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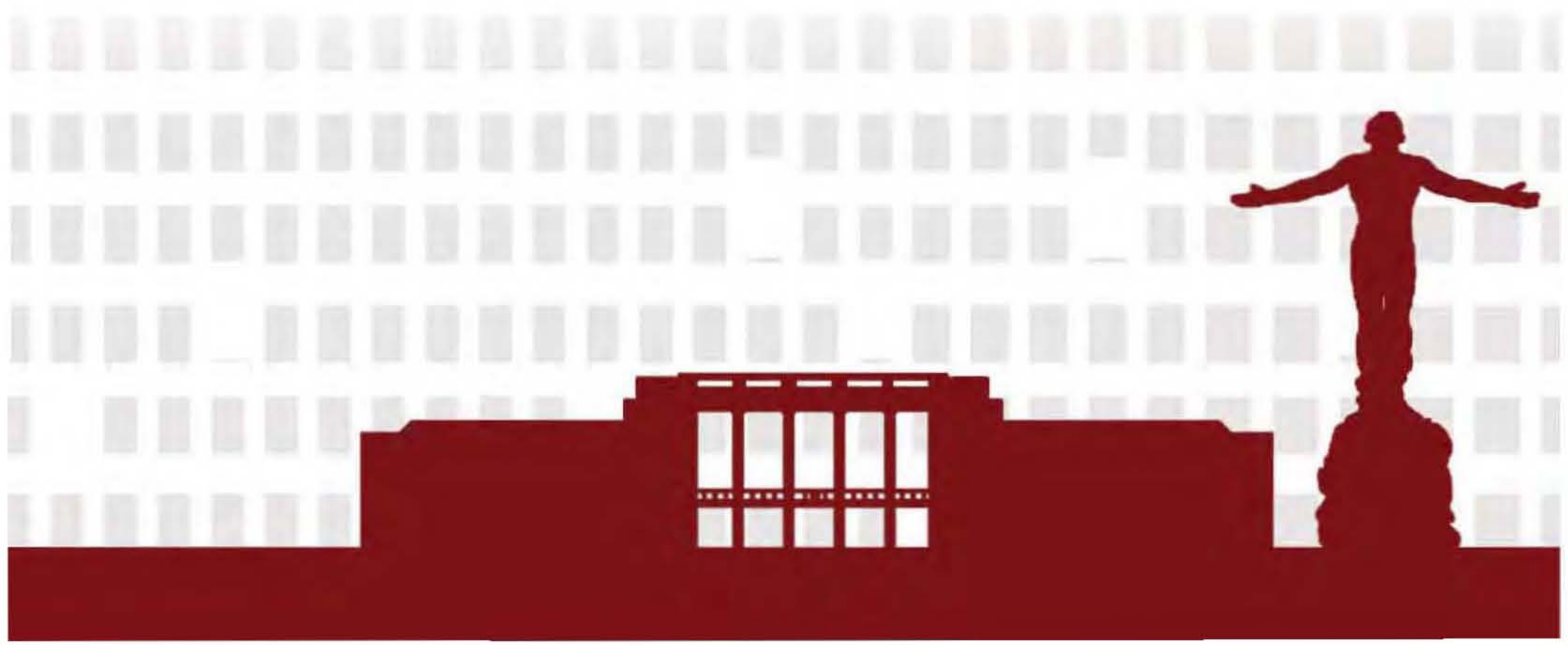

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ASER PERFORMANCE OF AMPLIFY-AND-FORWARD RELAYING MIMO/FSO SYSTEMS USING SC-QAM SIGNALS OVER GAMMA-GAMMA ATMOSPHERIC TURBULENCE CHANNELS

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ABSTRACT

Free-space optical (FSO) communications can provide high-speed links for a variety of applications. The most special characteristics are unlimited bandwidth, unlicensed spectrum, excellent security, and low cost [1]. The use of FSO communication systems is being specially interesting to solve the last mile problem when fiber-optic links are not practical, as well as a supplement to radio-frequency (RF) links. Among the most important disadvantages are the atmospheric propagation factors, such as haze, fog, rain and snow. However, there are several challenging issues in deployment of FSO systems, including the negative effects of scattering, absorption and turbulence. Among these impairment factors, the atmospheric turbulence has shown as the most serious problem on study of optical wireless communications. Atmospheric turbulence results in the fluctuationis of signal intensity, known as scintillation or fading, consequently degrades the system performance [2].

In order to combat with the impact of turbulence, relaying FSO systems have been proposed as a promising solution to extend the longer transmission and mitigate the turbulence-included fading [3]. This is because of the fact that the fading is reduced proportionally to the link length. Most recently, performance of relaying FSO systems over atmospheric turbulence channels has been studied. In [3], probability of both Amply-and-Forward (AF) and Decode-and-Forward (DF) relaying FSO systems employing BPPM modulation was introduced over weak turbulence channels modelled by log-normal distribution. Outage performance of multihop FSO systems over strong turbulence channels modelled by the Gamma-Gamma distribution, has been studied in [4], [5].

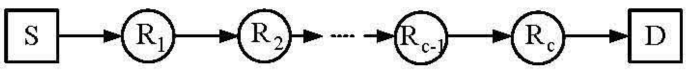

Figure 1. A serial relaying SISO/FSO system

Recent works have shown that, significantly reduce the effect of turbulence on FSO links has been also investigated recently by employing a multiple-input multiple-output (MIMO) with multiple lasers at the transmitter and multiple photodetectors at the receiver. The first use of advantage of spatial diversity in FSO systems has been proposed in [6]. In [7] and [8] Lee *et al.* have derived the outage probability of FSO MIMO systems over gamma-gamma turbulence channels assuming Gaussian noise statistics. Furthermore, in [9], under the assumption of intensity-modulation/direct-detection (IM/DD) with on-off keying (OOK), a closed-form expression for the BER expression of single-input single-output (SISO) case and approximated closed-form BER expressions of FSO MIMO links over strong turbulence channels have been investigated.

In this paper, we theoretically analyze the performance of the amplify-and-forward relaying MIMO/FSO systems using subcarrier intensity modulation (SIM) with general-order rectangular quadrature amplitude modulation (QAM) over Gamma-gamma atmospheric turbulence channels. The optical channels are considered to be impaired with path loss and atmospheric turbulence. They are modeled assuming independent but not necessarily identically distributed Gamma–Gamma fading statistics. We derive exact analytical expressions for the average symbol error rate (ASER) of the system considering of AF relay. The system average symbol-error rate is derived taking into account the atmospheric turbulence effects on the amplify-and-forward relaying MIMO/FSO channel, which is modeled by gamma-gamma distributions for strong turbulence conditions.

Keywords: FSO, MIMO, QAM, amplify-and-forward (AF), atmospheric turbulence.

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