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Performance Analysis of Apodized Fiber Bragg Gratings Formats in Optical Communication System

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ABSTRACT
This paper presents the performance analysis of apodized fiber bragg an optical communication system. The effected fiber bragg for capacities uniform, Gaussian and tanh capacity has been implemented and investigated. The variable file of FBG performance is talented for the distinctive apodized capacity, including utilization in the RZ beat generator. The corresponding framework throughout the fiber mode channel is simulated using optisystem version 9 programs. Results show a fit correlation for the range, eye diagram and Q-variable figure.

***Keywords**: Optical Communication, FBG, Optisystem9, Spreading, Q-Factor.*

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I. INTRODUCTION

In the course of recent decades have totally changed our lives in a lot of ways since the utilization of the fiber optic correspondence and this without a doubt is because of the low misfortune optical filaments, which thus prompted novel system in the field of optical fiber. In the optical interchange techniques, the vulnerability looks absent, in which the optical filaments are logically at extraordinary established [1]. In the uses of fiber optic, the specific developments in the channel are contrasted without change in the electrical properties. Hence, the information rate is rapid and limitation is founded and the optical outline includes transmitter, channel as well as receiver [2]. One of advance process is the apodization which utilize the various FBG uses, manage and enhance sensor understanding [3]. The execution of FBG based sensor in the current and old studies contain many missing to influence a grouping of setup apodization. This paper introduces wide investigation and utilizing in apodization profile for showing uniform, Gaussian and tanh execution of FBG to build tried parameters to get more optical range,eye chart.

II. FBG STRUCTURE

The effectiveness structure and rising selectivity of fiber bragg make this technology simple and low enlistment trouble. Furthermore, high wavelength selectivity of this technology will affect the system performance [5]. In optical fiber systems, the fiber bragg crushing could considered as small section resulting in a specific wavelength reflection of light [6]. In optic fiber, the mirror process in FBG divides the light center in optical fiber onto bragg wavelength depending on two factors, the fiber grinding length and refractive record. The mode of FBG will show a fundamental intermittent sample of exceptional UV in optical systems. Therefore, the refractive lists are extended frequently in the file of refractive. The consistence of piece structure will form the grinding list. Only a slender scope of light when the light source pass to FBG and relies on the reflected bragg wavelength. The other wavelength will slightly reflect at slight varieties of the list and medium road damaging this wavelength in the transmitter path as illustrated in Figure 1 [7].

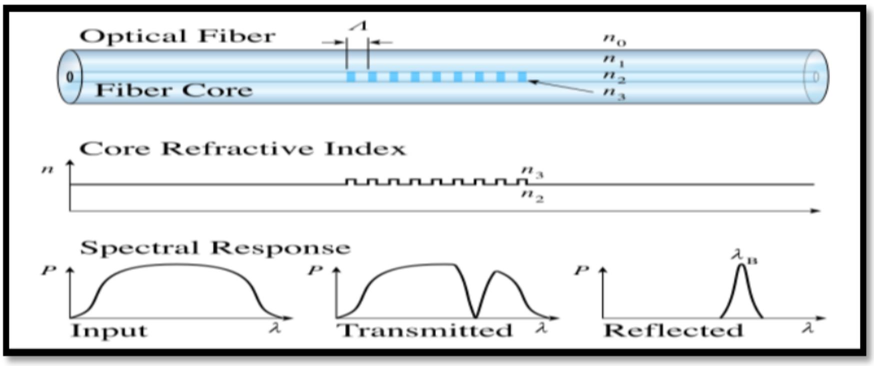

Figure 1: Fundamental of Bragg's light structure.

2.1 FBG Apodization

The unearthly reaction of grinding suggested in the proposed apodization with uniform record adjustment contains undesirable sounds in the projection sides. The variety of profundity adjustments alongside grinding length is so called "apodization". The FBG apodization assume critical section in the expulsion projection side to keep the reflectivity in data transmission. Figure 2 explains the profile of apodization in FBG techniques [8].

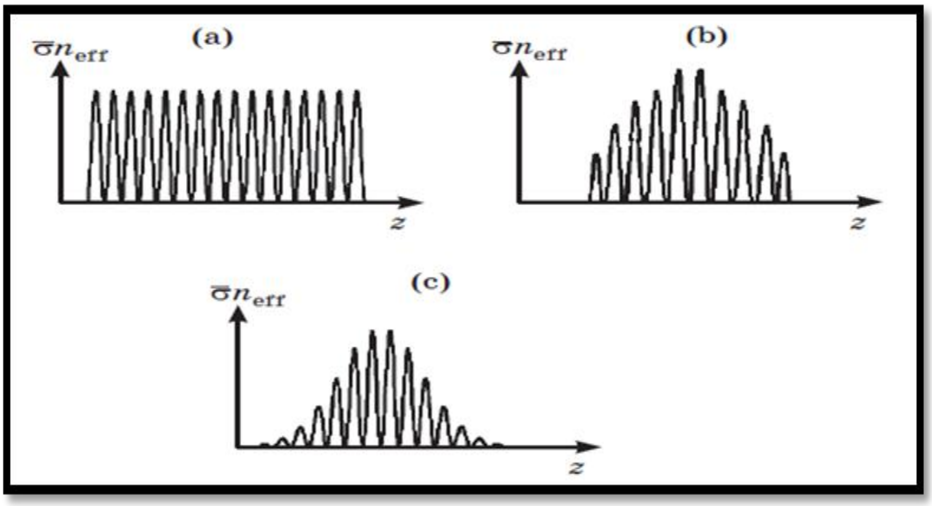

Figure 2: The apodization profiles refractive index.

Mathematically, the apodization profile could represented by the following formula as uniform, Gussian and tangent change as in [9]. The non apodize mode is formulated as f(z)=1 . The hyperbolic tangent model is formed as

A. Uniform (no apodization):

$$f(z) = \text{Constant} \tag{1}$$

B. Hyperbolic Tangent:

$$f(z) = \tanh\left(\frac{S.Z}{L}\right).\tanh\left[S.\left[1-\frac{Z}{L}\right]\right] + 1 - \tanh^2\left(\frac{S}{2}\right) \tag{2}$$

C. Gaussian:

$$f(z) = \exp.\left\{(-4\log 2).\left(\frac{\left(\frac{z-L}{2}\right)}{S.L}\right)^2\right\} \tag{3}$$

Where:

L: Length of the grating.

Z: direction of the light generation over the length for fiber bragg grating.

S: called decrease measurable factor utilized in the exact setting of reflection range.

III. EXPERIMENT RESULTS

The transmitter, channel and receiver of optical framework has been designed and simulated using optesim9 programs. The constant wave laser is the transmitter balanced using pseudo generator through heartbeat by spreading the signal mode over optical fiber in crosswise sign. The length of 10 km SMF has been utilized in transmitter channel with a weakening coefficient of 0.2 dB/km and photodetector in receiver path. The designed setup signals are, passing by coming back to zero pseudorandom in the form of double precision values. The Mach-Zehnder modulator is used to modulate constant wave laser signal as data transmission signals. The wavelength of 1550nm is used as a laser constant signal with 5 dbm forces balanced at 10Gbps in the proposed mach-zehnder modulation technique. In the corresponding optical frameworks, the 30db of termination proportion is used in the Mach-Zehnder modulation process. The refraction index variation from 1.45 to 1.8 is used in Uniform, Gaussian and tang profiles. Additionally, the utilization in EDFA with variable flag enhancement values. An equivalent grinding length of 2mm has been considered. The EDFA utilization in the in the PIN photograph locator is spread throughout it. Throght Bessel optical channel, the enhanced sign is gone due to several specifications in data transfer of 40GHz with a bearer wavelength of 1550nm in the suggested model as illustrated in Figure 3. The investigation outcome of the suggested techniques shown in Table 1, Table 2 and Table 3. The apodization capacities in FBG optic fiber group framework using optisystem9 shows correlation in examining parameters.

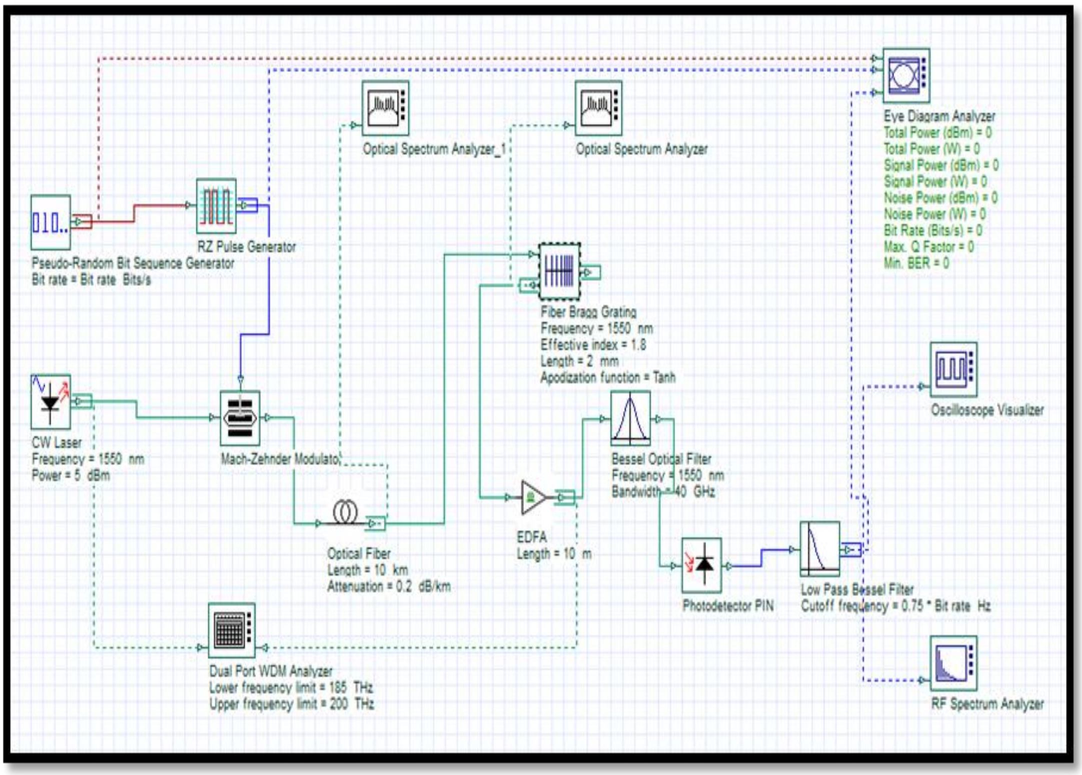

Figure 3: Proposed transceiver model.

IV. RESULTS AND DISCUSSION

During this search, examinations the parametric usage and correlation of the distinctive apodization capacities of the FBG group in single mode optical fiber transmission framework is accomplished by optisystem-9 reenactment programming. The outcome of the investigation, reproduction of the various refractive list utilizing different FBG apodization capacities for a solitary transmission divert so as to clarify from Table 1,Table 2 and Table 3.

Table 1: Uniform format of FBG with different refractive index.

Refractive Index	Gain (db)	Noise Figure(db)	Q. Faactor
1.45	11.514	17.478	70.18
1.5	11.517	17.481	71.15
1.6	11.523	17.482	72.93
1.7	11.54	17.483	75.61
1.8	11.55	17.488	78.51

Table 2: Gaussian format of FBG with different refractive index.

Refractive Index	Gain (db)	Noise Figure(db)	Q. Faactor
1.45	10.47	23.04	60.91
1.5	10.46	23.033	61.285
1.6	10.464	23.035	61.997
1.7	10.467	23.037	62.7
1.8	10.471	23.041	63.4

Table 3: Tanh format of FBG with different refractive index.

Refractive Index	Gain (db)	Noise Figure(db)	Q. Faactor
1.45	11.51	17.65	69.96
1.5	11.58	17.6405	70.91
1.6	11.504	17.645	72.431
1.7	11.51	17.648	75. 1
1.8	11.516	17.66	77.85

The eye diagrams of optical channel with 10 km length and 2mm FBG is illustrated in Figure 4, Figure 5 and Figure 6 which represent the Uniform, Gaussian and Tanh technique respectively.

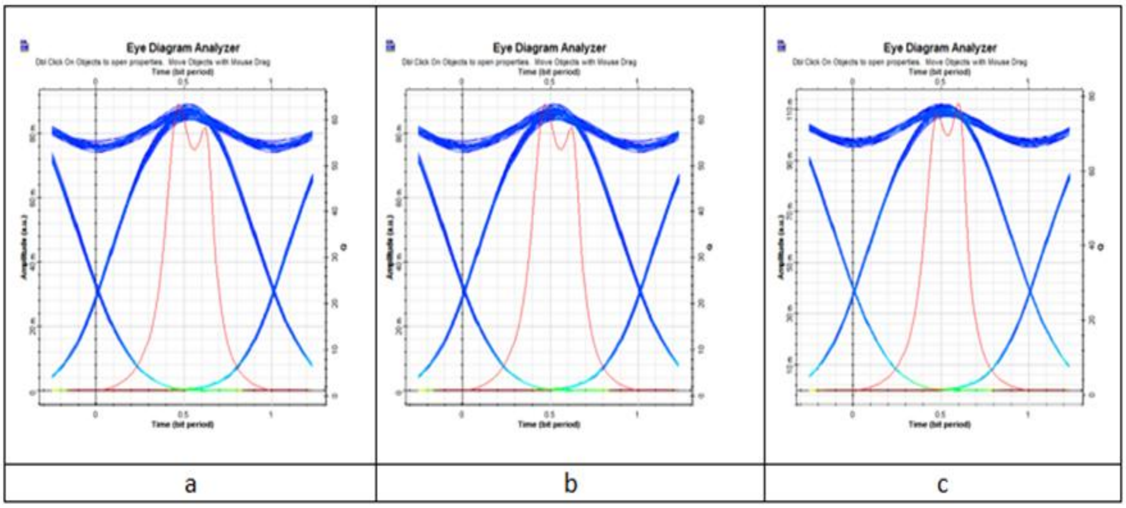

Figure 4: Uniform, Gaussian and Tanh eye diagrams.

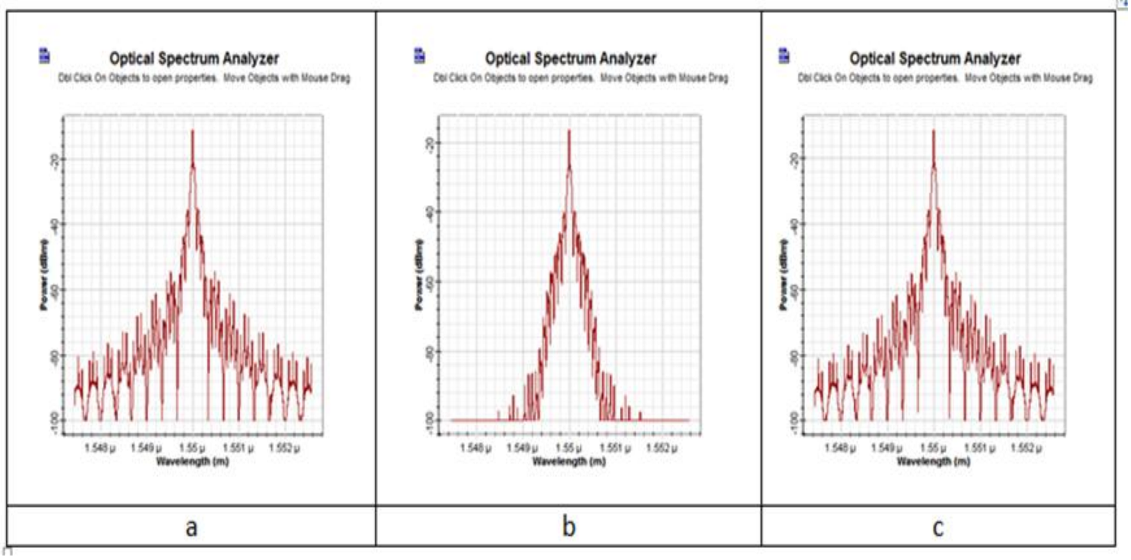

Figure 5: Optical spectrum of Uniform, Gaussian and Tanh.

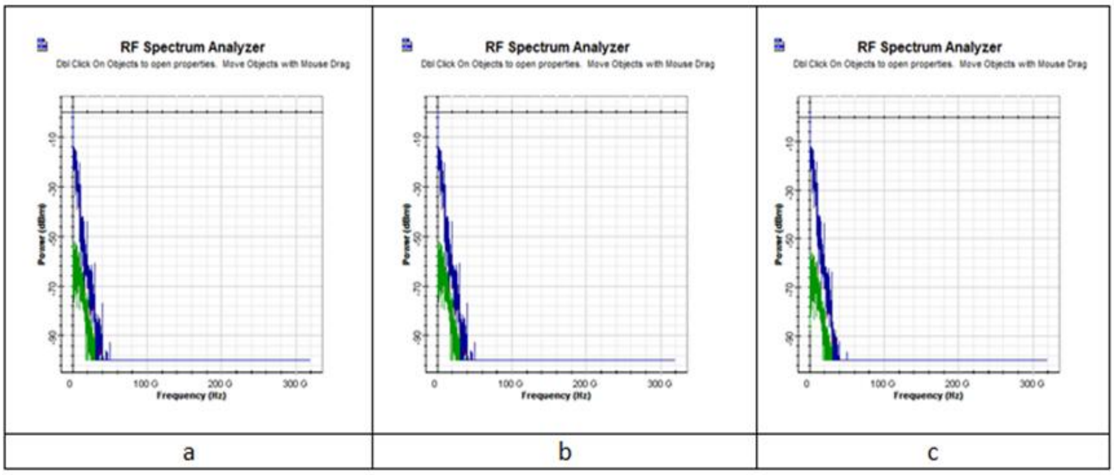

Figure 6: The optical spectrum of RF Uniform, Gaussian and Tanh.

The relationship among refractive list with specified parameters for various apodization FBG profiles of Uniform, Gaussian and Tangent profile is illustrated in Figure 7, Figure 8 and Figure 9

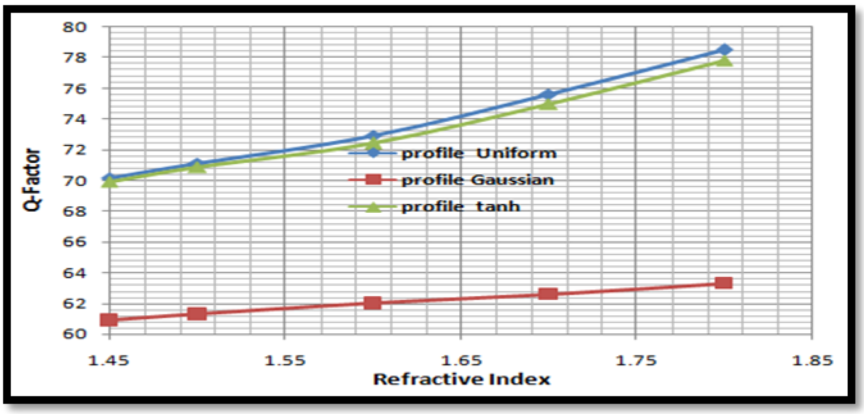

Figure 7: The refractive index with Q- Factor relationship profiles.

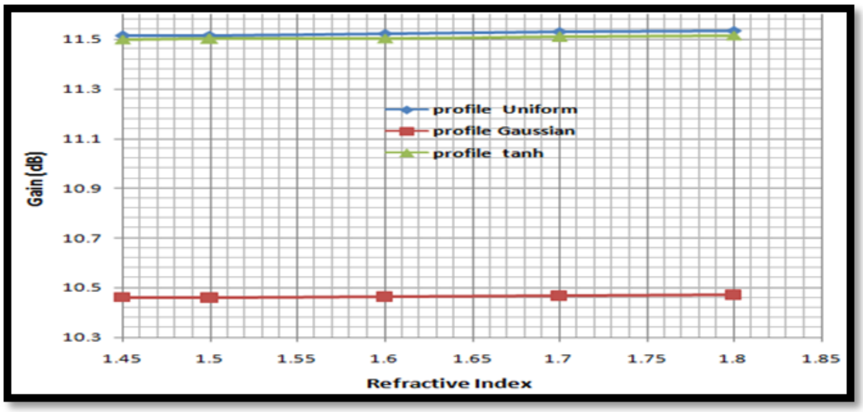

Figure 8: The refractive index with Gain relationship.

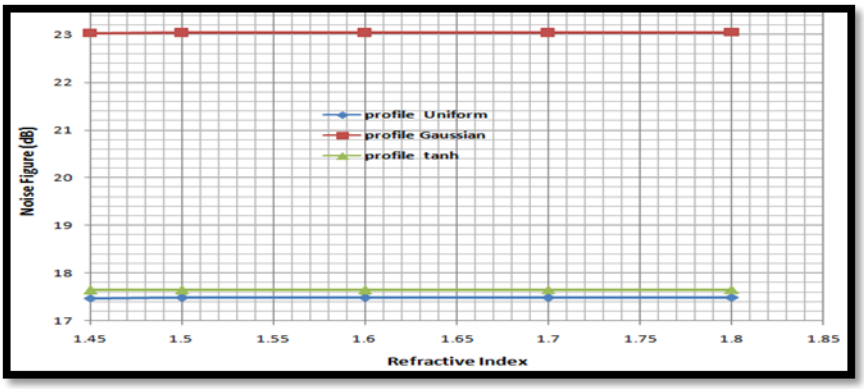

Figure 9: The refractive index and NF relationship.

In this work, study execution of the three distinct sorts of apodization capacities has been utilized name: Uniform, Gaussian and Tanh. Also advancing an extensive look at as far as the Q element, clamor figure, spectrum,BER and the normal yield energy to decide the favorable position and hindrance of optical interchange framework with apodization FBG appears in the above tables.
As shown up from Figure 7 into Figure 9, I think about the outcome acquired by utilizing three unique sorts of apodization capacities, presentation that all coherence brought about by changes refractive index estimations of apodization FBG , while picking five values that are 1.45 into 1.8 variations step 0.1, to compare the calculation setting the range on a 10 km by using single mode optical fiber and limited length of FBG at 2mm and refractive index 1.7, then the parameters calculated for an apodized **Uniform profile** gain=11.45dB, Noise figure=17.483, Q.Factor=75.61 while **Gaussian apodization** gain=10.467dB, Noise figure=23.037, Q.Factor=62.7 and **Tanh apodization** the parameters are gain=11.51dB, Noise figure=17.648, Q.Factor=75.1.

So by the results we have obtained show that the **Uniform profile** gives best results and have higher Quality Factor.

V. CONCLUSION

This paper presents the study and investigation of various apodization profiles in communication systems. Clearly, the results prove the FBG technique provide an expanding refractive of apodization fiber in term of gain, NF, and Q elements in modern user demand communication systems. The best attributes have been provided in capacities and uniform profile. A higher refractive list and uniform capacity are utilized which introduce an increasing in expanding and quality elements in optical systems. The suggested model and technique promising to support the current and future generation of communication system and gave the researcher enough chance to develop their idea, which enhance the developer to introduce new developed model.

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