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Filtering Analysis of SMF using MATLAB

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ABSTRACT: In optical fiber communication data loss occur when the factors like dispersion, attenuation, noise comes in picture. Dispersion is the main reason which limits the performance of overall communication system. In this paper a brief dispersion has been discussed & filtering concept is used so that a polarized signal could be transferred through a channel with less error. The signal which has to pass through a single mode fiber is analyzed using MATLAB & respective output graphs have been discussed.

KEYWORDS: SMF, Dispersion, Optical power signal, Filtering, AWGN Channel.

I. INTRODUCTION

In optical communication data is transferred from one destination to another in the form of light signals. Light signal propagates through the core of fibre and its basic principle of propagation is (TIR) Total Internal Reflection. However, the power dissipated during propagation results in some error or data loss or signal distortion. The possible reasons of signal distortion are attenuation, dispersion, macro or micro bending losses, path distance loss. In optical communication general simulation are performed on OPTSIM, MATLAB, ANFIS. Dispersion is a term which means broadening or degrading the signal. It may be like chirped signal or distorted one. [1] In single mode fiber (SMF) chromatic dispersion takes place. Also polar mode dispersion is observed and this dispersion is caused due to dependence of group index N_g to wavelength. Because of spreading of light pulse, two or more consecutive pulse signal may overlap each other which cause inter-symbol interference (ISI). Thus signals lose their original shape, size, amplitude & due to aliasing of signal receiver sometimes not able to identify that particular required signal & results in error in signal detection. Modal dispersion [8] may be defined as broadening of pulse due to time delay between lower – order modes & higher order modes. Majorly it is difficult to tackle in multimode fiber. We know that index of refraction of glass fiber depends on wavelength therefore Chromatic dispersion is also broadening of pulse due to different velocities of waves that are of different wavelength. Waveguide dispersion is caused due to physical appearance and structure of waveguide. Fibers with complex index profiles face major factor as waveguide dispersion. Material dispersion is caused because of wavelength dependency on index of refraction of glass. Mainly three technology are there to compensate dispersion that are:- Pre compensation method in which DCF with negative dispersion is placed before SMF. Post compensation method in which DCF with negative dispersion is placed after SMF. Symmetrical or hybrid method in which in this DCF with negative dispersion is firstly placed before SMF then placed after SMF.

II. RELATED WORK

Polarization mode dispersion is also kind of a modal dispersion where due to the random imperfections, two different light waves travel at different speed, whereas normally they travel at same speed. Imperfections occur randomly in the path of light while travelling through an optical fiber. Due to these random imperfection and asymmetry the light travelling through optical fiber starts spreading which results in limited rate of data that is to be transmitted. There are some factors which matters a lot in transmission of a signal in context of polarized wave of light, it depends whether the case is of an ideal fiber or realistic optical fiber. Practically it is not possible to have perfectly symmetry & exact circular cross sections of optical fiber however in ideal optical fiber there is proper circular cross sectional of core is assumed due to which two orthogonal polarization of waves exists, whereas in realistic fiber imperfections are random so breaks the circular symmetry of fiber. This causes the two polarizations travel at different speed & thus slowly get

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separate further it results in pulsespreading. Transmission of a signal also depends on how much noisy channel it is crossing through. Various modulation techniques are responsible for it like DPSK modulation or whwether DWDM

III.METHODOLOGY

The input signal which is going to be processed has an SNR Ratio 20. Here the total no. of sample taken is 5000 which is information sample length. The symbol slot $T_s = 1e - 10$. The sampling frequency $F_s = F_d * 10$. Rise cosine roll coefficient (r) is 0.5. The length of fiber (L) is taken 10Km. (aled) is a variable which defines light gain.

R cosine filter is an implementation of a low pass NY Quist filter & it is used for shaping of pulse by –limiting its bandwidth. It is capable of minimizing ISI that is why it is used frequently. Its spectrum exhibits odd symmetry about $1/2T$, where T is symbol period. Nyquist filter has a unique property of elimination of ISI as its impulse response is zero at all (nT).

In optical communication attenuation is described in no. of decibels/foot or Km. Attenuation simply means reduction in strength of any analog signal or digital signal. Also called as signal loss or data loss. Attenuation (A_p) can be define in terms of voltage or (dBs) decibels. If (P_s) is the signal power at transmitter end and (P_d) is the signal power at receiver end, It implies that $P_s > P_d$.

$$A_p = 10 \log(P_s / P_d)$$

In terms of voltage attenuation could expressed as (A_v) which is given as below where V_s is the input signal voltage and V_d is the output signal voltage.

$$A_v = 20 \log (V_s / V_d)$$

Less attenuation/unit distance means more efficient the cable is used for transmission and reception. If attenuation is more than, repeaters need to be used for long distance communication because repeaters boosts the strength of a signal, as a result at receiving end signal would not be weak.

IV.SCHEMATIC DIAGRAM

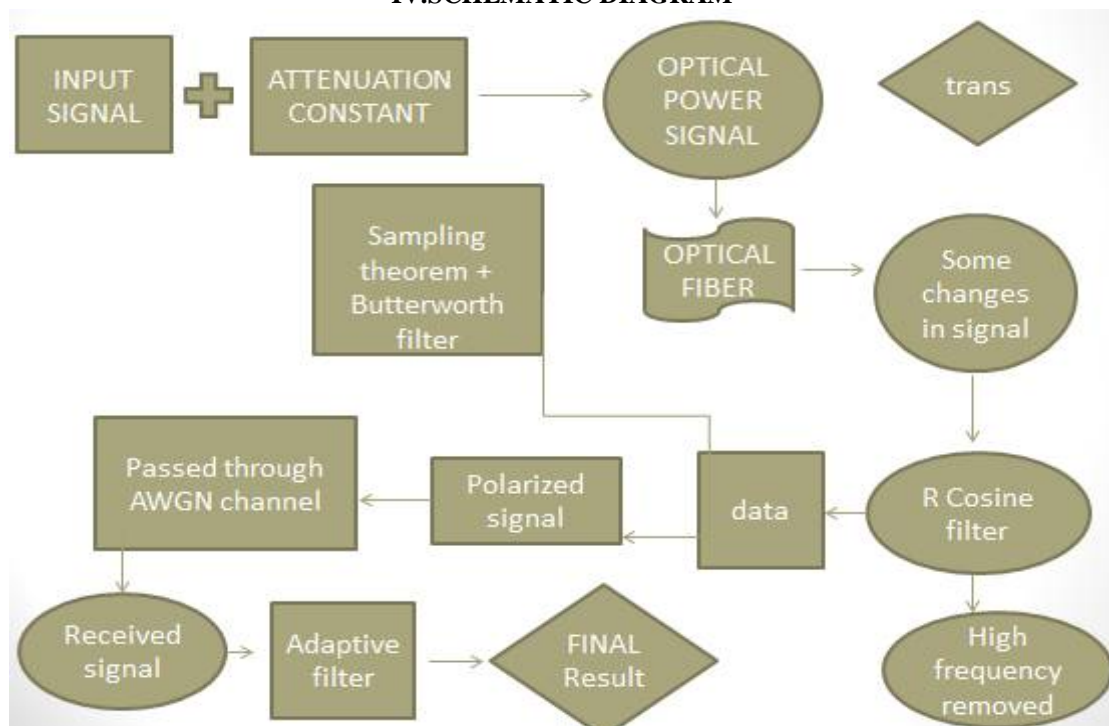


Figure1 Signal Flow

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Vol. 6, Issue 7, July 2017

Butter worth filter is used because it gives ripple free signal as output. Butter worth filter is also used in image processing. However Gaussian filter is supposed to be the best because of no ringing effect. In image processing also these filters are used for smooth filtering and enhanced images results. In medical applications, reading an x ray graph of a patient, more the image is enhanced, easy is image to read.

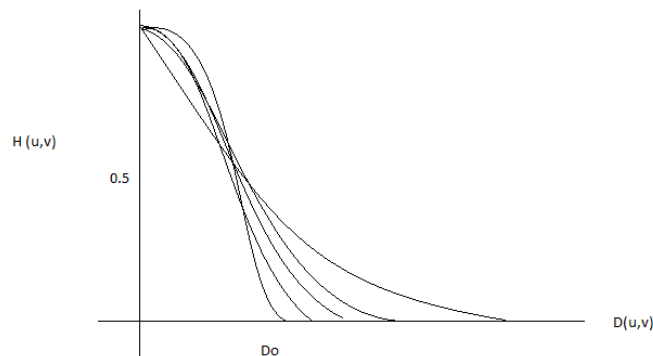


Fig 2 Butter worth Filter

Equation for Butterworth filter is

$$H(u,v) = 1 / 1 + [D(u,v)/D_0]^{2n}$$

The signal received from R Cosine filter is a signal from which High frequency is removed so that the signal could be transmitted over channel in accordance of channel capacity. If channel capacity is limited to low frequency then signal would not be able to pass through that channel. That is why there is a need to remove high frequencies from the processed signal. Following simulation graphs are obtained

V.SIMULATION & RESULT

Here are the following graphs which shows how the signal is processed in fig 3 a e(t) signal spectrum is shown and noise is added to the signal to make it behave like a real signal. The reason why we add noise to a signal is because in real signals there is a lot of noise. But the signal produced by our optical devices are so noise free that very less or negligible amount of noise is there. So, attenuation signal is added to it. Further Signal is being processed through optical fiber. At Receiver end some changes in properties of the signals is observed which shows that some error loss is occurred. Therefore, the concept of adaptive filtering is applied and below are the graphs obtained.

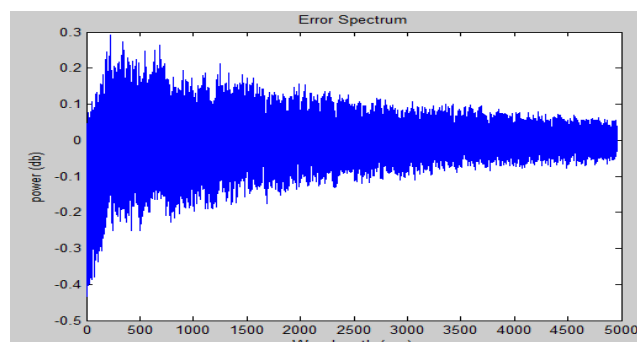


Fig1E(t) Signal

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Vol. 6, Issue 7, July 2017

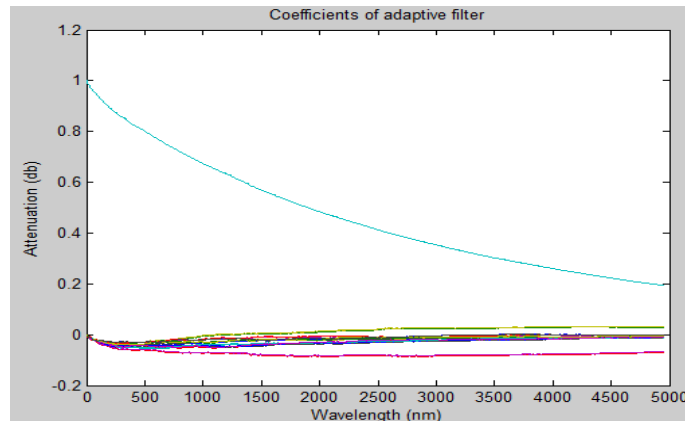


Fig 2 Coefficient of adaptive filter

Adaptive filtering (estimates the filter weight & coefficients to minimize the error between the output signal & the desired signal) is applied in which there is a cycle keeps on going, previous values are shown as colored signals and in every iteration a new value is updated.

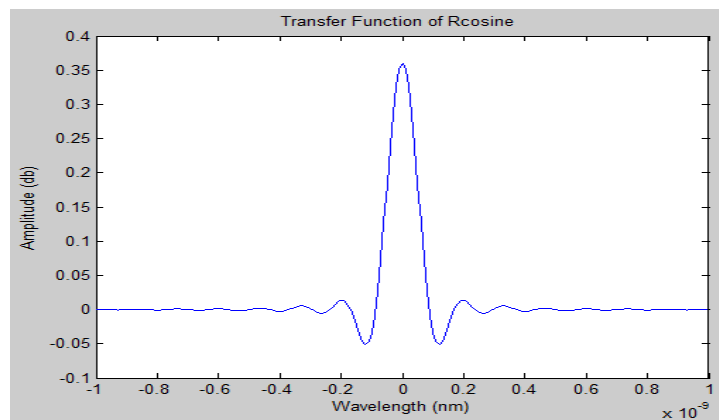


Fig 3 Transfer Function of R Cosine

Rcosine filter is used, as we know that signal can be send serially, & hence the signal components needs to reshape. at a particular threshold all the values are measured so that polarized waves can be passed through the fiber.

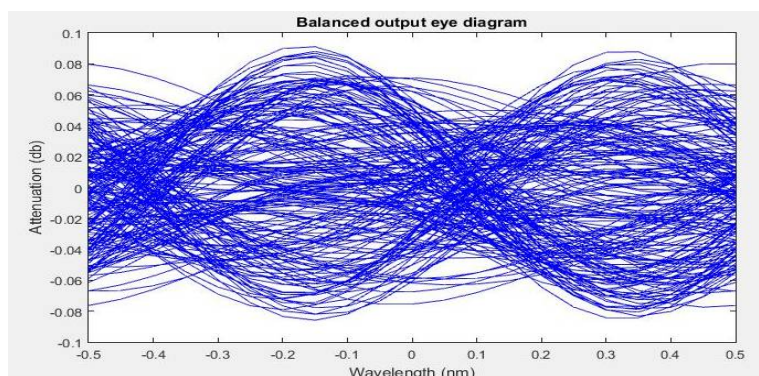


Fig 4 Balanced Eye Diagram

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In the figure 4, the output is shown, here it could be observed that a lot of zigzag signals are there along with the information signal, which needs to be rounded off or needs to make it more clear. Because jitter is a factor which is existing & need to reduce by equalizing or rounding off.

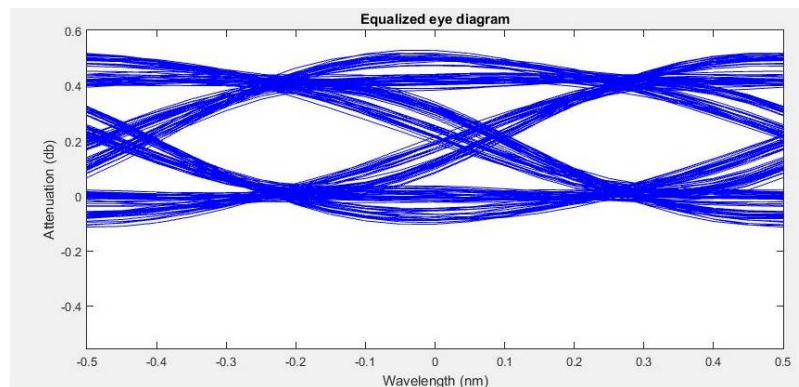


Fig 5 Equalized Eye Diagram

Figure 5 is the equalized eye diagram. It clearly shows that the signal threads transmitted over a clear pattern without any noisy signal. There is less amount of jitter (more the eye is aliasing with the alternate eye, more jitter will be there which degrades the performance).

VII. CONCLUSION

Initially an input signal is assumed to process. Attenuation constant is added to it. When the signal got attenuated it becomes an optical power signal which is named as trans. Some changes are observed when this signal is passed through a SMF so, a R Cosine filter is used so that channel bandwidth could be minimized. High frequency contents need to be removed & then sampling theorem is applied where F_s is the sampling frequency. Digital Butterworth filter is applied to the processed signal because there is no ripple contents in it. Further signal is passed through an AWGN channel and output signal is received. Corresponding figures show the simulation graphs. Figure 3 shows the balanced eye diagram and figure 4 shows the equalized eye diagram. Jitter is observed in figure 3 where there is horizontal overlapping of curves between two eyes. The upper half of an eye is the measure of amount of distortion. The maximum space when an eye is opened in graph in figure 6 is the best time interval to sample the signal.

REFERENCES

- 1) N.K. Kahlon and G. Kaur "Various Dispersion Compensation Techniques for Optical System: A Survey", Open Journal of Communication and Software, vol. 1, no. 1, 2014.
- 2) Manpreet Kaur, Himali Sarangal, Parveen Bagga, "Dispersion Compensation with Dispersion Compensating Fibre (DCF)", International Journal of Advance Research in Computer and Communication Engineering, vol 4, Issue 2, 2015
- 3) Pallavi Gupta, Rahul Sharma, Manoj Kumar, Lavi Agarwal, "IJIRSET" Optical Fiber Communication: Optimization using Simulation "International Journal of Scientific Research Engineering & Technology, vol 1, pp 184-189, 2012.
- 4) Gagandeep Singh, Jyoti Saxena, Gagandeep Kaur "Dispersion Compensation using FBG & DCF IN 120Gbps WDM System, IJESIT", International Journal of Engineering Science and Innovative Technology vol 3, 2014.
- 5) Er. Mamta Jangal and Er. Deepinder Singh Wadhwa, "Polarization Mode Dispersion System LMS Algorithm Based on Feed-Forward Compensation System Balance", International Journal of Engineering Research & Technology (IJERT), Issue 4, ISSN – 2278-0181, vol 4, 2015.
- 6) Michal Lucki and Tomas Zeman "Dispersion Compensating Fibres for Fibre Optic Telecommunication System" INTECH.
- 7) Barza Badar. Anisha A.P. "Performance Analysis of Dispersion Compensation in WDM Optical Communication System", International Journal of Science and Research (IJSR) pp-157-159.
- 8) Anandita Joy Aggarwal, Mukesh Kumar, Rohini Saxena, "Comparison of Different Techniques of Dispersion Compensation" International Journal of Electronics and Computer Science Engineering ISSN-2277-1956.
- 9) en.wikipedia.org/wiki/Fiber-optic communication.