Simulated Circuit for Generation of 40 GHz Soliton Train

Mehak Arora and Geetanjali Pandove

Abstract:- In any optical communication system dispersion is an obvious phenomenon and results in distorted signal at the receiver side. There are many ways to reduce the effect of dispersion like DCF and DDF but they have design considerations. One way to remove effect of dispersion are soliton pulses which are self shaping and self focussing pulses and their generation is an important issue concerned in this paper.

***Key words:* - EDFA, Four wave mixing, Multisoliton compression, Pump Laser, Spectral enrichment**

I. INTRODUCTION

Soliton is a wave which is formed because of cancellation of linear (dispersion) effect and non linear (Kerr) effect in an optical fibre. This wave has a property of self changing its shape while transmission to encounter the effect of dispersion thus resulting in dispersion less communication.

II. GENERATION OF SOLITON PULSE TRAIN

Soliton pulse train is generated by combination of multisoliton compression and spectral enrichment in a standard fibre and then passing them through DDF.

In an inhomogeneous optical fibre medium there is a compression in pulse of the signal whereas amplitude increases and similarly whenever there is transmission of multisoliton it is also compressed i.e. width of the signal decreases with increase in amplitude whereas its opposite is spectral enrichment in DSF where a signal is flattened (increase in width) when it passes through the DSF. Four wave mixing is a phenomenon in which propagation of two wavelengths results in formation of two new wavelengths (because of scattering of incident photons new photons are generated) and these new wavelengths are called sidebands and this can be the reason of signal flattening in DSF.

It is clear that Spectral Enrichment and Multisoliton compression have opposite effects on the signal and thus when combined they result in generation of a fixed shape signal called as a soliton.

III. BLOCK DIAGRAM

Fig1. Represents block diagram for generation of a SOLITON Pulse Train where two single frequency laser sources work at 1550 nm and then their outputs are combined through 3 db coupler. This is done to obtain a beat signal. This signal is then combined with a pump frequency of 1064 nm (wavelength) through wavelength division multiplexer and then the resultant signal is amplified by Erbium-Ytterbium Doped Fibre Amplifier. Then a Band Pass Filter is used to shape the signal and then amplified again through another EDFA. Now the signal is passed through a dispersion shifting fibre which is responsible for sideband generation by four waves mixing.

The signal is then passed through a standard fibre for multisoliton compression. At last is a DDF with standard parameters. What we get as a result is a soliton train which is not similar to ideal one but can be approximated to an ideal one by use of another DSF. The total loss of the system was 5.6 db. This circuit however has acute environment instability and requires additional chirp compensation at the system output

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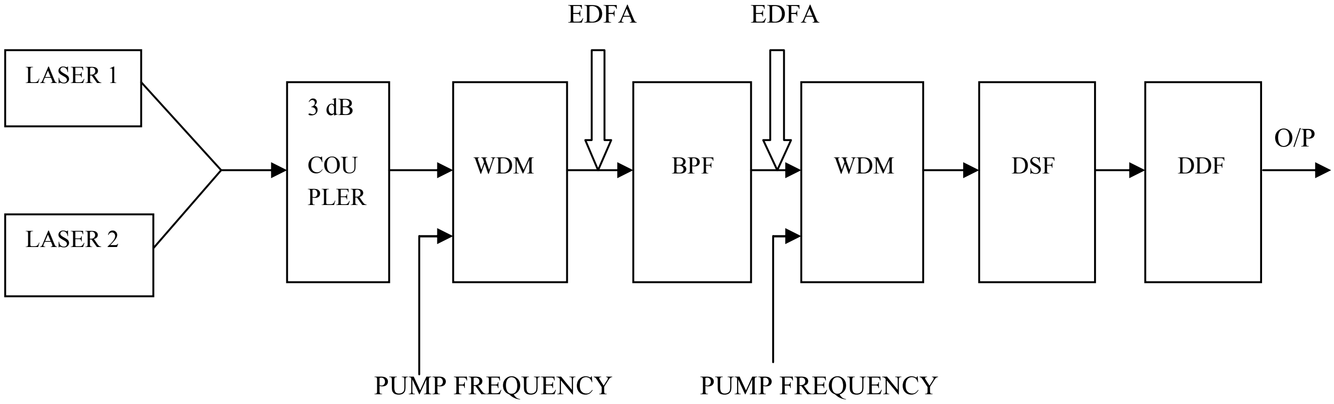

Fig 1. Block diagram for generation of SOLITON

IV.

V. SIMULATION OF THE CIRCUIT

The above circuit for generation of soliton pulse train was simulated using "OPTISYSTEM V 7.0"

We have used CW laser for generation of beat signal and as per the block diagram all the components are used with specific parameters. A Gaussian optical filter is used as a BPF. Pump Lasers are used for WDM and have characteristic wavelength of 1064 nm. Optical time domain visualizer and Optical spectrum analyser are used for analysing the output.

Time domain visualizer gives a curve of signal vs time whereas Spectrum analyser relates signal with wavelength. After specifying parameters

Table1:- Simulation Parameters

PARAMETER	VALUE
LASER WAVELENGTH	1550 nm
COUPLER	3 db
PUMP WAVELENGTH	1064 nm
FILTER	GAUSSIAN OPTICAL
DSF	LENGTH=1 km D=0.5 ps/nm/km
STANDARD FIBRE	LENGTH=1 km D=16 ps/nm/km
DDF	LENGTH=3.5 km LOSS=1 db/km
STANDARD FIBRE	LENGTH=7.5 km

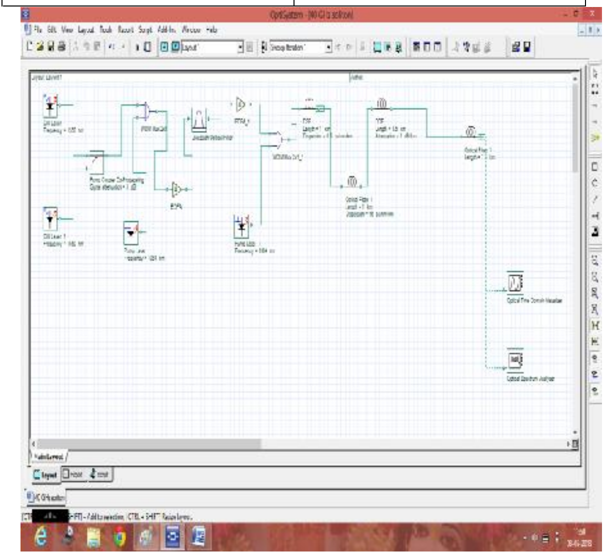

Fig2. Simulated Circuit

Calculations are done and resultant curves are analysed and visualized.

VI. SIMULATION RESULTS AND DISCUSSION

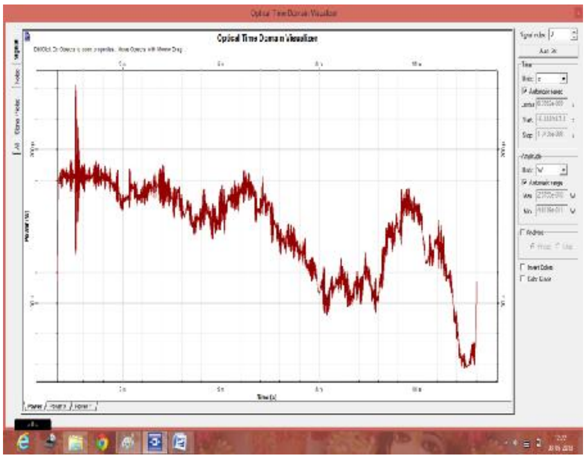

Fig3. Curve of signal vs time

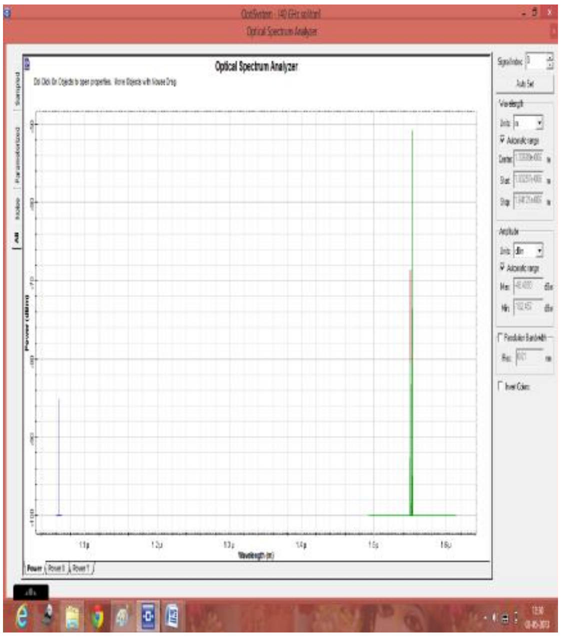

Fig4. Curve of signal vs wavelength

Fig3. is the curve of the signal vs time and it is clear that signal is very good but not same as that of an ideal soliton and is already stated in theory which depends of standard fibre length and beat signal power.

Fig4. is spectrum analyser graph of signal vs wavelength and as is very much clear that at our operating wavelength of 1550 nm we are getting a very good peak of approximately -51 dbm power.

As is very much clear by the results that if anyhow we can remove various anomalies we can get a very good soliton pulse train which can then result in dispersion free communication.

VII. ANALYSING THE PERFORMANCE OF THE SOLITON SYSTEM

Not only generation we can analyse also the performance of the soliton system by loop control for various length of fibres and various system parameters which can then help us in enhancing and designing the best system according to performance and our need. This analysing circuit can be simulated as well which contains a loop control, amplifier, receiver circuitry and input given is our soliton train.

VIII. CONCLUSION

Generation of soliton train is a very good method to reduce effect of dispersion and by changing and improving circuit parameters we can get an ideal soliton train not only their generation but their analysis can give us a very good idea about the system performance thus helping us to design the best circuit for distortion free communication.

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