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Research Article

SIMULATION OF DISPERSION COMPENSATION IN OPTICAL TRANSMISSION SYSTEMS BY THE FIBERS OF DISPERSION COMPENSATION AND BRAGG GRATING GRATINGS

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ABSTRACT
In this article we simulated an optical transmit system and observed the dispersion in it to remove the created dispersion using two compensator of Oti system software. The results of these two compensators are compared together and advantages and disadvantages of that are mentioned for each

Keywords: *Dispersion Compensation, Dispersion Compensation Fibers, Optical Bragg Fibers*

INTRODUCTION

The optical fiber is a de-electric environment through which information are passed. The main structure of an optical fiber includes the core and cover in which the optical cover is led by the internal reflection method. Light encounters factors such as weakness, destruction and changes while passing the fiber. In this project we deal with the simulation of the random dispersion compensation in fiber. Random dispersion in optical fiber is a phenomenon that creates wave due to dependence of the group breaking coefficient (Ng). In optical fibers, dependence of Ng to the wave length creates a temporal widening in dispersion pulses. As the pulse moves in the fiber, it starts to widen and lose its basic forms and covers its near neighbors and is unrecognized in the input receivers (Bo, 2010; Kengratingh and Gerald, 1997). One of the suggestions for compensating the dispersion is the dispersion compensation fibers which were widely used in random dispersion. Chipper Bragg gratings are recently used for random dispersion compensation of the fibers (Lin *et al.,* 2001; Nielsen and Knudsen, 2000).

How to Change the Performance of the Bragg Gratings and Dispersion Compensation Fibers

Bragg fiber is a part of a fiber which is one fashion and is in a form of a grating. Optical fiber gratings simply include repeated modulation of the break coefficient inside the optical fiber core. In a Bragg grating optical fiber, the dispersed light inside the core which meets the condition of the Bragg is intensified by the bragging and is reflected (Litchinister *et al.*, 2007; Miguel and Rui, 2004).

The distances between the gratings determine the length wave of Bragg grating and so the light determines the reflected wave length of the Bragg grating and so the reflected light is omitted from the passing spectrum.

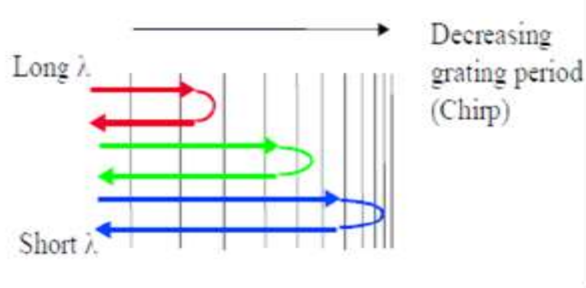

Figure 1: Dispersion compensation by reflecting the different wave lengths from various points along the grating

This is the most important feature of the Bragg gratings which is intensified during the wave length and reflects toward the source and other wave length pass inside without weakening. A chirp in Bragg grating is a kind of chirped that creates changes in the grating period. As the grating period changes along with the axis, different wave lengths are reflected along with different sections (figure 1) and so the time intervals are delayed (Othonos and Kyriacos 1999; Raman, 1999; SemaKurtaran and Selami, 2007).

Final effect of a compression is in the input pulse which can be accumulated for dispersion compensation in the telecommunication links. Using the fibers of dispersion compensation needs having them inserted in specified intervals with negative dispersion coefficient in a telecommunication link for removing the dispersion effect of the normal fibers (Toroqi, 2006).

3. Simulating the Transmitting System and its Results

In order to show the created dispersion in the optical fibers used in telecommunication systems and also compensating the dispersion simulated a system such as 2 in software.

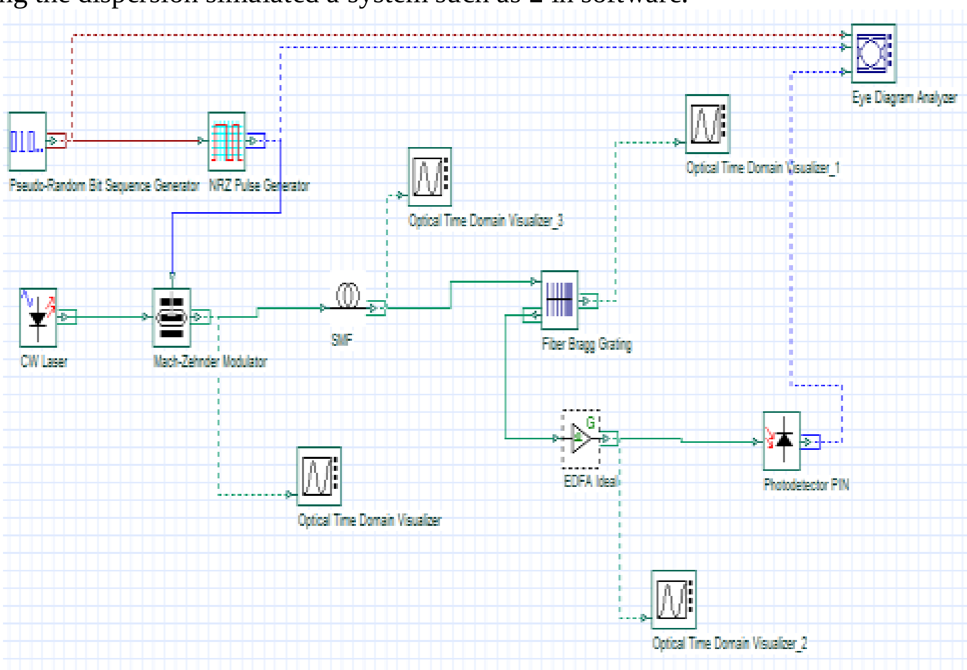

Figure 2: The systems created by FGB

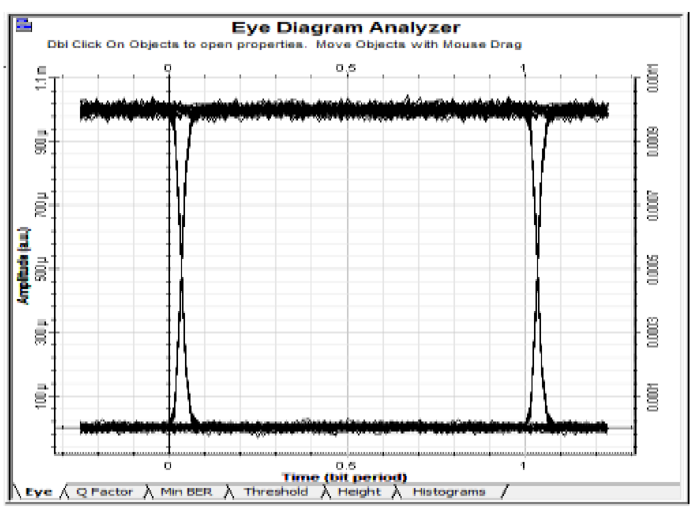

Figure 3: Modulator output

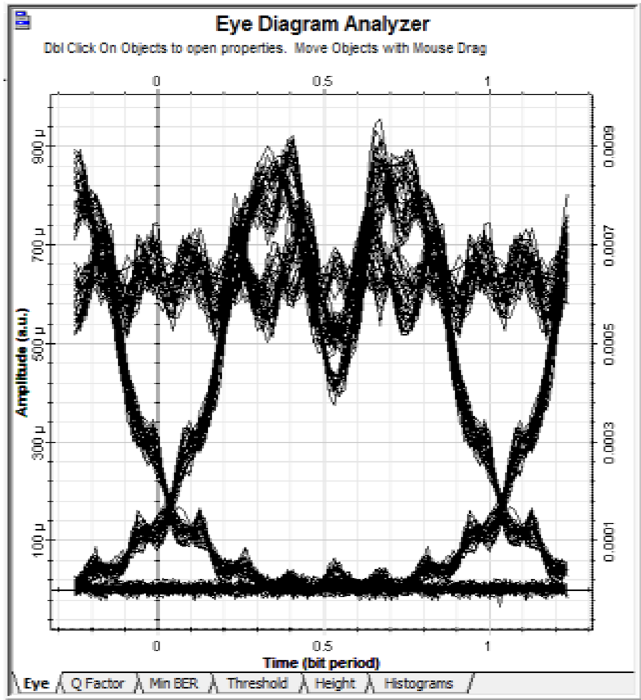

Figure 4: Fiber output

By observing the output modulator and fiber and comparing it, it is completely observed that after passage of the signal from the fiber, dispersion causes losing the primary form of the information. As a result in order to compensate the dispersion and reviving the primary signal, a tool is used for doing it. The input pulse of the fiber (modulator output) is like figure 3 and by comparing it with figure 4; we found that in addition to changes in pulse shape, the power is also reduced.

For this simulation the CW laser in frequency of 193.1THz and the output power of 1mW is used which is modulated by the binary semi-random piece of NRZ type in 10Gbits/s by a Much-zender modulator with the off tone of 30dB externally.

EDFA which is used in this model has a part of 6dB and is independent of the wave length and an ignorable noise. In addition the parameters of the fibers and FBG which are used in this system are mentioned in tables 1 and 2.

Table 1: Fiber parameters

17	dispersion (ps/km/nm)
0.050	Dispersion slope (ps/nm^2/km)
0.2	Loss coefficient (dB/km)
10	Fiber length (km)

Table 2: FGB parameters

193.1	Frequency of effective break coefficient(THz)
1.45	Grating length(mm)
6	function apodization
Tanh	parmeter tanh
4	function chirp
Linear	parameter linear(µm)
0.0001	

Figure 5 shows the reflection spectrum of FBG for the designed systems. As it is shown in the figure, the pulse is revived and the power reduction can be compensated.

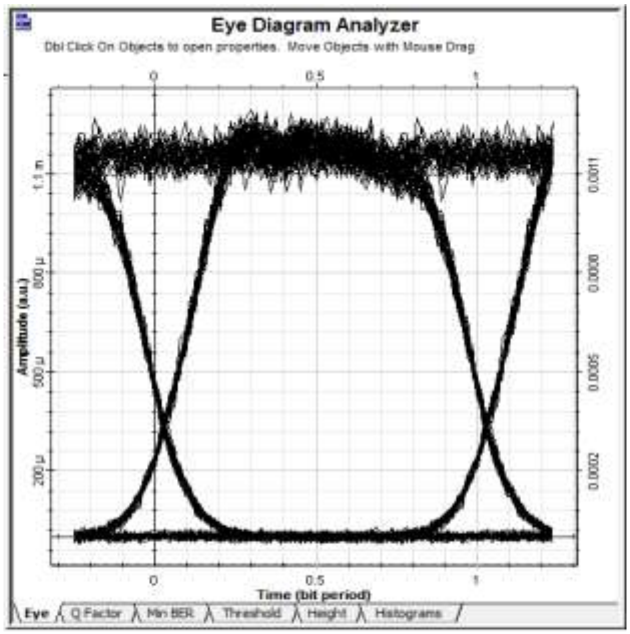

Figure 5: FBG reflection spectrum

In figure 6 the same system is simulated with DCF.

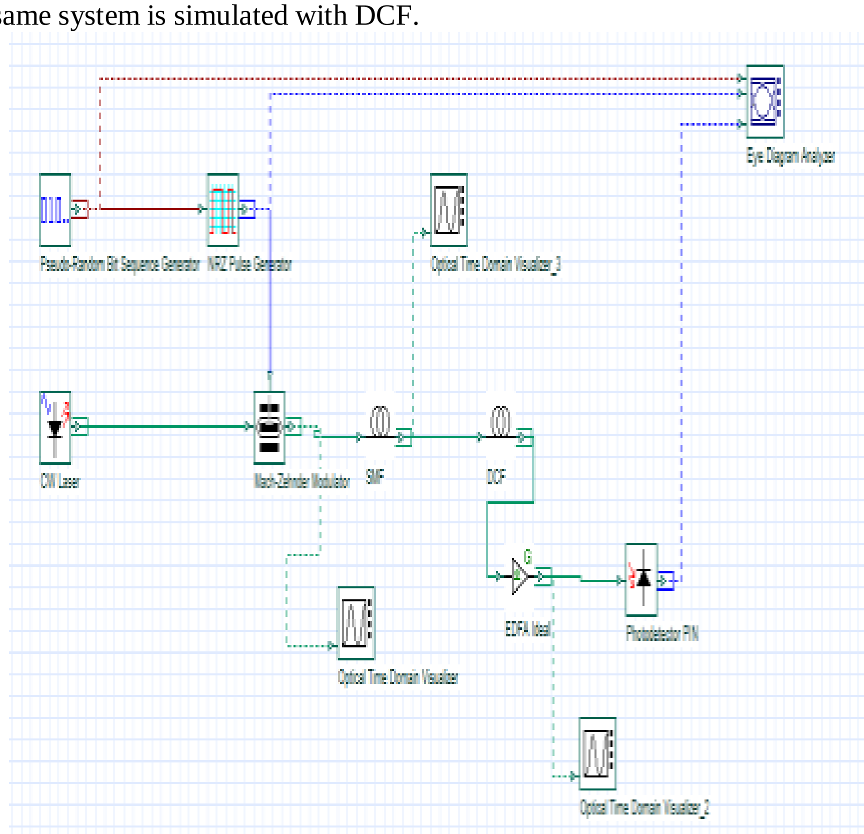

Figure 6: The system simulated with DCF

First, after fiber, we out a DCF which is completely same as the fiber parameters and the final parameter is seen in figure 7. Furthermore, the EDFA had the efficiency of 4.5dB.

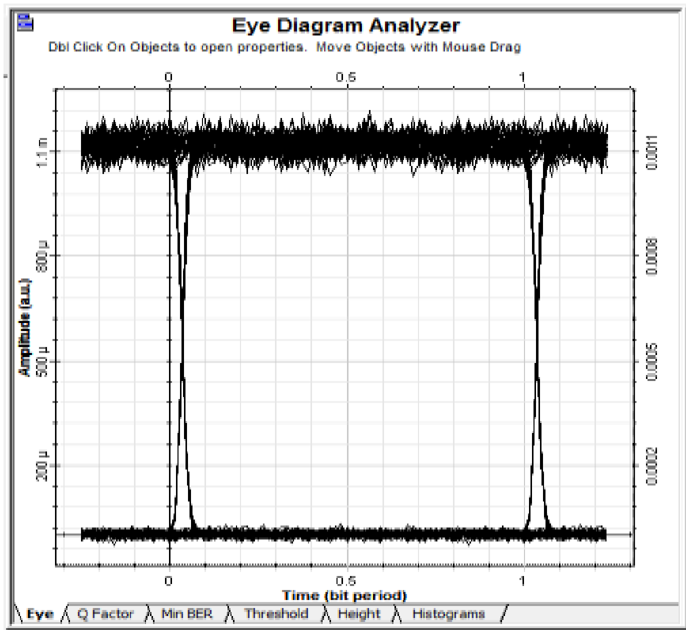

Figure 7: The output of DCF

It is found that for compensating the dispersion in an optical fiber with the length of 10km a DCF with the length of 10 Km is needed. If the length of the DCF becomes less the dispersion is not compensated and so figure 8 is resulted.

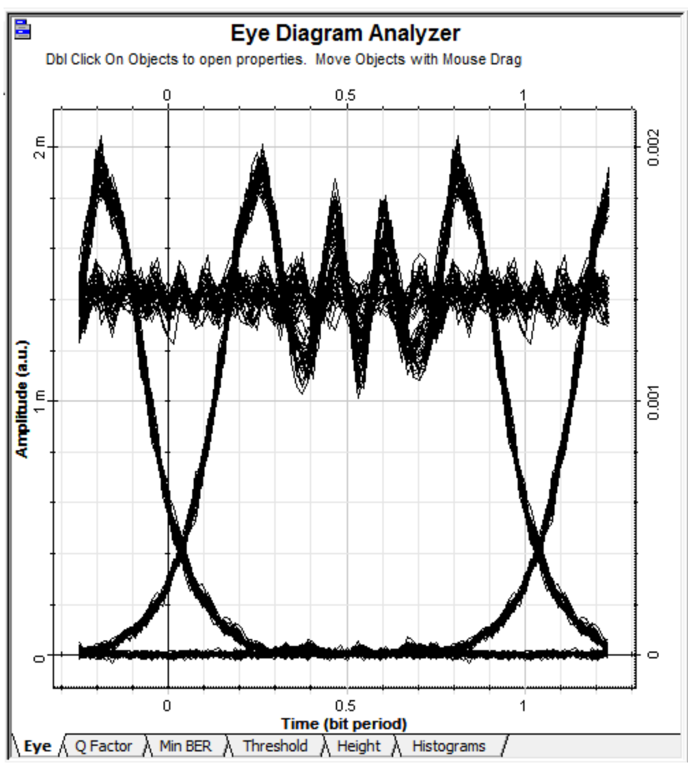

Figure 8: Output of DCF with 5Km length.

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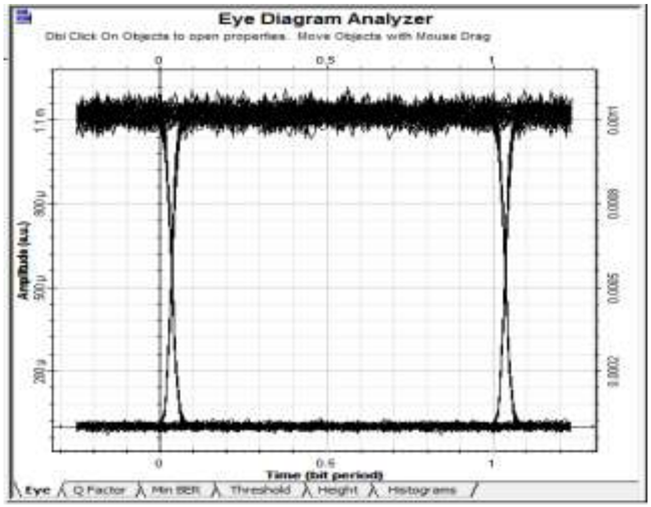

Figure 9: The output of DCF with 5km length.

So for compensating the dispersion the length of DCF should be increased or the number is added. For example, what is seen in figure 9 is the compensated dispersion due to using two DCF with 5km length.

Conclusion

Dispersion compensation is the optical telecommunication systems is a very challenging and important issue. Without compensating the dispersion, each sign in widened and covers the points near each other so that it cannot be recognized in the receiver. As it is shown the length of the dispersion compensation fibers is more and so the nonlinear effects appear and make problems. So using these fibers increases the general loss, nonlinear effects and the costs of the optical transmit systems. In addition, the amount of compensation depends on the wave length and can act in a narrow form. But on the other side the chirped Bragg fiber gratings are suggested for compensating the dispersion and based on the descriptions given in section 2, they have created random compensation in optical transmission systems. They have none of the mentioned disadvantages for DCF and the most important advantages of FBG compared to other suggested cases of internal loss include the nonlinear effects and low costs.

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