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Investigation to Reduce Flux Variance Effects Using Partial Coherent Beam in Free Space Optical Communication

A K Rahman, A L Tom, N A A Mohtadzar, **YMY Buswig, Nurdiani Zamhari, M R M Sharip and S K Sahari**

Department of Electrical & Electronic, Universiti Malaysia Sarawak (UNIMAS), Sarawak, Malaysia

karahman@unimas.my

Abstract. This paper focus on the employment of partial coherent beam (PCB) in free space optical communication to reduce the flux variance effects in the system. The implementation of PCB in the free space optical system is significantly able to reduce the flux variance effect. The reduction of the flux variance effect by using PCB in free space optical communication by using Gamma-Gamma distribution is presented in this paper. The analysis result shows that the FSO system with PCB have an improved in performance compares with FSO system without PCB implemented on it as it capable to decrease the flux variance and scintillation index. This can help FSO system to encounter with severe turbulence effect for optimum operation.

1. Introduction

The FSO communication is strongly influenced by the atmospheric channel effect which can cause the beam signal fading and wander. The study in the spatially Partial Coherent Beam (PCB) has an attractive number of researchers due to the capability for improving the performance of laser communication systems was indicated recently in a number of publications [1]–[4]. In this paper, the theoretical model for PCB focus on the scintillation index calculation in turbulence. This is because the scintillation index is the most important statistic for practical application FSO systems.

In this research study, the Kolmogorov spectrum model will be used in the case of weak atmospheric turbulence. By using the theory of Andrews [5], [6] the weak scintillation index of a PCB can be used in all atmospheric conditions. Therefore, the scintillation index depends on the strength of the diffuser and the strength of the atmospheric turbulence.

2. Partially Coherent Beam

The figure 1 shows the diffuser model for PCB with propagation channel. For the transmitted beam wave of the diffuser is characterized by TEM_{00} Gaussian beam wave parameters.

$$\Lambda_0 = \frac{2L}{kW_0^2} \tag{1}$$

$$\Theta_0 = 1 - \frac{L}{F_0} \tag{2}$$