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Comparative analysis of chirped, AMI and DPSK modulation techniques in IS-OWC system

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ABSTRACT

The work in this paper presents 64 Channel Inter-Satellite Optical Wireless Communication system using three Modulation methods. The advanced system has been achieved through Wavelength Division Multiplexing (WDM) by using optimized modulation methods like Chirped RZ, AMI and DPSK. The advanced system is composed and thus simulation is done at 10, 20 and 40 Gbps having range of 750 nm at different distances. The basic goal of the system is to provide good performance which has been achieved by high quality-factor and minimum BER. So eye diagrams have been presented at different bit rates. The comparative results show that at 10 and 20 Gbps, DPSK Modulation shows best performance. At 40 Gbps, AMI Modulation contains high Q-factor than Chirped and DPSK Modulation Techniques.

1. Introduction

An optical communication system comprise of transmitter part, transmission channel, and receiver part. There will be a merging of Wavelength-Division multiplexing (WDM) using OWC system which would result in providing excellent bit-rate, less bit-errors and high speed which can travel long distances. Free space optical communication is technology of optical transmission which is helpful for transmission of data and signals [1].One of the most important applications of FSO is IS-OWC. IS-OWC systems usually promote exchanging of information between two satellites. It has been helpful to carry an optical signal with the help of wireless links resulting in the combination of optical as well as wireless technology [3]. Optical wireless communication (OWC) contains certain merits such as it has the ability to operate at high bit rate, low loss, high bandwidth, the small size of the antenna and high efficiency of power. It has the ability to operate in several electromagnetic bands like ultraviolet communication (200–280 nm) and infrared wavelength (750–1560 nm) [6,10].

In a digital communication system, bit errors are the signal receiving bits that also contain a certain amount of disturbance, obstruction and interference. Thus bit rate is termed as the count of bits that is carried in certain amount of time [7]. Adopting inter-satellite with OWC system leads to the development in security and few bit errors [10].

The IS-OWC system has a number of benefits. First, no license is required in a communication link. The second benefit is the immunity and power to the RF interference or level of saturation [8]. An OWC system with 32-channels which operated at 10 Gbps adopted modulation techniques of Non-Return to Zero (NRZ) and Return to Zero (RZ) was described in [9].Thus OWC system with 64-channels which operated at 10, 20 and 40 Gbps adopted modulation techniques of carrier-suppressed

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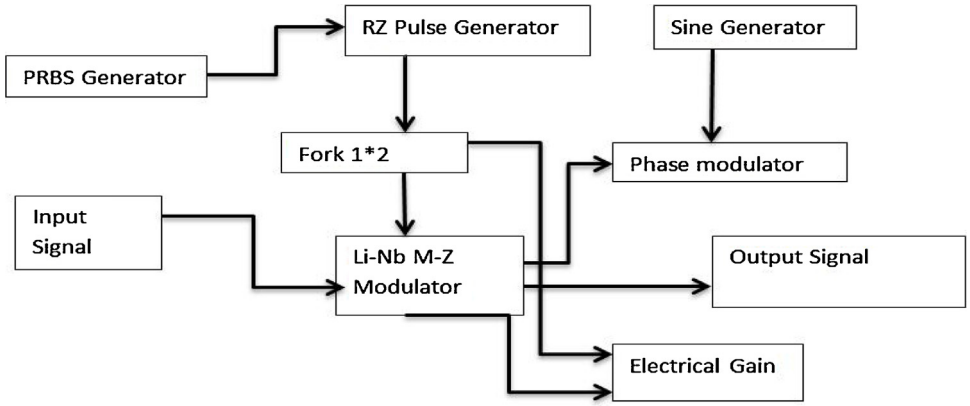
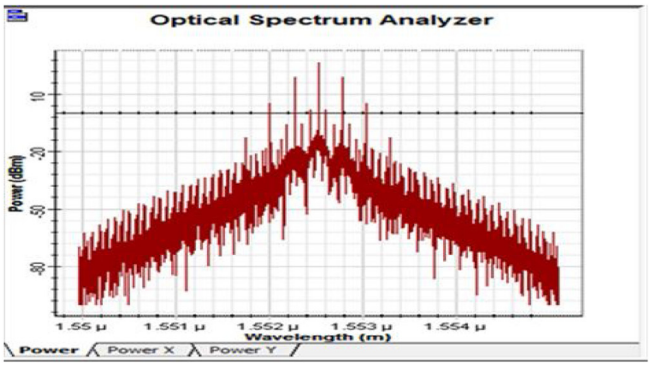


(a) Block Diagram of Chirped Modulation



(b) Optical Spectrum Analyzer at Chirped Modulation

Fig. 1. (a) Block Diagram of Chirped Modulation (b) Optical Spectrum Analyzer at Chirped Modulation.

Return to Zero (CSRZ), Duo-binary Return-to-zero (DRZ) and Modified Duo-binary Return to Zero (MDRZ) was described in [1].

In this paper, IS-OWC system with excellent capacity having chirped and AMI modulation methods has been presented. Characterization of modulation methods and proposed system has been explained. Thus results have been taken and thus conclusion and future scope has been discussed to determine the efficiency of IS-OWC system.

2. Characterization of modulation methods and its simulation

Fig. 1(a) illustrates the block diagram of Chirped modulation that is considered as the highly preferred modulation method. In this type of modulation, RZ optical signal which goes through LiNb Mach-Zehnder Modulator passes through phase modulator (PM). Chirped RZ, Chirped NRZ and Alternate Chirped NRZ are new modulation techniques that can be preferred in IS-OWC systems. The Extinction ratio is taken around 30 dB. Frequency is taken around 193.1 Thz and power is chosen around 30 dB. Chirped RZ is preferred as compared to other modulation techniques because of its high Q-factor and less BER. Chirped RZ have been quite useful in dispersion compensation and helps improvement in narrowband optical filtering. Non-linearity of optical fiber can be reduced by dispersion map [2]. The output of optical spectrum analyzer is shown in Fig. 1(b).

Fig. 2(a) shows the proposed block diagram of AMI Modulation format which is used to enhance transmission capacity of fiber and exhibit high SNR. AMI contains binary 0 for zero or neural voltage and binary 1 for alternate negative as well as positive voltages. AMI can be efficiently coordinated with WDM technology and it enhances the bandwidth of the optical system [3]. AMI is used in IS-OWC systems because it contains high encoding of data than NRZ and RZ modulation technique. In this type of modulation, NRZ pulse generator has been created by duobinary precoder and duobinary pulse generator. NRZ pulse generator drives to Low pass Gaussian filter and output of oscilloscope visualizer is measured. The sine generator takes the first Mach-Zehnder modulator and then connects it with another Mach-Zehnder Modulator. Fig. 2(b) shows the optical spectrum analyzer of AMI Modulation at 193.1 Thz.

Fig. 3(a) shows the proposed block diagram of DPSK Modulation format that requires the use of input bit sequence and its encoding. It has less complications in tracking, high tolerance to Doppler-shift and it performs at high data rates [4,5].