Analysis of Various Dispersion Parameters of Optical Soliton using Optisystem

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Abstract

We all know that, the fastest communication was possible only by optical fiber and the efficiency was also high when compared with other wired and wireless medium. Even though in optical fiber, there are several dispersion and other non-linear losses in the optical fiber communication. Here we analyze various dispersion parameters in optical mode of communication with the help of optisystem software and we rectify those errors to increase the efficiency by changing several parameter values and certain components.

Keyword- Optical Fiber, Optical Spectrum, GVD, CW Laser

I. INTRODUCTION

Optical fiber communication is the fastest communication medium. Here, we are going to analyze and simulate the optical communication by OPTISYSTEM simulation software. This software will help us to analyze the overall performance in optical simulation. In existing method, the group velocity dispersion and self-phase modulation reduce the transmission efficiency for low bit rate. If we increase the bit rate, the dispersion of pulse occurs. It is not at all good for the lossless transmission. Dispersion led to cross talk and interference in the pulses. So that, we are going to propose the efficient way to transmit the data pulses by various analysis and material changes. Our system has low dispersion and it was able to transmit information for long distance with reduced loss when compared to existing method with the help of Optisystem software.

II. EXISTING SYSTEM

The bit sequence generator is used to generate binary code and it will give as input to the optical pulse generator. The input is then transmitted to the receiver through the optical fiber. In this method, they used only low bit rate and the frequency was obtained also low which is approximately 193 THz. But, we can transmit the information or data for upto the frequency of 180 THz to 330 THz in the optical medium. By the analysis, we conclude that the bit error rate was high and there are several non-linear dispersions like group velocity dispersion (GVD), self-phase modulation (SPM) and other fiber losses like absorption loss, bending loss, scattering loss, dispersion loss, etc.

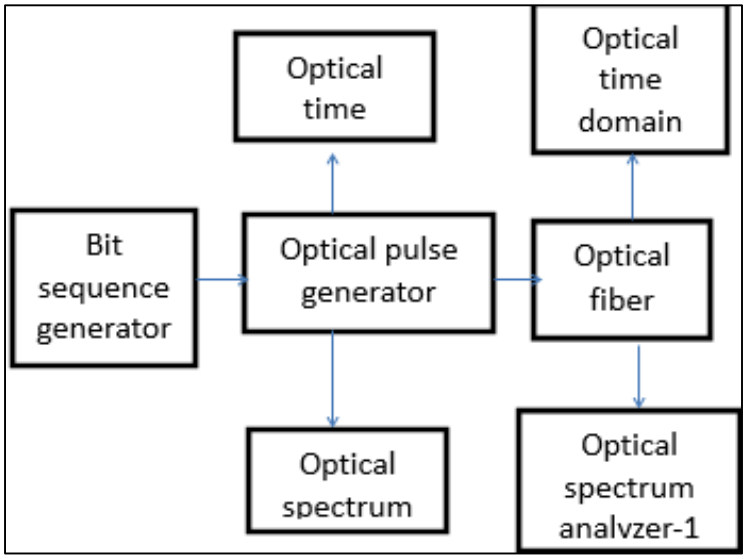

Fig. 1: Block Diagram for existing method

which will affect the original data during pulse transmission even for a short distance communication

Parameters	*Value*	*Unit*
Bit rate	*40*	*Gb/s*
Sequence length	*8*	*Bits*
Frequency	*193.1*	*THz*
Width	*0.5*	*Bits*
Wavelength	*1550*	*Nm*
Length	*3.94*	*Km*
Dispersion length	*2.51*	*Km*

Table 1: Parameters used in existing method

The above block presents the simulation result of the effects of GVD, SPM and other fiber losses for a particular distance using optisystem simulation software.

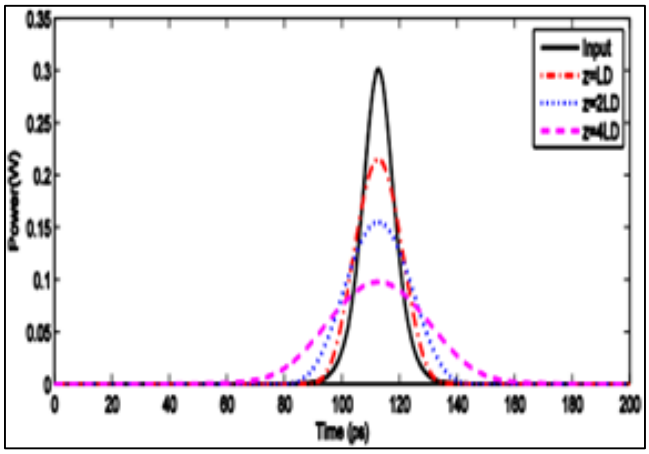

Fig. 2: The effect of GVD in Time domain

III. PROPOSED METHOD

In optics, the term soliton is used to refer to any optical field that does not change during propagation because of a delicate balance between nonlinear and linear effects in the medium. Spatial soliton and temporal soliton are types of solitons. Dispersion and non-linearity can interact to produce permanent and localized wave forms. Consider a pulse can be thought of as consisting of light of several different frequencies. Here, we replaced optical source as a Continuous wave laser. It will generate the wave pulses continuously without break. Hence, the equation was expressed to find the depression loss manually by using Runge-kutta method.

$$D = \frac{d\beta_1}{d\lambda} = -\frac{2\pi c}{\lambda^2}\beta_2 \approx \frac{\lambda}{c}\frac{d^2n}{d\lambda}$$

Where,
D- Dispersion of the optical fiber
β- Order of dispersion
λ- wavelength
n- Refractive index

IV. METHODOLOGY

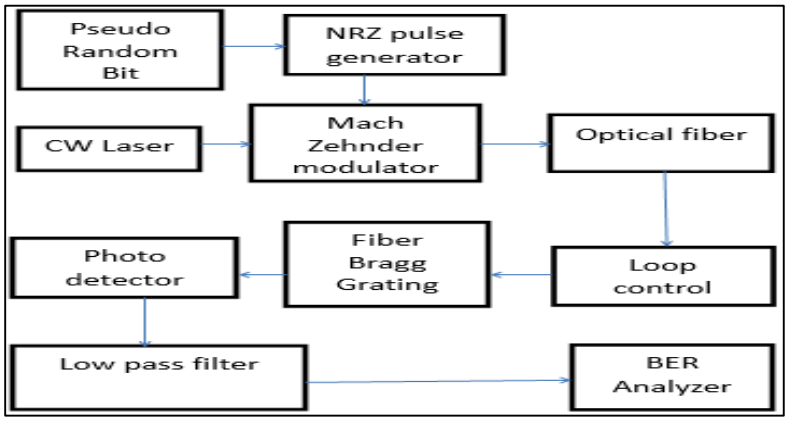

Fig. 3: Block diagram for proposed method

The Mach-Zehnder modulator is used to control the modulation of data pulses. If the data pulses vary according to external environment or surroundings, then will be the error occurs in the respective pulse. Loop control and the Fiber Bragg Grating will act as combinational parts. The loop control will find the dispersed pulse and it will pass the pulse to fiber grating. The fiber grating separate the particular dispersed pulse and it will transfer to the loop control to resolve the dispersion and the remaining pulses were transferred to the photo detector.

The dispersion will leads to cross talk and inter channel interference. Here we used BER (Bit Error Rate) analyzer for analyzing various parameters of optical fiber like quality and efficiency. The Eye diagram will give the overall communication efficiency and about noise. Attenuation or loss in optical fiber basically refers to the loss of power. It is defined as a dimensionless parameter that will describes how under damped an oscillator is minimum signal to noise ratio required to obtain a specific BER for a given signal. Refractive index is also referred as a dimensionless number that describes how light will propagates from one medium to the other medium. Several dispersion parameters like bit error rate is at which error occur in the transmission of digital data and Self-phase modulation of light caused by an instance change in the light intensity which broadens the spectrum of the signal. The Cross phase modulation which comes under non-linear optical effect where one wavelength of light can affect the phase of another wavelength of light through the optical kerr effect. Attenuation is also a major factor which is expressed as the ratio of optical output power to the input power in the fiber length. In optical, there is a two type of bending losses that are macroscopic bending and microscopic bending. The bending losses was caused because of the absorption of light energy due to heating of ion impurities results in dimming of light at the terminal end of the fiber. Two types are absorption losses are intrinsic absorption and extrinsic absorption. The important parameter that affects fiber communication is Group velocity dispersion and the phase velocity is directly proportional to the group velocity. The wave packet of the phase velocity moves at the group velocity. The GVD is the characteristics of a dispersive medium and Pseudo random sequence generator is used because it easy to implement and it is possible to write program in any language.

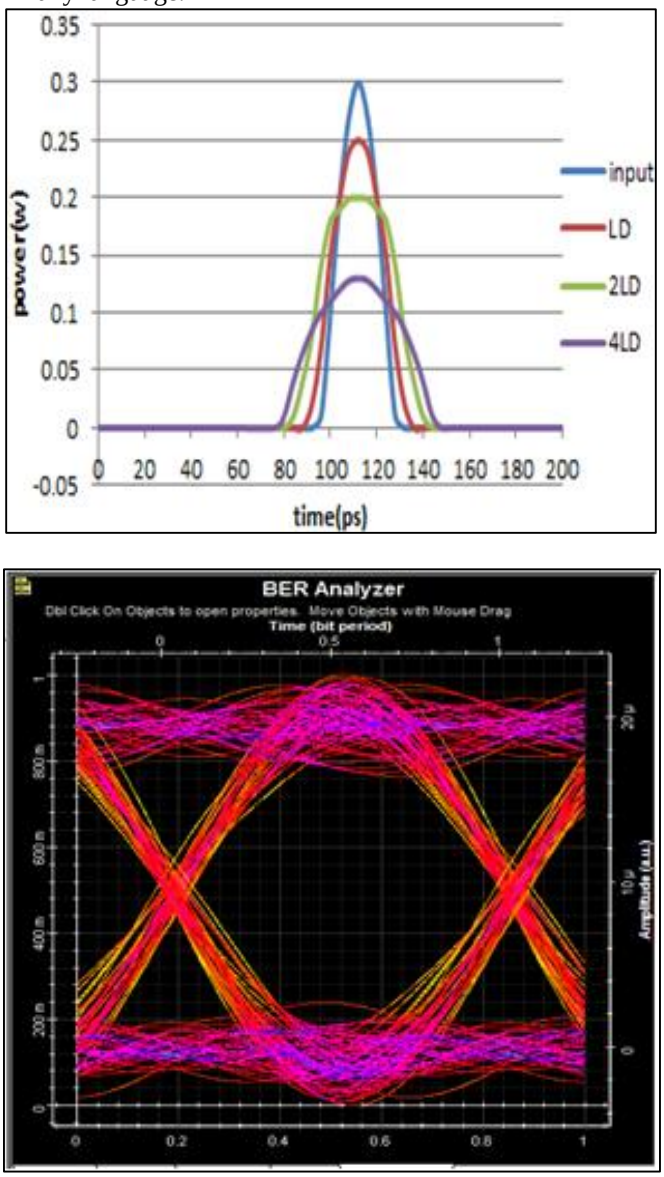

Fig. 4: Eye diagram for proposed method

V. CONCLUSION

The entire system design was based on the operation of Optisystem software. From this analysis, we came to know that the dispersion parameters and other non-linear effects were reduced. Even though the dispersion was reduced, there may be some disadvantages. Circuit complexity and dispersion was not fully reduced. The 100 percent communication efficiency is not possible in any system. The eye diagram shows the clear vision about the communication. We had overcomed the problem which are we faced in existing method.

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