

A Review of Chromatic Dispersion Compensation in Optical Fiber Communication System and its Simulation

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Abstract: This paper review of the chromatic dispersion compensation in optical fiber communication system. In optical communication system to compensate dispersion Fiber Bragg grating (FBG) is one amongst the applicable and necessary components. During this the appliance of chirped FBG was studied as a dispersion compensator in optical communication systems. This paper studied the various types of simulation in optical fiber communication system. The reviews of the analysis based on the chromatic dispersion are studied in the paper.

Keywords: (DCF) Dispersion Compensating Fiber, (OPC)Optical Phase Conjugator,(FBG)Fiber Bragg Grating.

I. INTRODUCTION

Now a day's communication is major analysis section. We tend to are work to transmit information in high distance with none noise thus we tend to are design different kind of system. Optical fiber transmission systems are designed, analyzed and simulated to get long length of fiber. The performance of optical fiber on optical signals is characterized by chromatic dispersion, background loss, polarization mode dispersion (PMD) and nonlinearity. Through an optical fiber, transmit data from one place to another by transmitting light pulses; this technique is named fiber-optic communication. Electromagnetic carrier wave is modulated to carry data. within the 1970s initial developed, fiber-optic communication systems have transform the telecommunications industry and have played a necessary role within the advent of the data Age. Chromatic dispersion and polar mode dispersion occurs in single mode fiber (SMF).

In optical system dispersion is compensated by also using erbium doped fiber amplifier (EDFA). [2] Chromatic dispersion broadening the pulse of optical fiber and causes inter symbol interference (ISI). A preferable solution is that will|we will|we are able to} use Dispersion compensating fibers and that they can provide broadband dispersion compensation. However there are many drawbacks of using dispersion compensating fiber, like high nonlinearity and high insertion loss. The impacts of optical fiber on optical signals are characterized by background loss, chromatic dispersion, polarization mode dispersion (PMD) and nonlinearity. Thereinto, Chromatic dispersion makes optical pulse broadening, and causes severe inter symbol interference (ISI). For high-bit-rate WDM transmission systems, optical fiber is no longer a transparent pipe. Dispersion compensating fibers will provide broadband dispersion compensation that may be a preferable solution. However, there are many drawbacks for this technique, like high insertion loss and high nonlinearity.

Among the various possible methods for achieving chromatic dispersion compensation—the major limitation for today's high speed telecommunication networks—the chirped fiber bragg grating (FBG), [dispersion compensating grating (DCG)] could be a very promising candidate due to its high figure of merit (FOM) [5], and its capacity for operating in wavelength-division-multiplexed (WDM) operation [5]. Here, we tend to report 2 methods to realize chromatic dispersion compensators, results on fabrication and tests of elements in four wavelengths multispan WDM systems at 10 Gb/s. the basic function of optical fiber is to transport a signal from one location to different location through communication equipment for ex.

A laptop video device or telephone with high reliability and accuracy. the most constituents of an fibre communication link are data sources, optical transmitter, optical connectors, cabled optical fibers, optical amplifiers, passive or active optical devices and optical receivers. one in all the most necessary parts in an fibre link is cabled fiber. In fibre communication the part velocity or group velocity of a wave depends on the frequency it's known as dispersion. In fibre due to dependence of group index to wavelength chromatic dispersion occurred. There are 2 bands within the third transmission window that are conventional or C-band from approximately 1525nm – 1565nm and also the different one is long or L-band from approximately 1570nm – 1610nm.

II. LITERATURE SURVEY

An R. Udayakumar et al. [1] "Chromatic Dispersion Compensation in Optical Fiber Communication System and its Simulation", in this paper author proposed different dispersion techniques in optical fiber communication system are studied. Result of dispersion in fiber optic link was analyzed using eye diagrams. We tend to additionally study the various techniques used to compensate the chromatic dispersion. Simulation model for dispersion compensation using fiber bragg grating is developed. Bit error rate of signal before and once transmitting through the fiber bragg grating was compared by varied its grating amount and linear chirp coefficient.

S. O. Mohammadi et al. [2] "Simulation of a transmission system to compensate dispersion in an optical fiber by chirp gratings", in this paper projected simulated a communication system in data transmission. As presently as we tend to observed dispersion, we tend to decided to compensate it so as to receive information in receivers as they are. to the current purpose, we tend to used chirp FBG and simulated it. Also, it may be obtained that increase in grating length leads to decrease in pulse extension, and additionally increase in its power. By considering the power of the output spectrum of modulator and also the pulse form in that purpose, the most appropriate length that equals to six millimetre may be resulted. Apodization function isn't very effective in FBG reflected spectrum, though the best shape is Tanh function due to its grating length. Finally, it may be understood that the pulse was broadened and its power increased as a result of the increase in chirp parameter that is that the best amount.

Huang Liqun et al. [3] "Computer Simulation of 40Gb/s Optical Fiber Transmission Systems with a Fiber Grating Dispersion Compensator", this paper projected the chirped grating as a dispersion compensator in high bit-rate DWDM systems ought to have the following characteristics. The reflection spectrum includes a steep rising and falling edge that is able to avoid out-of-band dispersion interaction among cascaded fiber gratings. The chirped grating length is less than 14cm, and also the reflection spectrum includes a wide flat top with high reflectivity. Moreover, the time delay ought to exhibit good linearity, and also the ripple amplitude of time delay ought to be very small. Once a chirped grating dispersion compensator designed by the normal apodization technique, the time delay curve includes a slight nonlinearity, and this defect can degrade the grating performance as a dispersion compensator. Then, a chirped grating is synthesized using the LP algorithmic rule for dispersion compensation in high-bit-rate transmission systems. By solving the nonlinear schrodinger equation using the Split-Step Fourier technique, 40Gbit/s NRZ transmission system with a chirped grating dispersion compensator is numerically simulated, and eye diagrams show that this chirped fiber grating has excellent performances as a dispersion compensator. when 800km transmission, the power penalty is simply 0.45dB.

S Sujith et al. [4] "A Simulation study on DCF compensated SMF using OptSim", in this paper planned analyzed the performance limitations of SMF because of SPM effects. With the aid of OptSim simulation software system we tend to used a DCF with correct variation long to tackle the non linear effects within the transmission system. Better performance was shown once a mixture of SMF length 85km and DCF length 15km was chosen. The BER and eye diagram technique are evolved as a good means for evaluating the system performance within the present work.

Gnanam Gnanagurunathan et al. [5] "Comparing FBG and DCF as dispersion compensators in the long haul narrowband WDM systems", in this author presented found that each kinds of dispersion compensators worked as meant, but the FBG compensator outperformed the DCF module for the short haul link, long haul link, traffic load variation and modulation scheme variation analysis on the four channel WDM systems. FBG may be a feasible choice to be looked into for chromatic dispersion compensation compared to DCF for a WDM long haul transmission and additionally long-run network growth purposes. The FBG compensates by reflecting numerous wavelengths at different points on its chirped grating. In contrast to DCF, FBG occupies smaller dimensions and additionally smaller insertion loss. Though, FBG may be a good solution for narrowband compensation however its physical dimension may increase linearly for broadband applications [11] - [12]. it was interestingly noted that once the traffic load for the system was made to increase from 2.5 GB/s to 40 GB/s, the performance for the DCF compensated system deteriorated additional compared to the FBG compensated system. Though each system deteriorated, the FBG compensated system deteriorated much slower once the traffic load was increased. The varied of the modulation scheme between RZ and NRZ on the optimal models additionally indicates that FBG as a compensator is able to sustain the variation in modulation schemes. The BER versus received power for these models show that though usually RZ systems are less susceptible to chromatic dispersion because of the smaller width of it pulse, yet each the RZ and NRZ systems saw improved performance with the compensators.

Isabelle Riant et al. [6] "Chirped Fiber Bragg Gratings for WDM Chromatic Dispersion Compensation in Multispan 10-Gb/s Transmission", this paper given 2 strategies for the fabrication of dispersion compensating gratings has been studied within the ACTS program PHOTOS. Initial results on system performances of a primary set of cascaded gratings fabricated by these techniques are given. the use of cascaded DCG's to compensate many hundreds of

kilometers has been demonstrated. Compensation for four channels over 80 km, and over 400 kilometre for 2 channels has been shown. These DCG's were not optimized for this application: the telescopic scanning technique has allowed the fabrication of good chromatic dispersion compensators for mono channel operation, however, to be used in WDM transmission, the strategy needs to be improved, especially the concatenation of the elementary gratings and also the central wavelength positioning. Another fiber, with lower birefringence and adaptable to standard fiber should also be used. It's been demonstrated that the symmetrical stretch scheme for fabricating apodized gratings will produce high quality gratings which 10 ps deviation from linear dispersion is possible. Experiments have already given good results and noticed many observations, particularly the influence of the input wavelength on the time delays introduced by the DCG's also because the necessity of reducing the optical losses. Good agreement has been observed between experiments and simulations of system performance.

III. METHOD

A. Fiber Bragg Grating

The FBG could be a kind of common single mode fiber that's like a grating. The bragg conditions satisfied propagated light, during a FBG core is resonated by grating structure and reflected wave. The gratings distance specifies the reflected wavelength, so that, from transmission spectra reflected light is removed in bragg wavelength. A fiber bragg grating (FBG) could be a kind of distributed Bragg reflector made in a very short segment of optical fiber that reflects specific wavelengths of light and transmits all others. This can be achieved by making a periodic variation within the refractive index of the fiber core that generates a wavelength specific dielectric mirror. A fiber bragg grating will so be used as an inline optical filter to block certain wavelengths, or as a wavelength-specific reflector.

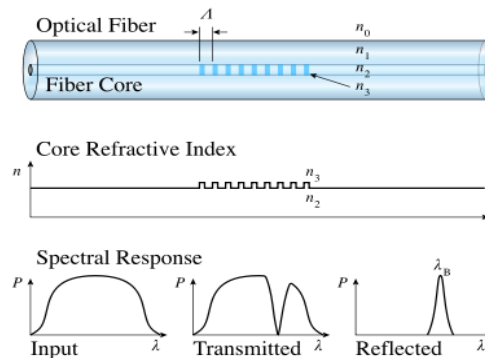


Fig.1 FBG

The first in-fiber Bragg grating was demonstrated by Ken Hill in 1978. Initially, the gratings were fabricated using a visible laser propagating on the fiber core. In 1989, Gerald Meltz and colleagues demonstrated the much more flexible transverse holographic inscription technique wherever the laser illumination came from the side of the fiber.

This instrument performs some operations like reflection and filtering with high efficiency and low losses. Some variations are created in period of gratings (as result variations on the grating during a chirp FBG. there's a delay occurred in wavelength with different time intervals, on the axis the period of grating changes, different wavelengths are reflected by different components of grating. in a very communication link chromatic dispersion will be compensated and compression in incident pulse occurred finally. most important reason to use chirp FBGs than all different suggested types, are price efficiency and low internal lose nonlinear effects.

B. Dispersion

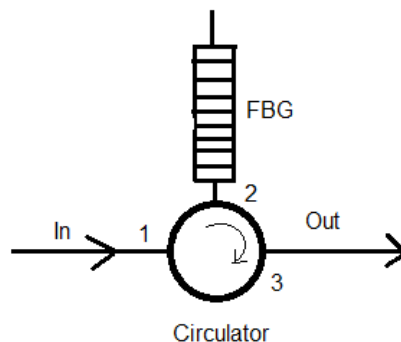


Fig.2 Dispersion

Title In single mode fiber chromatic dispersion occurs owing to the inherent property of silica fiber during which the refractive index varies with wavelength. Therefore, at slightly completely different speeds inside the fiber different wavelength channels can travel.

Because of this spreading of the transmission pulse takes place because it travels through the fiber. Chromatic dispersion in optical fiber is formed due to the dependence of group index to wavelength. Some data are missing because of spreading of pulses. It should be decreased so original data are often attained. Dispersion compensation is that the process of planning the fiber and compensating part within the transmission path minimize the total dispersion. In different sentence dispersion compensation will be referred because the control of overall chromatic dispersion of the system.

C. Dispersion Compensating Fiber (DCF)

No The DCF introduces a negative dispersion coefficient. Post compensation is achieved by adding the DCF onto an existing fiber. The fiber's dispersion may be manipulated by varied the refractive index profile and also the relative index value. Very high negative dispersion is achieved by ways like depressed cladding or decreasing the core radius [4]. However these could induce different penalties like non-linear effects and insertion loss.

A 30 kilometer SMF that features a dispersion of 16ps/nm/km would encounter a total of $(30 \times 16) = 480$ ps/nm of dispersion. Assuming the DCF features a negative dispersion of -80 ps/nm/km, and so 6km $(480\text{ps/nm} \div 80\text{ps/nm/km})$ of DCF is required for the compensation. A matched-cladding kind DCF contains a positive dispersion slope similar to transmission fibers and also the dispersion slope of the DCF is vessel than that of the traditional single-mode fiber [4]. once this kind of DCF is used for dispersion compensation, the dispersion slope for the entire transmission system as well as the DCF becomes larger than that for the transmission fiber alone and a wavelength region wherever the dispersion is well compensated is restricted to a narrow vary. During a WDM system, multiple wavelengths are used to transmit data. DCF provides an "un-tunable" fixed negative dispersion for all the various channels within the WDM system. DCF could be a good compensating device for its reference wavelength however it will leave residual dispersion at different wavelengths during a multi-channel transmission [4]. In different words, it'll only correct the middle wavelength of a pulse causing shorter wavelength to be overcompensated and longer wavelength to be under-compensated. The magnitude of accumulated residual dispersion depends on the degree of DCF slope matching and also the length of the transmission fiber link [4].

IV. CONCLUSION

This paper has reviewed the in the main analysis trends and proposed the chromatic dispersion compensation in optical fiber communication system. This paper studied is Chromatic Dispersion Compensation Techniques in optical fiber communication system. We tend to additionally study the various techniques used to compensate the chromatic dispersion.

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