Fiber Communication System based on FBG as Dispersion Compensator, Design an Experimental Setup

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Abstract. The technological progress in the means of transmission of information is very fast and it became necessary to obtain high speed in data transmission and high rate of data. Therefore, optical communication systems are the leading methods in this field because they cover these needs, but despite all these characteristics, there is a problem. And we will get rid of this problem in practice in this research through the use of two separate and different wavelengths and connect them to the Wavelength Division Multiplexing and send them to a distance of 3 Km and calculate the amount of dispersion in the signal to the outside of the Optical spectrum analyzer with and without Optical Fiber Bragg Gratings.

Keywords—Wavelength Division Multiplexing, Fiber Bragg Gratings, Optical Spectrum Analyzer

1. Introduction:

Wavelength Division Multiplexing (WDM) technique considered as one of the most important and promising concepts for communication system of high capacity. Optical networks that’s depend on WDM support multiple signals with different frequencies or wavelengths in a single fiber[1]. WDM is similar to Frequency Division Multiplexing, optical fiber data system requires high data rate and large number of transmission channels. The higher bandwidth of optical network compare to copper based networks make it very effective in network applications. The chromatic dispersion appear to make serious problem in optical fiber communication system because it cause significant distortion in pulses during transmission. To overcome this problem and then enhancing the quality of transmission, dispersion compensators are required. Optical Fiber Bragg Gratings (FBG) are used to compensate dispersion. FBG reflects different wavelengths (or frequencies) at different significant points along its length[2]. As the reflected wavelength, change regarding to the change of the period grating the reflected spectrum broadens. There are many types of FBG’s, like chirped FBG introduce different wavelengths (frequencies) so they very suited to use as a dispersion compensation elements for one wavelength of multiple ones. In general FBG’s have many features which make them very suitable in dispersion compensation application like fibergeometry, low insertion loss, high return loss or extinction, and potentially low cost[3].
2. Overview of (WDM) System:

The technique of WDM in optical fiber communication system multiplexed many optical signals of laser light in one signal. Bidirectional communications over one line of fiber, and multiplication of capacity could be achieved by this technique. The wavelength and frequency are gathered by a simple and well-known relationship, in which the product of frequency and wavelength equals the speed of light.

The multiplexer is used at WDM system at the transmitter side while the de-multiplexer at the receiver side. The modern system multiplexed over 160 signals while the earlier one was combine just two. The reason behind chromatic dispersion in optical fiber is that light is propagate in different speeds so the light will have different impulse and arrive to detector at different time [4].

3. System Design:

This circuit has been connected to make sure that the signal is exposed to dispersion and its properties are known by connecting two different and different sources at the wavelength (1310 nm) and the second (1550 nm) and collecting them by (WDM). Then we send the signal produced through the optical fiber to 3 km. The optical dispersion of the Optical spectrum analyzer (OSA) device and see the signal exposure of the dispersion, and we address the dispersion in the signal by connecting the (FBG) to improve the signal, data from a programmable OSA from (Thorlabs Inc.) to extract the drawings showing the signs of dispersion before and after the linking of the (FBG) in the design [5].

![Figure 1: Block diagram Fiber Optic transmission system without FBG.](image-url)
4. Results of the practical part:

Significantly, attenuation and dispersion effects directly to bit rate and link range of fiber optic communication system. Standard SMF manufactured to optimize transmission by eliminating dispersion at 1310nm wavelength, while for 1550nm the dispersion is a limiting factor in both single channel or WDM system. Figure (5) shows the effect on reducing dispersion for 1310nm wavelength in case of using FBG as a dispersion compensator in compare without using it. Figure (6) , the same cases but for 1550nm wavelength.
5. Conclusion:

We have verified the validity of the designs that we designed through the results obtained in the (OSA) in several different cases, we used a source with a wavelength 1310 and connect with it (FBG) once and without again, and in the second case we linked a source with a wavelength of 1550 wavelength With the (FBG) once and without it again, and collected the exporters 1310,1550 users (and blood), we have confirmed through the results that the proposed design is affected by dispersion and the greater the distance sent whenever the dispersion more and we noticed how the (FBG) reduce or get rid of Dispersion is exposed to the signal.In this experimental result , dispersion at initial point is about zero. When the signal passes through 3 km long optical channel then signal wave dispersed, the value of dispersion is reduced . FBG component used For minimizing the dispersion, from the received optical signal the dispersion it is shown in above waveforms. The value of dispersion after FBG is reduced. Hence Fiber Brag Grating is an useful component for minimizing the dispersion.
6. References:

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