Analysis of Free Space Optics System

Vasundhara Shukla[1], Durgesh Shukla[2]
[1]*Corporate Institute of Science & Technology, Bhopal, India*
[2]*Technocrat's institute of Technology, Bhopal, India*

Abstract – Free Space Optics (FSO) systems are generally employed for 'last mile' communications and can function over distances of several kilometers as long as there is a clear line of sight between the source and the destination, and the optical receiver can reliably decode the transmitted information. Our paper is based on relative performance comparison of different modulation techniques for coherent transmission system is presented to improve the receiver sensitivity for wireless optical communications.

Keywords **-** wireless optical communication, differential phase-shift keying, balanced receiver, scintillation.

I. INTRODUCTION

Basic Optical Wireless System

The basic sub system of an optical wireless system is transmitter based on either (LEDs or LDs), the channel (the medium between the transmitter-receiver) the receiver based on (PIN or APD based) .the link length can vary from a few meters to a few km.The electrical information signal produced by source modulates an optical carrier. The one commonly modulate is intensity modulation (IM).The modulated optical carrier is propagated through the channel. At the receiver, the received optical field is optically collected and converted back to an electrical signal by detector, which is further processed by electronic stages to recover the original information with an acceptable level of error.

II. FREE SPACE OPTICAL COMMUNICATION

Free Space Optics (FSO): In telecommunications, is an optical communication technology that uses light propagating in free space to transmit data between two points. Free Space Optical (FSO) communication systems, also known as wireless optical communications, provide tremendous potential for low-cost time-constrained high-bandwidth connectivity in a variety of network scenarios.

III. ELEMENT OF WIRELESS OPTICAL COMMUNICATION

Laser diode: A laser diode is a laser where the active medium is a semiconductor similar to that found in a light-emitting diode. Laser diode is formed from a p-n junction and powered by injected electric current.

LED: A light-emitting diode (LED) is a semiconductor light source. LEDs are used as indicator lamps in many devices, and are increasingly used for lighting.

MZI: Mach–Zehnder interferometer is a device used to determine the relative phase shift between two collimated beams from a coherent light source. The interferometer has been used, amongst other things, to measure small phase shifts in one of the two beams caused by a small sample or the change in length of one of the paths.

Optical amplifier: optical amplifier is a device that amplifies an optical signal directly, without the need to first convert it to an electrical signal.

Optical filter: Optical filters, generally, selectively transmits light having certain properties, while blocking the remainder.

IV. OVERVIEW OF MODULATION FORMATS

A. *RZ-OOK*

RZ means 'return-to-zero', so the width of optical signal is smaller than its bit period. First, NRZ optical signal is generated by an external intensity modulator then, it is modulated by a synchronized pulse train with the same data rate as the electrical signal using another intensity modulator

B. *NRZ-DPSK*

A very important characteristic of NRZ-DPSK is that its signal optical power is always constant. a one-bit-delay Mach-Zehnder Interferometer (MZI) is usually used as a DPSK optical receiver.

C. *RZ-DPSK*

In order to improve system tolerance to nonlinear distortion and to achieve a longer transmission distance, return-to-zero DPSK (RZ-DPSK) has been proposed. Similar to NRZ-DPSK modulation format, the binary data encoded as either a "0" or a "π" phase shift between adjacent bits.

V. EXPERIMENTAL RESULT

Comparison of ASK, PSK, DPSK S/N v/s BER & SR v/s BER

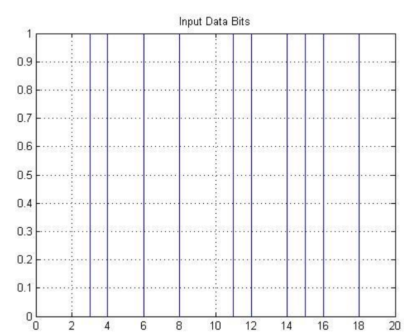


Fig.1: Input data bit

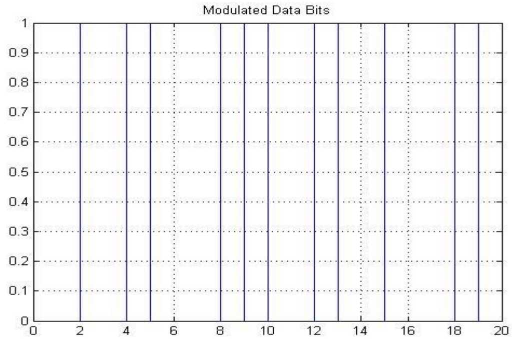
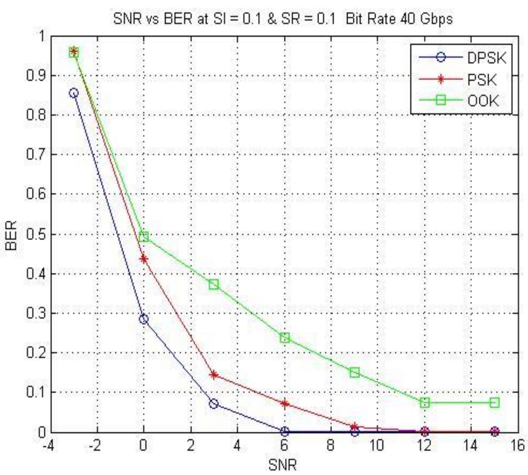


Fig.2: Modulated data bit

Comparison of ASK, PSK, DPSK

S/N v/s BER



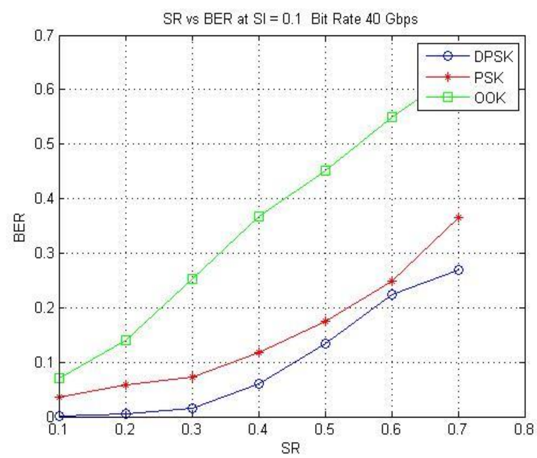
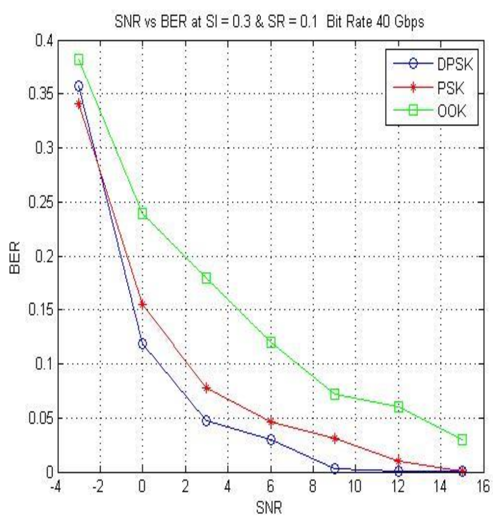


Fig.4: SNR v/s BER

Fig.3: SNR v/s BER



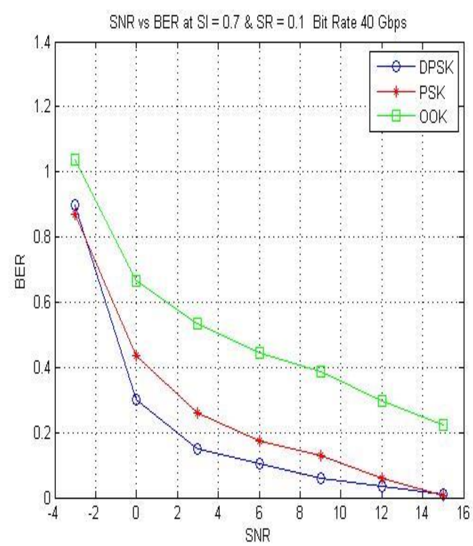


Fig.5: SNR vs BER at SI=0.3 & SR = 0.1

Fig.6: SNR vs BER at SI = 0.7 & SR = 0.1

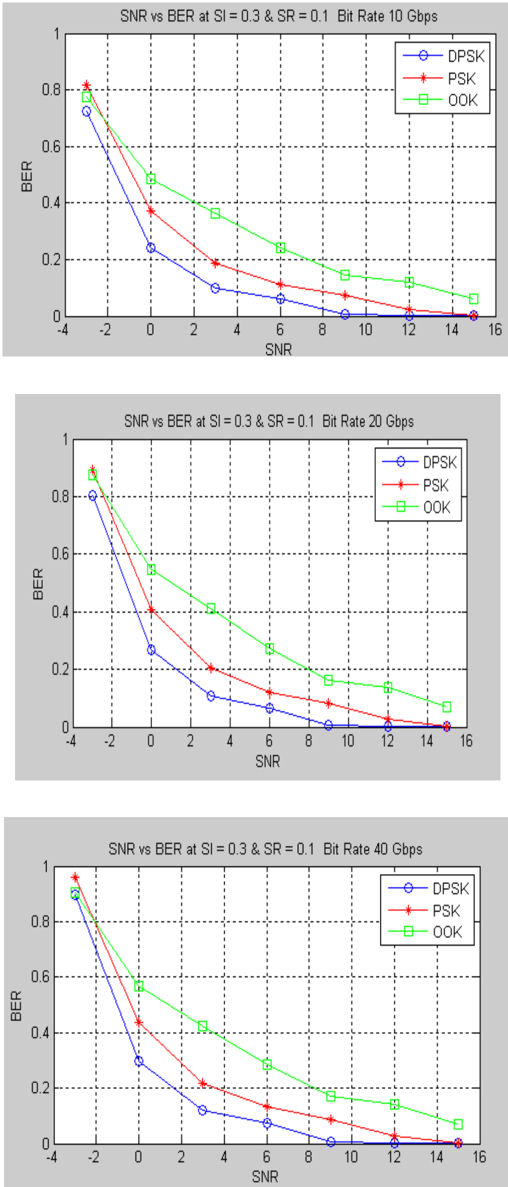


Fig.7: SNRV s BER at Scintillation index=0.3 bit rate 10Mbps, 10Gbps, 20Gbps& 40 Gbps

VI.CONCLUSION

Wireless optical system, the DPSK format has a better performance than OOK in atmosphere turbulence for its longer symbol distance and being signal intensity insensitive. An appropriate coding technique improves the performance for the Wireless optical transmission system.

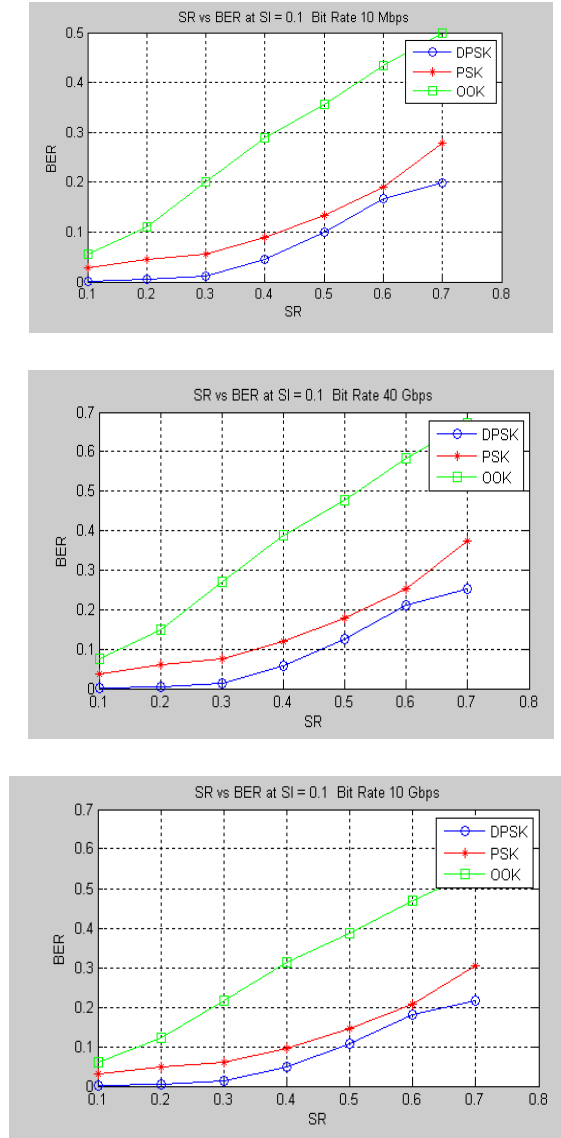


Fig.8: SR v/s BER at Scintillation index=0.1 bit rate 10Mbps, 10Gbps, 20Gbps & 40 Gbps

VII. REFERENCES

[1] Song Gao,Anhong Dang and hong Guo, "Performance of wireless optical communication system using DPSK Modulation" in *ICACT*, pp.1793-1796, Feb. 15-18 2009.

[2] K. Kikuchi, "Coherent optical communication systems," in *Optical Fiber Telecommunications V, vol. B, Systems and Networks*, Eds. New York Academic, pp. 95–129, 2008.

[3] Jia Li,John Q.Liu. and desmond P. Taylor "optical communication using subcarrier PSK intensity modulation through Atmospheric Turbulence channels," in *Proc. IEEE ,vol.55,No.8*, pp. 1598-1606,August 2007.

[4] P. J. Winzer and R.-J. Essiambre, "Advanced optical modulation formats," *Proc. IEEE*, vol. 94, no. 5, pp. 952–985, 2006.

[5] A.H. Gnauck and P. J. Winzer Meng, "Optical Phase shifted key transmission atmospheric turbulence channel," *IEEE J. Light wave Technology,* vol.23 no.1, pp.115-130, Jan 2005.

[6] M. Razavi and J. H. Shapiro, "wireless Optical communications via diversity reception and optical preamplification," *IEEE Transaction on communications* vol.4 ,pp.975-983,May 2005.

[7] K. Kiasaleh, "Performance of APD-based, PPM free-space optical communication systems in atmospheric turbulence", *IEEE Trans. Commun.*, vol.53 ,pp. 1455-1461,2005.

[8] Ron Hui, Sen. Zhang,"Advanced Optical Modulation Formats and Their Comparison in Fiber-Optic Systems", *A Technical Report to Sprint, by Light wave Communication Systems Laboratory, The University of Kansas,* 2004.