Performance Completion of Spectral Efficient Free Space Optical System Using Electro Optic Modulator

P. Vanmathi[1], V. Harithra[2], E. Indhu[3], P. Helen Sandhiya[4], R. Janani[5]
[1]Assistant Professor, Dept of ECE
[2, 3, 4, 5]Dept of ECE
[1, 2, 3, 4, 5] K. Ramakrishnan College of Technology.

Abstract- *This paper proposes multilevel linear polarization Shift keying (MLPolSK) modulation, based on high polarization –dependent gain optical amplifier (PGD-OA), for spectral efficient free space optical (FSO) communication.FSO has wide advantage of wide Bandwidth ,Power efficiency, Small Size, Unlicensed Spectrum compared to Radio Frequency. Application of FSO Technique are studied in recent decades. 5G Communication demand for high capacity,quality, massive connectivity, ultra –low latency increases exponentially. High order modulation is essential to improve Spectral efficiency. Instead of Mach-Zehnder modulator an Electro Optic Modulator (EOM) is used. Because Mach-Zehnder modulator has less power control and high insertion loss. Experimental results illustrate that multilevel linear SOPs Can distinguished effectively by the proposed –technique.*

I. INTRODUCTION

This Free space optical (FSO) communication has the advantages of wide bandwidth, power efficiency, small size, unlicensed spectrum, and high security when compared to radio-frequency (RF) communication [1]. The application of the FSO technique into mobile networks has been intensively studied in recent decades. For fifth-generation (5G) mobile networks, and beyond, the demand for ultra-high capacity and quality, massive connectivity, and ultra-low latency services increases exponentially [2], [3]. Therefore, higher-order modulation is essential to improve the spectral efficiency (SE). The amplitude, phase, and polarization properties of laser beams have been researched to improve the order of modulation. For the amplitude, multiple levels of amplitudes were studied to improve the SE for the individual wavelength [4]. In the atmospheric turbulence channel, the turbulence induced-scintillation effects cause serious signal intensity fluctuations, which requires scintillation mitigation. However, it is difficult to mitigate scintillation effectively for the multilevel amplitude modulation due to the serious signal intensity level distortion during the process of scintillation mitigation. Regarding the phase, the multilevel differential phase-shift keying (MDPSK) was studied to improve the SE and reduce phase noises [5]. However, the precise control of a one-bit delay interferometer and the coherent detection, make its practical implementation significantly more complex. The state of polarization (SOP) maintains a stable state for the spatially coherent plane wave in the turbulence channel [4], [6]. Therefore, multilevel polarization-shift keying (MPolSK) was introduced to improve the SE by the transmission of various SOPs [7].

As to the detection of MPolSK, both direct and coherent detections have been studied to estimate SOPs of the received signal [7]– [9]. Stokes parameters of the received signal are obtained by multiple-photodiodes (PDs). And then, SOPs are calculated symbol-by-symbol using the knowledge of Stokes parameters. Therefore, numerous calculations are required for this estimation of SOPs symbol-by-symbol, and this makes real-time processing difficult. Besides, it adds significant complexity to the receiver system due to the application of multiple-PDs. Therefore, it is preferable to simplify the detection process of MPolSK signal with effective scintillation mitigation.

In this paper, we propose the high polarization-dependent gain optical amplifier (PDG-OA) based MLPolSK modulation for spectral efficient FSO. Based on the PDG In this paper, we propose the high polarization-dependent gain optical amplifier (PDG-OA) based MLPolSK modulation for spectral efficient FSO. Based on the PDG characteristics of the OA, various SOPs obtain different optical gains from the high PDG-OA. In the transmitter, we employed various linear SOPs with different optical gains from the PDG-OA to modulate the MLPolSK signal and thus improve the SE. In the receiver, a polarization-independent semiconductor optical amplifier (SOA) was applied to mitigate scintillation using gain saturation feature of SOA. The SOA has a high dynamic gain frequency and the MLPolSK signal has a constant signal intensity, thus, scintillation was effectively mitigated from nonlinear gain from SOA. Next, a high PDG-OA was deployed before a PD to transform the different SOPs into various signal intensity levels. Finally, various SOPs were determined using multilevel-thresholds decision. Consequently, the detection of MLPolSK signal was simplified by a single PD direct detection using multilevel-

thresholds decision instead of the estimation of SOPs symbol-by-symbol using multiple-PDs detection. The proposed method was verified in experiments with Mach–Zehnder modulator (MZM)-based fading emulated turbulence channel. The reflective semiconductor optical amplifier (RSOA) was used to supply a high PDG-up to 20 dB. Experimental results show that the SE was improved with the effective scintillation mitigation and simplified MLPolSK detection in the turbulence channel instructions beyond this point are from IEEE.

II. LITERATURE SURVEY

[1]" Direct Detection of Optical Digital Transmission Based on Polarization Shift Keying". Receiver structures for the direct detection of binary and multilevel digital optical modulation schemes employing the modulation of the state of polarization of light, or POLarization Shift Keying (POLSK), are proposed and accurately analyzed, in the presence of optical amplifier ASE noise and electrical receiver noise. Direct Detection of Optical Digital Transmission Based on Polarization Shift Keying.

[2]"MDPSK Based Non-Equalization OFDM for Coherent Free –Space Optical Communication". We apply a non-equalization orthogonal frequency-division multiplexing (NE-OFDM) technique in optical turbulence channel for coherent free-space optical (FSO) systems, utilizing multilevel differential phase-shift-keying (MDPSK).

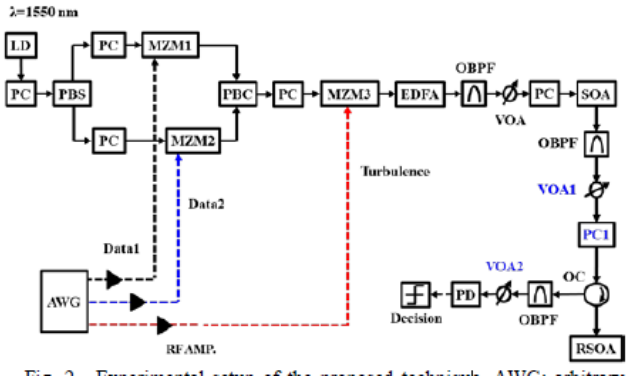
[3]"Polarization –Multiplexed Optical Communication". we verify polarization-multiplexed optical wireless transmission with coherent detection as a means of improving performance and increasing the per-wavelength data rate in the presence of atmospheric turbulence.

[4]"Up to 10.7-Gb/s High-PDG RSOA-Based Colorless Transmitter for WDM Network". The operation of a network-embedded colorless self-tuning transmitter for WDM networks is experimentally demonstrated from 2.5- up to 10.7-Gb/s data rates. Colorless operation is achieved by self-seeding an ultra-fast reflective semiconductor optical amplifier (RSOA) with the feedback signal reflected at the WDM multiplexer filter.

[5]"Enlargement of Beam Coverage in FSO Mobile Network". Pointing, acquisition and tracking of a free-space optical node in a mobile network experiencing misalignment due to adverse factors including vibration, motion and atmospheric turbulence requires a different approach than traditional free-space optical transceivers.

III. OPERATING PRINCIPLE

Electro optic modulator (EOM) is used to modulate intensity of laser beam via electric voltage. Its principle of operation is based on the Franz- Keldysh effect, i.e., a change in the absorption spectrum caused by an applied electric field, which changes the band gap energy (thus the photon energy of an absorption edge) vitality (accordingly the photon vitality of a retention edge) yet as a rule doesn't include the excitation of bearers by the electric field. For modulators in broadcast communications, little size and adjustment voltages are wanted. The EAM is possibility for use in outer adjustment connects in broadcast communications. These modulators can be acknowledged utilizing either mass semiconductor materials or materials with numerous quantum dabs or wells.



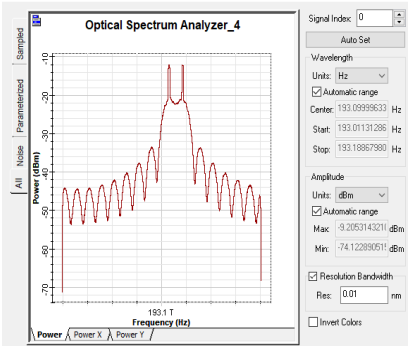
IV. SYSTEM MODEL

Multilevel linear polarization shift keying

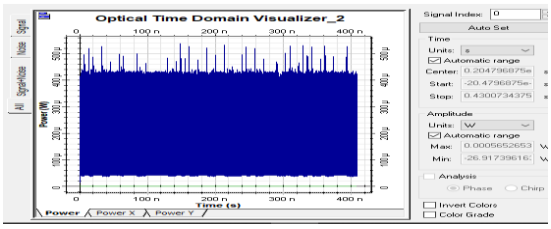
The essential thought depends on the property of solitons that the advancement of the condition of polarization during proliferation can be spoken to with a decent level of guess with an inflexible turn of the Poincare circle. In this manner, other than the inflexible pivot that can be made up for at the recipient, the condition of polarization of the sign can be utilized to convey data. Here the restrictions of the inflexible turn that are because of polarization mode scattering and enhanced unconstrained emanation commotion are conceived. Results show how this plan allows the transmission-separation cutoff to be defeated for single-channel power tweaked direct-identification soliton frameworks. For instance we show how a 2.5-Gsymbol/s framework with 24 polarization levels prompts an absolute limit of 10G bits/s over separations up to 3000 km in joins including standard scattering filaments. we present reenactment of polarization subordinate addition in semiconductor optical amplifier. Assume that the enraptured optical field can be decayed in to transverse electric and transverse attractive part that have aberrant connection with one another through the increase immersion. The addition is

represented by a populace unevenness factor (f) because of elastic strain in the enhancer.

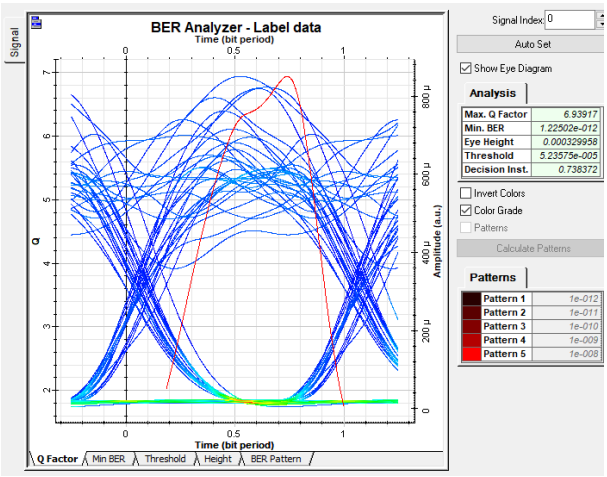
1) Optic spectrum analyzer



2)optic time domain analyzer



3)BER Analyzer



V. CONCLUSION

In rundown, a high PDG-OA based ML Pol SK tweak was proposed in ghastly proficient FSO. High PDG-OAs were examined to tweak ML PolSK flag and change SOPs of ML PolSK into various force levels. The viability of shine relief utilizing a polarization-autonomous SOA was assessed. The SE was improved by the transmission of staggered SOPs. The estimation of SOP was disentangled by a solitary PD location and the staggered limits choice rather than the figuring of SOPs image by-image utilizing numerous PDs identification. The proposed system was checked through investigations utilizing polarization-autonomous SOA, high PDG-RSOA, and MZM-based blurring emulator. Experimental results demonstrate that 4LpolSK can be detected with effective scintillation mitigation and simplified SOPs estimation. Therefore, it has high potential and is a feasible technique for spectral efficient real-time FSO transmissions.

.

REFERENCES

[1] H. Kaushal, et al., "Optical communication in space: challenges and mitigation techniques," *IEEE Common Survey. Tutor.*, vol. 19, no. 1, pp. 57-96, FIRST QUARTER. 2017.

[2] M. Z. Chowdhury, et al., "A comparative survey of optical wireless technologies: architectures and applications," *IEEE Access*, vol. 6, pp.9819-9840, Jan. 2012.

[3] D. Zhou, et al., "Enlargement of beam coverage in FSO mobile network," *J. Lightw. Technol.*, vol. 29, no. 10, pp. 1583–1589, May. 2011.

[4] R. Zhang, et al., "4×100 -Gbs PAM-4 FSO transmission based on polarization modulation and direct detection," *IEEE Photon. Technol. Lett.*, vol. 31, no. 10, pp. 755–758, Mar. 2019.

[5] C. Chen, et al., "MDPSK-Based Non-equalization OFDM for coherent free-space optical communication *IEEE Photon. Technol. Lett.*, vol. 26, no. 16, pp. 1617–1620, Mar. 2014.

[6] D. F. V. James, "Change of polarization of light beams on propagation in free space," *J. Opt. Soc. Am. A.*, vol. 11, no. 5, pp. 1641–1643, May. 1994.

[7] X. Zhang, et al., "Coherent heterodyne multilevel polarization shift keying with spatial diversity in a free-space optical turbulence channel," *J. Lightw. Technol.*, vol. 30, no. 16, pp. 2689–2695, Aug. 2012.

[8] N. Cvijetic, et al., "Polarization-multiplexed optical wireless transmission with coherent detection," *J. Lightw. Technol.*, vol. 28, no. 8, pp. 1218– 1227, Apr. 2010.

[9] S. Benedetto, et al., "Direct Detection of Optical Digital Transmission Based on Polarization Shift Keying Modulation," *IEEE J. Select. Areas* Modulation," *IEEE J. Select. Areas Common.* , vol. 13, no. 3, pp. 531–542, Apr. 1995.

[10] Handbook of Fiber Optic Data Communication A Practical Guide to Optical Networking, USA, NY, New York: Academic, 2013.