Analytical Solution of FSO-Mimo System Peformance Using DWDM Optical Communication

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Abstract: Now days, in optical communication network challenge requirement are a high quality factor, good performance in terms of parameters like Bit Error Rate (BER), Eye Diagram. An objective of this paper, to analysis the attenuation value for a haze and normal weather condition respectively, and analysis, performance result of the different optical system has been compared in terms of received signal strength and quality factor of the different haze atmosphere. In this proposed paper used FSO with SISO and FSO-MIMO system for measuring the Q-factor and BER for various data link in different atmosphere. Finally, simulation result shows that the improved FSO link over the existing technique in terms of both the parameter signal power strength and quality factor.

Keywords: DWDM, Free Space Optical System (FSO),BER and Q-factor

1. Introduction

Marvi Grover et al proves the performance result of different weather condition using multibeam system over the single beam technology in free space optical communication link and the comparison parameter analysis of bit error rate and quality factor of either under normal and hazy weather condition as shown (In terms of numerical analysis of multibeam system performance under hazy weather and single beam is taken 53 kilometer and 8.5 kilo meter).

The author [2] present the optimum analysed performance of free space optical communication link in various atmospheric condition (three rain condion like light, medium and heavy) over the data rate 2.5 Gbps with 35dB power level. In this performance output result provide increase the system reliability and reduce the implementation cost using NRZ pulse generation and mach-zehrzer modulation. The author sooraj parkash et al. Demonstrate the high data rate with low bit error rate in free space optical communication system over the NRZ pulse generation modulation by using return to zero modulation format. An excellent performance simulation result had shown the 4kilo meter distance with high data rate 40 GB/s and minimum bit error rate respectively. The paper [4] performed an analysis by varying attenuation aspect and varying the turbulence in FSO system. In previous literature survey paper mostly using FSK and PSK modulation scheme, but in this paper using spectrum slicing approach adopted in DPSK modulation scheme and log-normal, gamma-gamma turbulence model, which is provided to achieve high quality signal with low BER in different turbulence.

The analysis performed of FSO present in [5] with different weather condition using different modulation technique. The simulation result of Q-factor is high in the case of gamma-gamma model over the log-normal model which has provide avoid complete link failure in FSO link so, that attenuation is reduced in some of the cloud condition. In [6], the presence of an inter satellite, free space optical communication link performance can be surveyed on the two basis parameter that are selection of different operating wavelength and detector types. The performance result is providing better quality factor and low bit error rate in different hazy weather condition.

2. RELATED WORK

2.1 Dense Wavelength Division Multiplexing

The dense wavelength division multiplexing method is carrying the multiple optical signals from different source onto single optical fibre with different wavelength through free space. The figure 1 shown the multiplexer coupled the multiple signals from the varies link and send to the multiplexer through single optical fibre and demultiplexer separate the individual signal.

2.2 Free Space Optical Communication

In telecom industry need best optical revolution capacity with cost effective, an excellent solution provide by FSO with different atmospheric condition. In optical communication link which transmit desired optical light signal with the required bandwidth towards the advance wireless communication. FSO has both transmitter and

receiver part used, in APD, which convert the optical light signal into an electrical signal and a laser or led generate light signal in in transmitter section is shown in Figure 2.

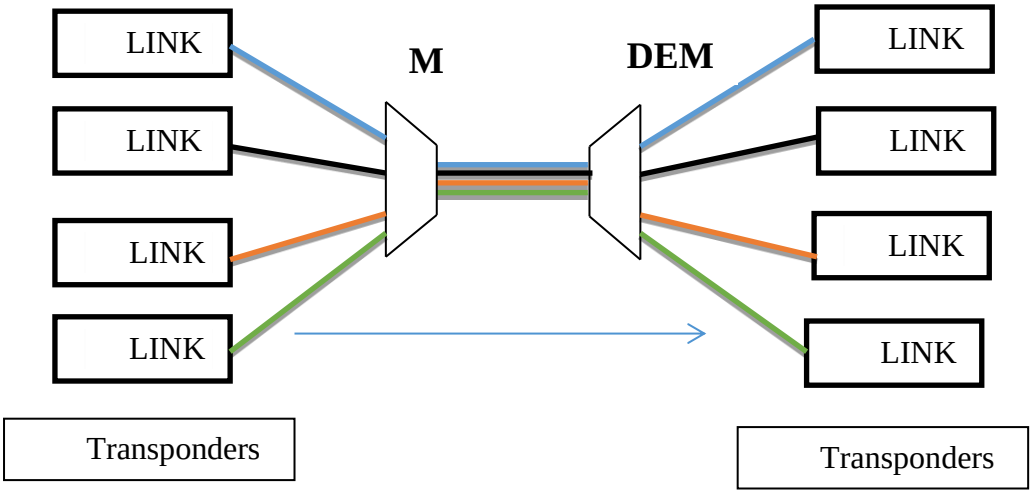

Figure 1: Dense Wavelength Division Multiplexing

2.2.1 Atmospheric Effect

An atmospheric effect has many impacts, when light signal travels in air space, which is affected by a major disturbance due to atmospheric pressure, atmospheric refraction and temperature [9-10]. So, the light signal deflects from the signal path which means varying the refractive index of the light signal. Finally, large amount of signal attenuated by scattering effect and grater observation of an object (like water, air) in free space.

2.2.2 Weather Effect

In day to day weather condition is changed, especially when heavy rain affects the light signal in the free space link. In FSO communication link affect by different effect due to different weather condition occur which means the radius of the raindrops is greater than the wavelength of the signal.

The author [7] has been demonstrated of historical aspects in data transmission over FSO by mirrors and optical telegraphs in wireless system. The basic requirement the components of the individual link design in practical link to satisfy required power and transmission speed. In this paper [8] has been overcome the sensitive misalignment by the parameter of background noise due to haze weather condition like sunlight in FSO system. Demonstrate result is 3.6 b/s Hz, 18 Gbaud symbol rate, high efficiency and obtained by using 32 QAM modulation techniques

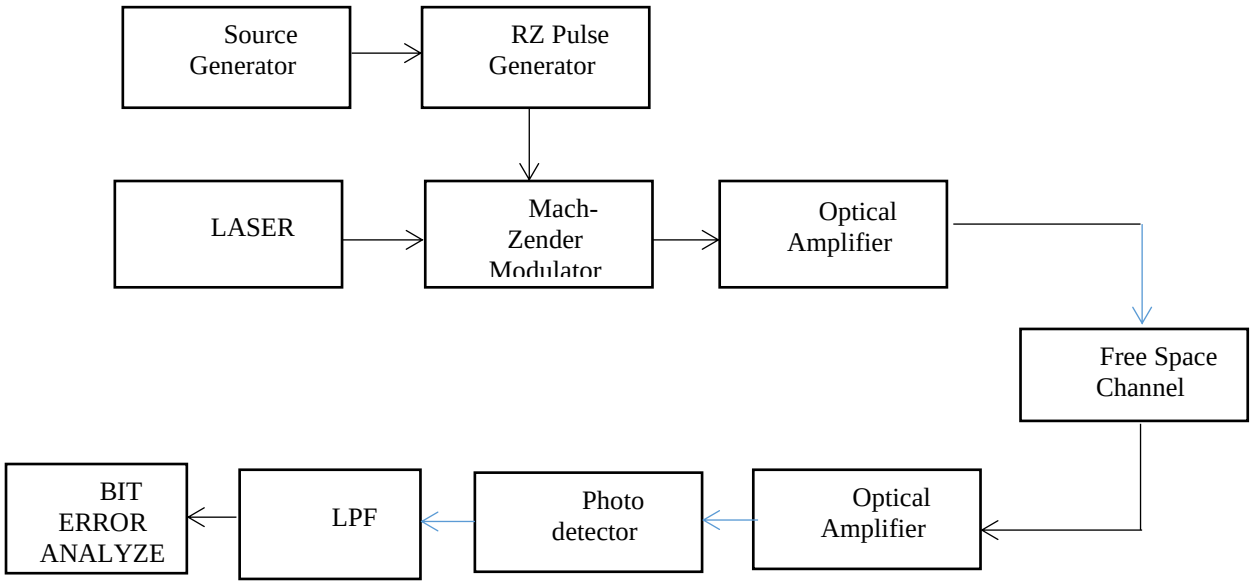

Figure 2: Block diagram of Free Space Optical (FSO) transmission System

3. Result and Performance

The figure 3 has shown the schematic representation of 8 x 8 DWDM with FSO channel link. This proposed system model, namely FSO-SISO and FSO-MIMO with dense wavelength multiplexing transmitter consider the 4 x 4 and 8 x 8 DWDM with 16 channel link, date rate is 2 GB/sec and 15dBm power.

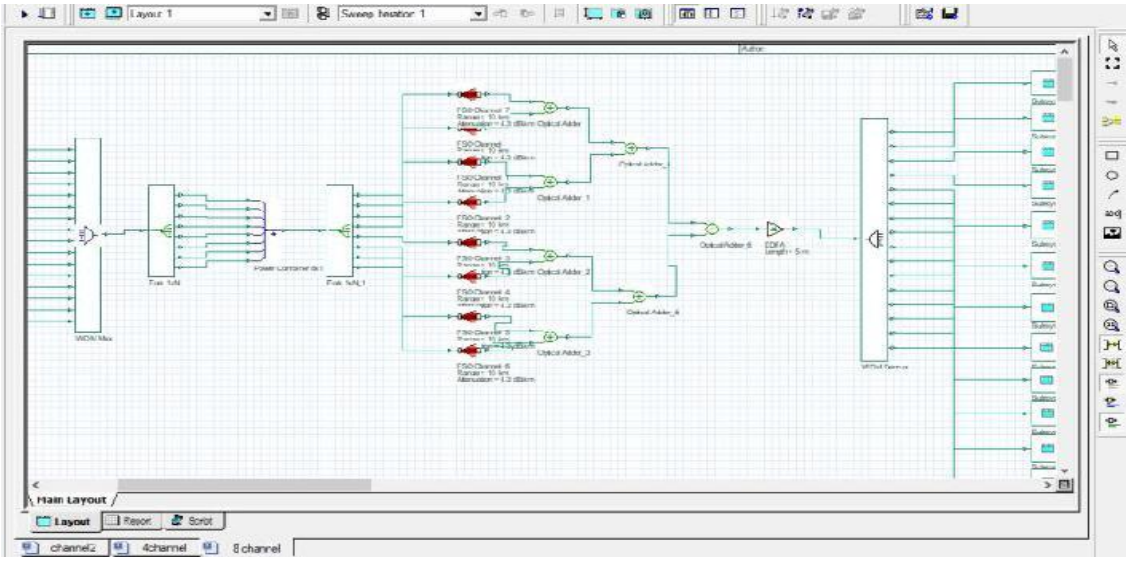

Figure 3: Schematic representation of 8x8 DWDM FSO-MIMO systems

S.no	Range in Km	4 x 4 Channel		8 x 8 Channel	
		BER	Q-Factor	BER	Q-Factor
1	4	0	47.82	0	52.00
2	6	$1.6e^{-72}$	16.85	0	50.20
3	8	$1.2e^{-003}$	3.94	$5.93e^{-129}$	22.8
4	10	$1.01e^{-011}$	0	$1.01e^{-011}$	6.5

Table 1: Weather condition analysis using 4 x 4 and 8 x 8 DWDM FSO-MIMO System with haze

A bit analyser is used to measure the minimum BER and maximum quality factor with help of height and threshold value from eye diagram in 4 x 4 and 8 x 8 FSO system with haze condition is shown in Table 1. Figure 4 shows the maximum Q-factor against range plot for the two models SISO and MIMO-FSO communication link under the haze weather condition with 10 km distance range. From, that simulation result concludes the FSO-MIMO system has higher value at lower values of distance range(1 – 2 k.m) and decrease the lower range to the higher distance range (6-10 k.m). The measure of the BER in MIMO-FSO system value from the eye diagram for a haze weather condition is 20 d/km in 10 km distance range which is shown in figure 5.

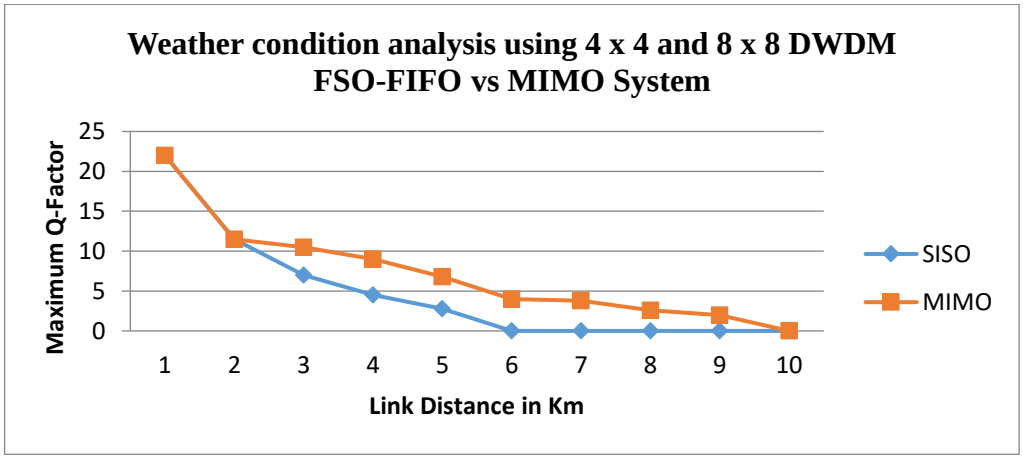

Figure 4 Comparison of DWDM FSO-SISO versus MIMO systems with haze weather condition

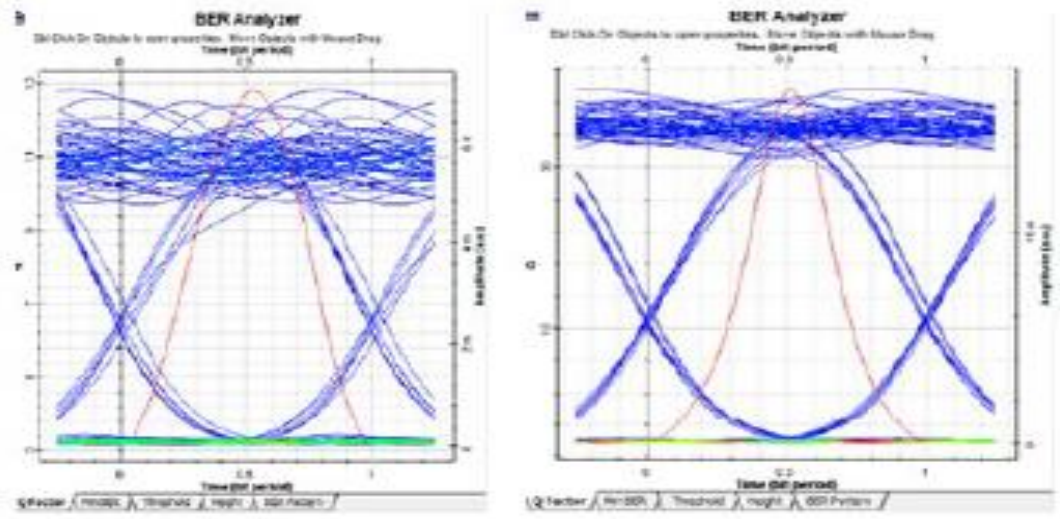

Figure 5 BER output of 10 km distance range under the haze weather condition

5. Conclusion

The quality higher data rate transmission requires free space optical communication over the normal and haze weather condition. In this paper, experimentally demonstrated the high performance analysis of FSO-MIMO system with flexible transmitter, in this regard shown the 20 dB/sec data rate by using an RZ modulation technique in distance range is 10km. The achievements of low bit error rate and high quality factor using the Opti System for different data flow in FSO-MIMO over the FSO-SISO in the haze weather condition.

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