Performance Analysis of Double-MIMO Free Space Optical System under Atmospheric Turbulence

A L Tom[1,] A K Rahman[2] , Tamrin F.K[2], Sahari S.K[1], Zamhari N[1].

[1] Department of Electrical & Electronics Engineering, Universiti Malaysia Sarawak, Kuching, Malaysia
[2] Department of Mechanical Engineering, Universiti Malaysia Sarawak, Kuching, Malaysia

ABSTRACT

Over the last few years, free space optical communication (FSO) has emerged as a viable alternative to radio frequency communication. It provides a promising high-speed point-to-point communication solution. However, atmospheric absorption, scattering and turbulence degrade wireless optical communication significantly, lowering device efficiency. The attenuation of signals due to the above atmospheric reasons is another major factor that affects device efficiency. The atmospheric turbulence conditions are observed implemented into different models of FSO systems, such as Single Input Single Output (SISO), Multiple Input Multiple Output (MIMO), Wavelength Division Multiplexing MIMO (WDM-MIMO) and proposed model Double Multiple Input Multiple Output (DMIMO) using the Gamma-Gamma model for a variety of reasons. The OptiSystem 7.0 software was used to run simulations to study how various weather conditions (clear, haze and fog) affected the performance of the channel. Simulation results show that implementing Double Multiple Input Multiple Output (DMIMO) techniques for FSO systems provides high quality factor for various ranges while still achieving accurate transmitted data at the receiver side. In the presence of atmospheric turbulence conditions such as clear air, haze and fog, performance improvements signal power levels, quality factor and link distance range have been demonstrated.

Keywords: atmospheric turbulence, free space optical communication, Gamma-Gamma modelling, multiple-input multiple-output, on-off keying

1. INTRODUCTION

Free Space Optics (FSO) is an optical wireless communication technology that sends data between two points by using light. Optical communications, which use visible and infrared wavelengths to transmit high-speed data optically wirelessly across the atmosphere, is thought to be more powerful technology [1], [2]. In the field of wireless networking, FSO communications has emerged as a game-changing technology. The enormous increase in the amount of data transfer across the world, as well as the resulting increase in bandwidth requirements, has given rise to this technology. Optical fibre is without a doubt the most dependable mode of optical communication. However, the cost of laying fibre is typically prohibitively high because to the digging, delays, and other costs [3]. FSO's main characteristics, such as rapid data transmission, faster implementation, cost-effective infrastructure, and data rates of tens of gigabytes per second, make it a viable short-range radio frequency (RF) link alternative [4], [5]. The underlying mechanism of FSO transmission is identical to fibre optic communication, except that instead of using a directed optical fibre, the modulated data is transferred through an unguided channel [6].

Despite their numerous benefits, they have a number of significant drawbacks that limit their widespread adoption. Physical obstructions such as flying objects, buildings, and natural obstacles; geometrical losses such as beam spreading attenuation and signal power loss;

*Corresponding Author: amlionyy@gmail.com