IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

# HIGH SPEED BROADBAND COMMUNICATION SYSTEM FOR UNDERGROUND TRAIN USING OPTISYSTEM

[1]Anushya M

[1]Department of Electronics and Communication Engineering
Alagappa Chettiar Government College of Engineering and Technology
Karaikudi, Tamil Nadu, India

*Abstract:* FSO (Free Space Optics) has been developed as technology for highspeed Broadband communication system which act as an alternative for RF technology. The FSO system is investigated for 1550 nm wavelength. The proposed system consists of base stations which are positioned at a distance of 500-1400m from each other so that the number of base stations can be reduced and the coverage area can be improved and also analyse the bit error rate, Q factor of the proposed system . Further to improve the quality of FSO communication and coverage area by different filters like Gaussian filter, Rectangular filter, Butterworth filter, Trapezoidal filter under Fog condition conditions and to analyse which filter improves the coverage area to maximum.

***Index Terms* – Underground train, Filters, Fog condition, OptiSystem.**

## I. INTRODUCTION

The FSO is a Line of Sight (LOS) communication and if operated in the infrared region, it can provide broadband wireless communication service. FSO is a line-of-sight technology that uses lasers to provide optical bandwidth connections orFSO is an optical communication technique that propagate the light in free space means air, outer space, vacuum, or something similar to wirelessly transmit data for telecommunication and computer networking. Currently, FSO is capable of up to 2.5 Gbps 1 of data, voice and video communications through the air, allowing optical connectivity without requiring fiber- optic cable or securing spectrum licenses. Operate between the 780 – 1600 nm wavelengths bands and use O/E and E/O converters.

## II. HIGH SPEED TRAIN

High-Speed Internet service has become an important part in our daily life. Consequently, passengers on high-speed trains (HSTs) are always like to connect internet while travelling also. However, it is challenging for existing radio frequency technologies to provide broadband data services in HSTs, because of some limitations in RF technology. Free space optics (FSO) is an alternative technology for increasing the demands for high speed data transmission.

## III. SIMULATION SETUP

The FSO system consists of base stations which are positioned at a distance of 500-1400m from each other so that the number of base stations can be reduced and the coverage area can be improved. The simulation is performed using these parameters.

**Table 1 Parameter for FSO Design**

| PARAMETER | VALUE |
|---|---|
| Frequency | 193.1 THz |
| Optical Wavelength | 1550 nm |
| Optical Power | 25 dBm |
| Range | 500-1400 m |
| Attenuation | 25 dB/km |
| Beam Divergence | 2 mrad |
| Transmitter aperture diameter | 5 cm |
| Receiver aperture diameter | 20 cm |
| Transmitter loss | 0 dB |
| Receiver loss | 0 dB |
| Responsivity | 1 A/W |
| Bit Rate | 1.25 Gbps |

Considering the eye safety standards, the FSO system is investigated for 1550nm wavelength and power of 25dbm. The signals from the PRBS (Pseudo random bit sequence) codes the optical signals as 0's and 1's and transmits to the pulse generator which has its code as NRZ (non-return to zero). The output is modulated using Mach-Zehnder Modulator . This Signal then passes through FSO channel . Based on the simulation design and model the results were obtained from BER Analyzer. To improve bit error ratio and Max Q Factor of the received signal as well as improve the range coverage of the system by using different filters such as Rectangular filter, Gaussian Filter, Butterworth filter, Trapezoidal filter under Fog condition.

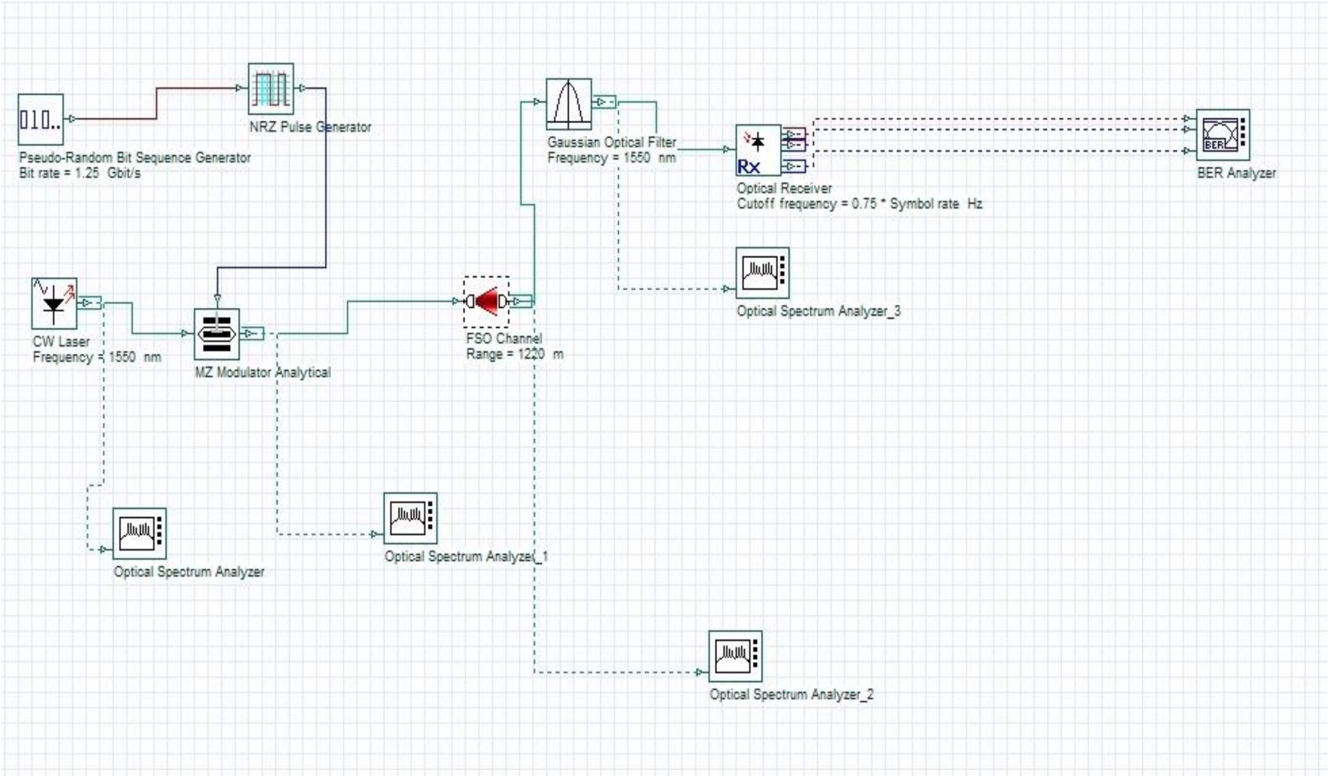


**Figure 1 Simulation setup for FSO Design with filter**

## IV RESULT AND DICUSSION

Choosing the different pulse generator such as NRZ pulse detector, RZ Pulse generator, Sine pulse generator, Triangular pulse generator and analyze the better performance between them in the range of 500-1400 m. The respective comparison graph is shown in Figure 2 .

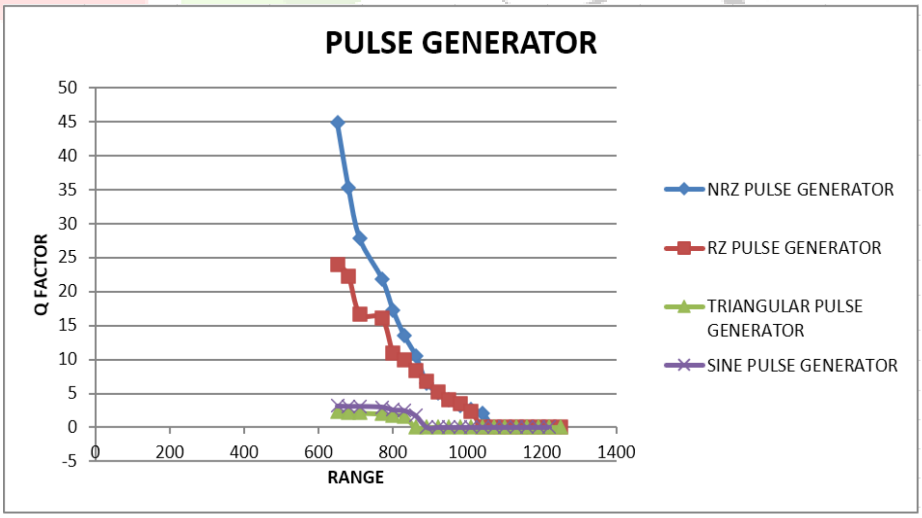


**Figure 2 Q factor vs Range of different Pulse Generator**

From Graph shown in Figure 2, Presents the analysis between Q factor vs Range. It can be observed that the Q factor and Min BER in NRZ Pulse generator has better performance than RZ, Sine and Triangular Pulse generator in range of 500-1400 m.

Next Analyzing the performance of Q factor and Min BER in underground train under Fog condition by using Different filter and comparing the design with and without filter. Considering the Fog attenuation is 42.2db/km . [9]

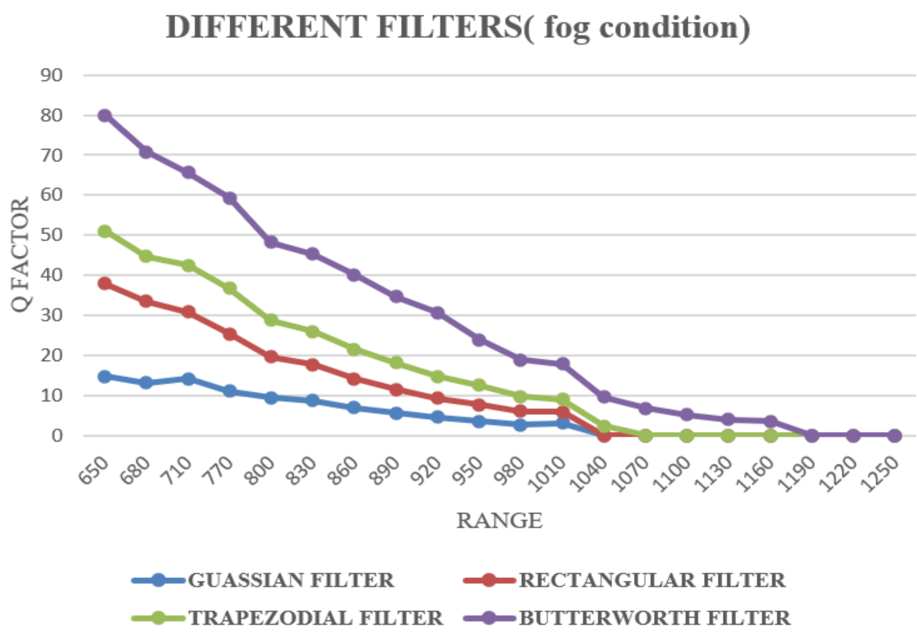


**Figure 3 Q factor vs Range of different filters under Fog condition**

From Graph shown in Figure 3, presents the analysis between Q factor vs Range of different filters. It can be observed that Butterworth filter perform better than other filters such as Gaussian Filter, Rectangular Filter, Trapezoidal Filter. Now Comparing the design with Filter and without Filter.

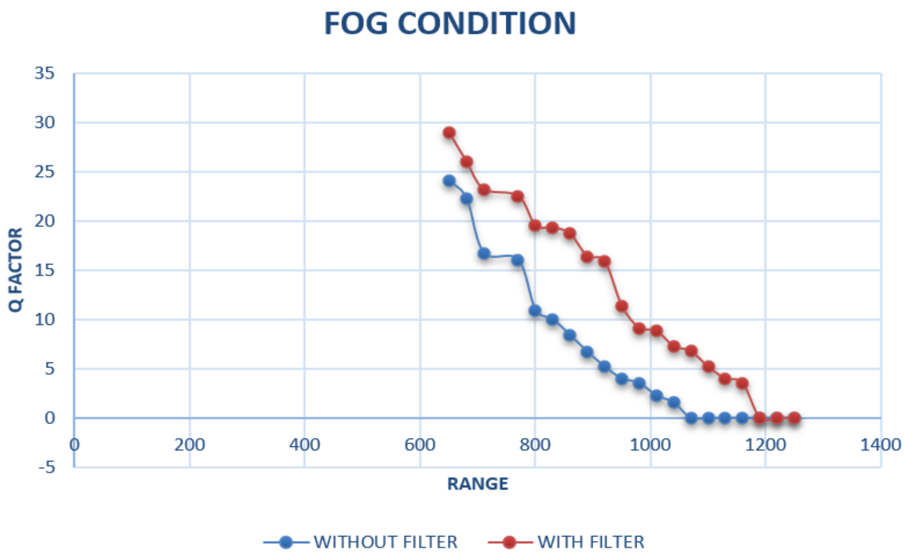


**Figure 4 Q factor vs Range of with and without filter under Fog condition**

From Figure 4, It can be observed that the Q Factor for the simulation design consisting of filter is more than the simulation design without filter under Fog condition. The signal received with a Q Factor of nearing 6 (i.e. 6.77971) is received at a distance of 1070m for simulation design consisting Butterworth filter whereas at 890m (i.e. 6.72215) for simulation design without filter under Fog condition. From the results of the simulations and the observations it can be implied that the results of simulation design using the Butterworth filter gave more promising results than the simulation design without filter under fog condition.

## V CONCLUSION

Different Ranges are implemented to enhance the performance of underground train using OptiSystem . Also analyzed and simulated a FSO based system model for communication with a coverage length of 500-1400m using different filters. On the basis of the results of simulation and relationship graphs between BER Versus Range and Q factor Versus Range under Fog condition is analyzed.

From the results of the simulations and the observations it can be implied that the results of simulation design using the Butterworth filter under Fog condition gave more promising results than the simulation design without filter under Fog condition. It can be concluded that the performance achieved by the communication model consisting of filter is significantly better than the communication model without filter.

## IV. ACKNOWLEDGMENT

The Author Thank the principal of Alagappa chettiar Government College Of Engineering And Technology, Karaikudi , Tamilnadu for Providing The Optisystem 16.1 Simulation for carrying out this experiment.

## REFERENCES

[1] Ekta Saini, Richa Bhatia, Saurabh Prakash, " High Speed Broadband Communication System for Moving Trains using Free Space Optics", International Conference on Computational Techniques in Information and Communication Technologies (ICCTICT) 2016.

[2] Rupak Paudel, Xuan Tang and Zabih Ghassemlooy, "Laboratory Demonstration of FSO Ground-to-Train Communications with Multiple Base Stations" 10th International Symposium on Communication Systems, Networks and Digital Signal Processing (CSNDSP) 2016.

[3] Rupak Paudel, Student member, IEEE, Zabih Ghassemlooy, Senior member, IEEE, Hoa Le-Minh, Member, "Investigation of FSO Ground-to-Train Communications in a Laboratory Environment " International Conference on Computational Techniques in Information and Communication Technologies (ICCTICT) 2011

[4] H. Kotake, T. Matsuzawa, A. Shimura, S. Haruyama & M. Nakagawa, "A new ground-to-train communication system using free-space optics technology" Department of Information and Computer Science, Keio University, Japan 2010

[5] R. Paudel,Z , Ghassemlooy , H. Le Minh, "Lambertian Source Modelling of Free Space Optical Ground-to-Train Communications" 8th IEEE, IET International Symposium on Communication Systems, Networks and Digital Signal Processing 2012

[6] R. Paudel, Student Member, IET, H. Le-Minh, Z. Ghassemlooy, M. Ijaz and S. Rajbhandari , "High Speed Train Communications System Using Free Space Optics" International Conference on Computational Techniques in Information and Communication Technologies (ICCTICT) 2011

[7] Qiang Fan , Mina Taheri, Nirwan Ansari , Jianghua Feng, Roberto Rojas-Cessa , MengChu Zhou and Tairan Zhang , "Reducing the Impact of Handovers in Ground-to-Train Free Space Optical Communications" Ieee Transactions On Vehicular Technology, Vol. 67, No. 2, February 2018

[8] Abhijot kaur, Neeraj Sharma, and Jatinder singh, "Performance Analysis of Free Space Optical Communication Systems for High-Speed Trains" 10th ICCCNT - 2019

[9] A. Mansour , R. Mesleh , M. Abaza, "New challenges in wireless and free space optical communications" Optics and Lasers in Engineering 2016