Comparative Analysis for Performance of Soliton System with Different Parameters

Mehak Arora and Geetanjali Pandove

***ABSTRACT*: Solitons are very effective in dispersion free communication and if properly generated and transmitted they can be used in tremendous applications and thus a network which gives better transmission has to be there and for it comparative study is necessary. We have a circuit which results in soliton system for any input and is used as analysing the performance. But if we give it a soliton as an input it can give us better results. In this paper we are doing such a comparative study for different circuit parameters.**

***KEYWORDS:* Bessel filter, Fibre span, Loops, Soliton, Trapezoidal filter**

I. INTRODUCTION

If a sech pulse is used as an input and transmitted through a Soliton System we can get error free or dispersion less communication by using EDFA (Erbium Doped Fibre Amplifier) and DCF (Dispersion Compensating Fibre) to compensate for any losses. But if we give a soliton as an input then the result would be better because a lossless wave would be transmitted over a lossless system and there would be no need of DCF because DCF is being used to generate soliton.

Rest of the paper is structured as follows: section 2 discusses generation of soliton pulses, section 3 deals with analysing circuitry, section 4 gives simulated circuit and parameters related, section 5 deals with results and comparison and, section 6 concludes the paper.

MEHAK ARORA (Pursuing M Tech), GEETANJALI PANDOVE (Assistant Professor) are with Department of Electronics and Communication Engineering, DCRUST Murthal, Sonepat, Email: mehak.arora470@gmail.com, pandove_geet @yahoo.co.in

I. GENERATION OF SOLITON PULSE

A soliton pulse is generated because of cancellation of dispersion with self phase modulation (change in phase of wave because of induced change in refractive index of the medium by travelling wave as per the Kerr Effect). Here we are using Soliton train which is generated by compensation of spectral enrichment (flattening of the signal due to four wave mixing) with multisoliton compression (decrease in width of the signal) in a standard fibre.

II. CIRCUIT FOR ANALYSING THE PERFORMANCE

In this circuit we are using loop control which helps to change transmission distance and three fibre spans with EDFA in between are used to amplify the signal at particular intervals in order to prevent loss of signal strength and there is one filter to shape the signal as we want. By varying no of loops we can vary the transmission distance as required. For example 3 fibre spans of 60 km and loop value of 50 will give effective distance of 1800 km. Soliton train is given as input to loop control then there are fibre spans and by shaping the signal we can analyse the input by time domain visualizer, spectrum analyser and BER analyser.

III. SIMULATED CIRCUIT

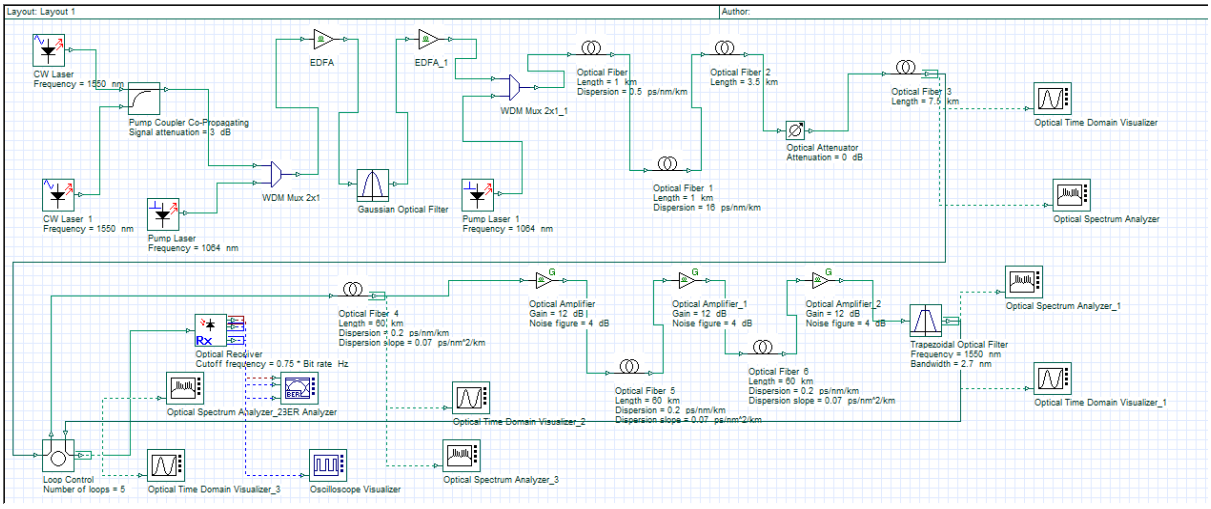

Fig1. Simulated circuit for generation and analysis purpose

IV. SIMULATON PARAMETERS

A. FOR GENERATION OF SOLITON

PARAMETER	VALUE
REFERENCE WAVELENGTH	1550 nm
PUMP LASER WAVELENGTH	1064 nm
DIFFERENT FIBRE LENGTHS	1km,1km,3.5km,7.5km
FILTER	OPTICAL GAUSSIAN

B. FOR ANALYSIS

PARAMETER	VALUE
NO OF LOOPS	VARIABLE
FIBRE LENGTHS	VARIABLE
AMOLIFIERS GAIN	12db
NOISE FIGURE	4db
FILTER	CHANGEABLE

For generation of Soliton two frequencies are coupled to generate beat signal then proper amplification and shaping of signal is done then passed through fibre for multisoliton compression and at last what we get is a Soliton train.

After generation this is passed through analysis circuitry where as stated earlier is loop control, 3 fibre spans, amplifiers and a filter section to shape the signal and result is compared by help of different graphs we get from test sets.

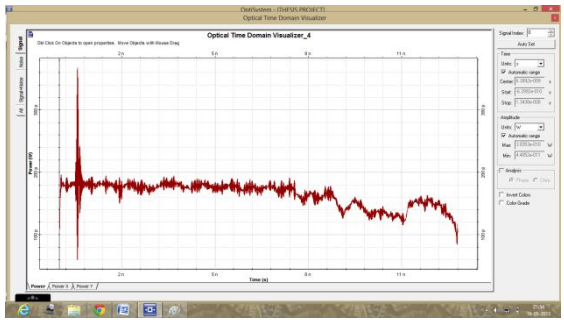

Fig2. Generated Soliton

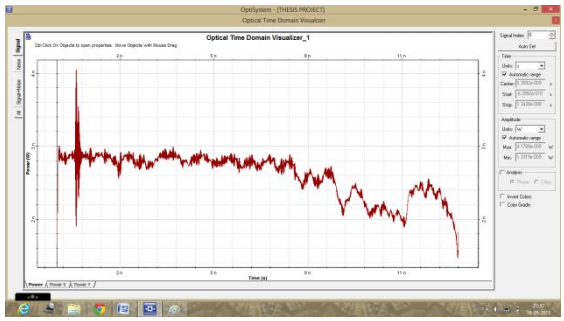

Fig3. Received Soliton

As we can see from figure 2 and 3 that the soliton generated and the output we get at the receiver are 99% same so we can say that soliton transmission is very effective for dispersion compensation.

V. RESULTS AND DISCUSSION FOR ANALYSIS

First of all fibre span is varied for particular no of loops to get variable distances of transmission.

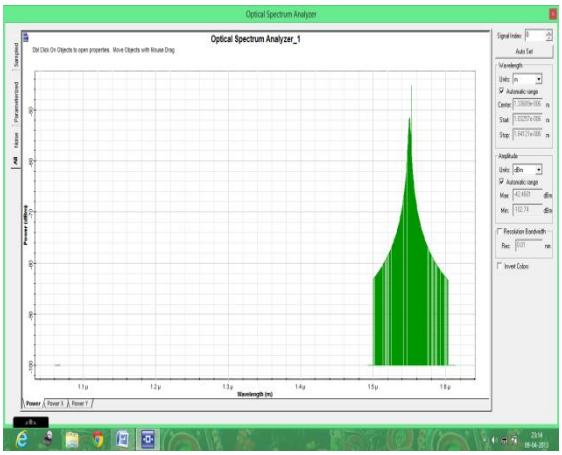

Fig4. O/P for 60 km fibre span

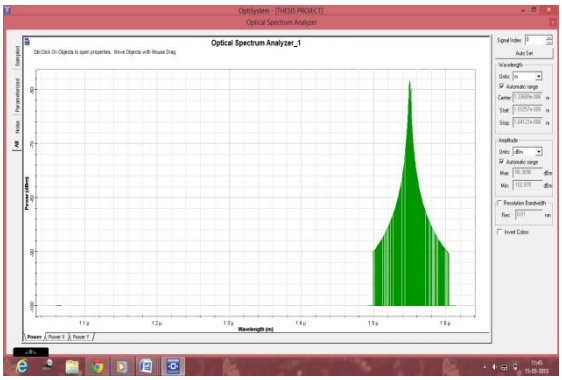

Fig5. O/P for 100 km fibre span

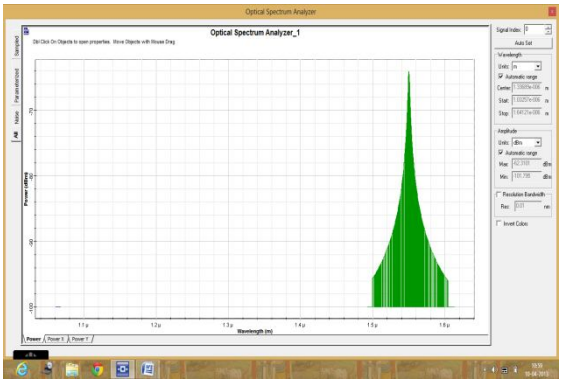

Fig6. O/P for 600 km fibre span

Fig 4, 5, 6 show graphs between output signal and wavelength. As we see changing fibre spans tremendously affects the amplitude of signal but shape of signal is same because of use of same BESSEL FILTER. For span of 60 km signal strength is -51dbm (7.9432823472e-9 W) for 100 km it is -59dbm (1.2589254118e-9) and for 600 km it is -64 dbm (3.9810717055e-10) and this is because of use of amplifiers at long distances as we increase fibre spans and it is best for 60 km because of proper amplification after particular periods.

Table 1 "Comparison of signal strength"

Similarly various results were taken and Comparison table was made which is represented in table 1.

Fibre Span → / Loops ↓	60 Signal (W)	100 Signal (W)	600 Signal (W)
5	3.16e-9	1.58e-9	3.98e-10
10	3.16e-9	1.58e-9	3.98e-10
50	3.16e-9	1.58e-9	3.98e-10
100	3.16e-9	1.58e-9	3.98e-10

As it is very clear from the table that as fibre span increases signal strength i.e. power decreases because of frequent attenuation of signal and less amplification because of amplifiers being at large distances as stated earlier but this should not be confused with dispersion because dispersion distorts the signal which means changing the shape of signal and very interesting fact clear from table is that increasing no of loops does not create any effect because shape is not being affected because of soliton transmission and thus distance not matters at all and at particular intervals there are amplifiers to properly counteract the attenuation of signal.

VI. CONCLUSION

We come to a conclusion that dispersion can be minimised by using Soliton System and we analysed the system for best results and found out that signal does not distort for any transmission distance and if we use amplifiers at proper distance intervals we can have tremendously better results.

REFERENCES

[1] J. Adaikala Susai, S. Robinson, "Analysing the Transmission Performance of the Optical Soliton System", International Journal of Emerging Technology and Advanced Engineering, ISSN 2250-2459, ISO 9001:2008 Certified Journal, Volume 3, Issue 2, February 2013

[2] Ali Ebadi, F.E. Seraji, E. Mohajerani, S. Darvishi "Study of Dispersion and its relationship with power confinement in a single-mode Optical Fiber" 11th International Conference on Laser and Fiber-Optical Networks Modeling, 5-8 September 2011.

[3] Md. Jahedul Islam, Mostafezur Rahman Talukdar, and Md. Rafiqul Islam "Impact of Optical Fiber Dispersion and Self Phase Modulation on the Performance of DS-OCDMA" Proceedings of 2009 12th International Conference on Computer and Information Technology 21-23 December, 2009, Dhaka, Bangladesh

[4] Johan Hult, Rosalynne S. Watt, and Clemens F. Kaminski " Dispersion Measurement in Optical Fibers Using Supercontinuum Pulses" Journal of Lightwave Technology, Vol 25, No 3, March 2007

[5] George I.A. Stegeman, Member, IEEE, Demetrios N. Christodoulides, Member, IEEE, and Mordechai Segev "Optical Spatial Solitons:-Historical Perspectives", IEEE Journal on selected topics in Quantum Electronics ,Vol 6, No.6,November,December 2000

[6] V. N. Serkin and T. L. Belyaeva "Amplification of Femtosecond Optical Solitons in Er-Doped Fibers with Smooth and Strong Varying Dispersion," IEEE 0-7803-3895-2/97/$10.0 1997

[7] Akio Sahara, Hirokazu Kubota, and Masataka Nakazawa, Fellow IEEE "Optimum fiber Dispersion for Two-Step Dispersion-Allocated Optical Soliton, RZ at Zero GVD and NRZ Systems," IEEE Photonics Technology Letters, Vol 9. No 8, August 1997

[8] A.V. Shipulin, E.M. Dianov, D.J. Richardson, D.N. Payne "40 GHZ Soliton train generation through multisoliton pulse propagation in a Dispersion Varying Optical Fibre Circuit," IEEE Photonics Technology Letters, Vol 6. No 11, November 1994

[9] Soliton (optics) From Wikipedia, the free encyclopedia

[10] Kerr Effect from Wikipedia, the free encyclopedia

[11]Tensor from Wikipedia, the free encyclopedia

[12] Irradiance from Wikipedia, the free encyclopedia

[13] Saturable Absorption from Wikipedia, the free encyclopedia

[14] Cross Phase Modulation from Wikipedia, the free encyclopedia

[15] JH Franz, VK Jain, Optical Communications Components and systems, Narosa publications, September 14, 2000

Mehak Arora is doing M. Tech. from Deenbandhu Chhotu Ram University of Science and Technology (D.C.R.U.S.T.) Murthal Sonipat (India) in Electronics and Communication Engineering. She received B.Tech. degree in year 2011 in Electronics and Communication Engineering from University Institute of Engineering and Technology (Maharishi Dayanand University Rohtak).Her interest includes Optical Communication ,Satellite Communication and Wireless Communication.

Geetanjali Pandove has done her M.Tech and B.Tech from AMU Aligarh and today she is working as assistant professor at Deenbandhu Chhotu Ram University of Science and Technology (D.C.R.U.S.T.) Murthal Sonipat (India) in Electronics and Communication Engineering. Depaetment. Her intrest includes Optical communication, Image Processing and Digital signal processing.