit data wirelessly. Comparing with other communication methods, FSOC system has higher transmitting speed and larger bandwidth with lower price and more convenient installation[1]. FSOC is one feasible solution for some situations where the optical fiber based system are impractical, such as high speed communicating between the Earth and satellites, or communicating among satellites, etc. In addition, as FSOC system has more flexible network and better secrecy performance, this technology is also appropriated for military use.

Recently, FSOC system is regarded as one of the most promising solutions for the “last mile” communication bottleneck[2]. The main difference among FSOC and other optical communication methods is the use of atmospheric channel, which brings that the reduction of the influences from atmospheric channel becomes the key problem. According to the Kolmogorov turbulence theory, when laser propagates in atmosphere, random atmosphere