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High-quality data transmitted by ROF, FSO and DPSK systems

Ali A. Hadi[1*] and Hiader Ali Laftah[1]

[1]Department of Computer and Electrical Engineering, Imam Al-kadhum College (IKC), Baghdad, Iraq.

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Abstract

In communications, many Factors affect the quality and quantity through different of radio transmission via optical transmission in open space. In this study OPTI System software is utilized to simulate a real-world configuration of free space optical (FSO), and differential phase shift keying (DPSK) techniques. The ROF signal was transmitted over FSO by loading the ROF signals via light as a carrier signal. With regards to the bit error rate (BER), visual, and receiving energy style scheme, channels FSO one and two are contrasted and examined. The results showed that data was successfully received over long distances of up to 100 km with a Q factor of 23.224. Future installations of several FSO system processes will be possible to accommodate the growing demand for high-bandwidth communications.

Keywords: Differential Phase Shift Keying; Free Space Optical; High Quality Data Transmitted; OPTI System; Radio Over Fiber.

1. Introduction

The system for high-quality data transmission rates has become a landmark and a promising architectural solution for the next communication systems. Following this accomplishment, it has had a significant impact on the production world, despite the fact that diffuse optical fiber cables for large distances are exceedingly difficult to diffuse, and it has significant advantages over present microwave communication [2]. In addition, the Improved lasers' power for transmitting information over long distances has the following characteristics: relatively inexpensive, fast throughput, compact antenna dimensions, fewer bit-errors, amazing bit-rate, high energy efficiency, large transmission implementations, highly secure, no EMI intervention, no permit needed, simple maintenance, easy implementation, longer lifetimes, and broadband internet assistance juncture communication [3]. Optical phase shift keying (PSK) is a method of encoding information in the phase of an optical carrier. PSK required exact alignment of the transmitter and demodulator center frequencies in its early days. As a result, PSK systems are not frequently used. Coherent detection is no longer necessary with the introduction of the DPSK technique, as DPSK detection only requires source coherence over the one-a-bit period by comparing two successive pulses. If the logic of the current input bit and the previous encoded bit is the opposite, a binary "1" is encoded, and if the logic is similar, a binary "0" is encoded. The XOR logic operation is equivalent to this operation. As a result, an XOR gate is commonly used in differential encoders. In differential encoding, NOR can also be used to replace the XOR process. Electrical data "1" is represented in optical applications by a phase shift between consecutive data bits in the optical carrier, whereas state "0" is recorded with no phase shift between consecutive data bits. As a result of this encoding approach, two points

* Corresponding author alihadi@gmail.com

in the signal constellation are situated exactly at a phase difference with regard to each other [1]. In this work, the development of a long-range transmitting data network has been specified in order to resolve the problem of variables influencing data transmission methods. This system has been designed using OPTI Systems 7.0 software.

Radio Over Fiber (ROF)system in a Pico- or FEMTO-cell design, the ROF system may be capable of supporting a substantial percentage of base stations (BSs) forced to support a large number of mobile services [4]. Wireless communication networks have been forced to extend their network bandwidth and availability due to the demand for wireless broadband capacity. An optical fiber link has the capacity, velocity, and dissipation factor features of a ROF system, as well as the mobility of mobile communication, which meets the future of 5G wireless transmission development trends and the demand for gigabyte scale applications [5]. Electromagnetic waves in the GHz range have higher bandwidth, which means they can hold more data, but they suffer more losses when sent wirelessly, so they can't travel long distances. Low- frequency signals, on the other hand, suffer fewer losses and can travel longer distances. Corresponding losses are high at high frequencies. As a result, these waves must be transmitted using a waveguide. The central station (CS) in ROF is connected by optical fiber to a great amount of BS. The BS is only responsible for converting light exposure into a wireless link and conversely, while the CS is responsible for modulating, demultiplexing, forwarding, and encoding. The ROF package includes the RF signal between the CS and the BSs via an elevated waveguide [6].

Free-spaceopticalSystem(FSO) Free space optical (FSO) transmission systems operate in the near-infrared (IR) spectra (about 700 to 1675 nm) and use an atmosphere channel as the data transmission for both inter-satellite and global communication. FSO is a radio communication system that proposes high data rate (HDR) transmission, low bit error rate (BER), unlimited bandwidth, low power operation, simple implementation, and worldwide connectivity. Because of the wide optical bandwidth of fiber lasers, FSO messages have traditionally been used in inter-satellite communications. To meet the growing number of internet of things (IoT) applications and the bandwidth demands of 5G, FSO communications equipment can now be employed for wideband communication. Laser communication has advantages such as high fidelity and robust anti-interference functioning, but skin and eye safety factors make the proper selection of an optical communication system window crucial [7]. Adaptive optics (AO) and optical simulation studies can be used to monitor the performance of a wide range of FSO applications, from newer UAV-based FSO power transmission to light wave-based remotely operated vehicles (ROVs) for submerged FSO data transmission to any aerial FSO network connection [8]. Because it uses unregulated spectrum and abundantly available optical beams as data transporter signals to enable high-speed data lines with secure information transport, FSO is a viable substitute to current radio frequency (RF) based wireless transmission systems [9].

2. Materials and Methods

As illustrated in Fig. 1, Opti Systems software was used to link the circuit, and DPSK was utilized to transport data through the wire utilizing the ROF system.

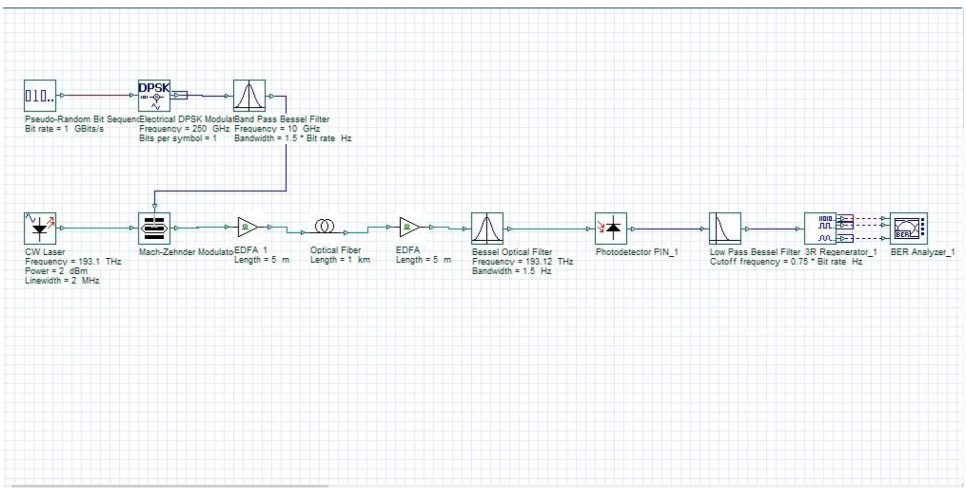

Fig. 1: Simulation design of ROF using DPSK.

A pseudo-random binary sequence that can be used in a variety of ways is part of the project component. The bit sequence is intended to estimate the features of arbitrary information. The NRZ Pulse Generator produces a Non-Return to Zero (NRZ) oblique signal. A CW laser and a Mach-Zehnder modulator are simulated. Under steady conditions, EDFA generates an ER-doped fiber amplifier by evaluating approximate methods to the rates and transmission formulas [10]. This refers to the fact that all of the optical signals collected are in the same frequency band. For photodetector PIN, a Low Pass Bessel Filter with a Bessel frequency converter is used. The DPSK Modulator encodes and modulates a binary electrical signal using DPSK. The 3R Regenerator is an electrical signal regeneration device.

3. Results and discussions

The system described in Fig. 1 showed high optical dispersion as illustrated in Fig. 2. The eye drawing has vanished, indicating that the data has vanished entirely. Furthermore, the outcome of the factor Q is zero.

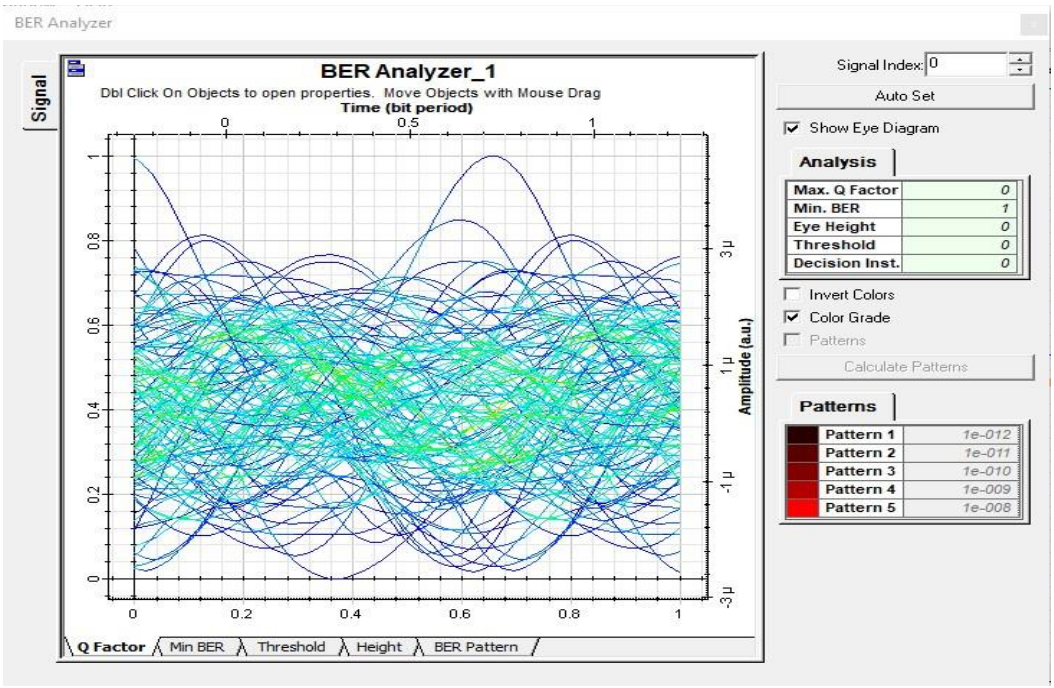

Fig. 2: As a result, there was a significant loss in data transfer. In BER, the eye chart has vanished.

The ROF and FSO systems have indeed been linked together as indicated in Fig. 3 so we can use both systems simultaneously to preserve data before delivering it over free space via the ROF system. When we correlate it with 1K distance, we obtain a fair result, but as the distance increases, we lose data, which is what occurred to the information when it was transmitted, as seen in Fig. 4. The eye chart has vanished in BER, and the Q factor is zero; the reason for this is that the data transmission is completely absent due to the enormous distance across the fiber and the use of one space scheme.

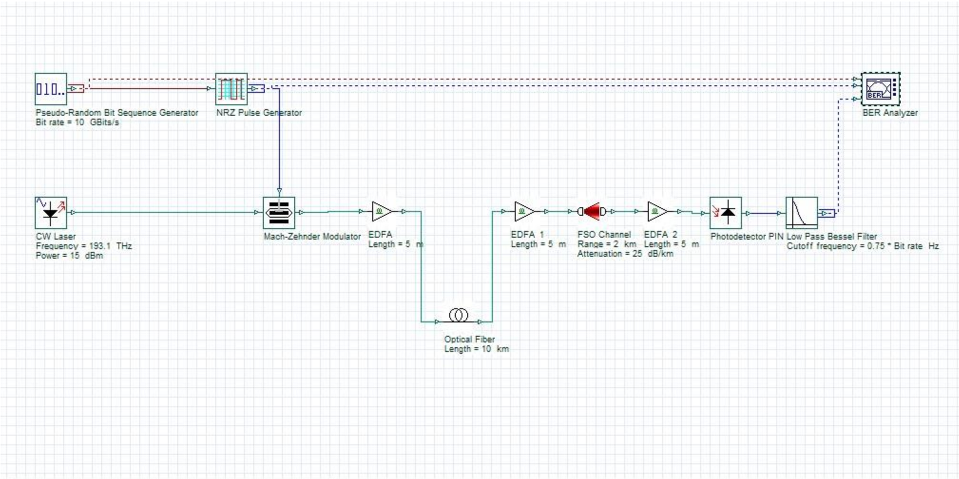

Fig. 3: Simulation model of the optical fiber system's circuit to the optical system's circuit.

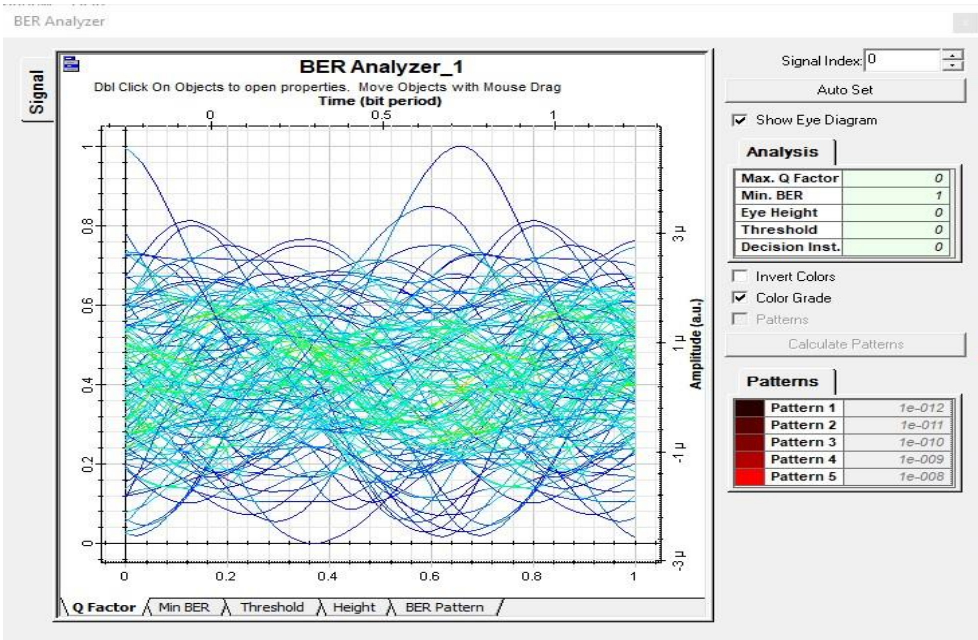

Fig. 4: The result was a huge loss of data transmission. The eye chart has disappeared in BER

The two networks have been linked together as shown in Fig. 5, as well as another FSO device was introduced to the same ROF cable. The range of the first device was set to 1 km, which is the longest range needed for complete data access, and the distance of the other device was set to any distance, requiring up to 100 Km. It can be concluded that as the FSO system is increased, we can send data to any extent and completely, with the result being access to the information when it is sent as shown in Fig. 6. This technique of communication worked, as evidenced by the introduction of the eye chart in BER.

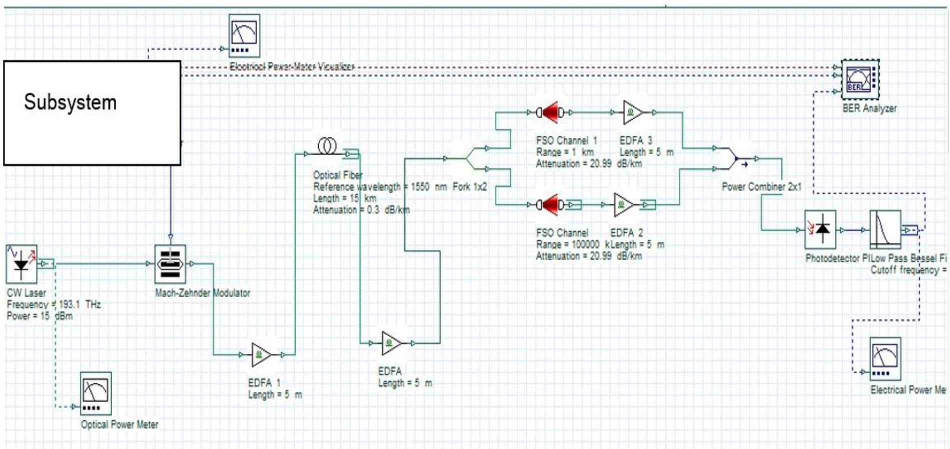

Fig. 5: The optical fiber system's circuit is connected to the optical system with the doubling of the optical device

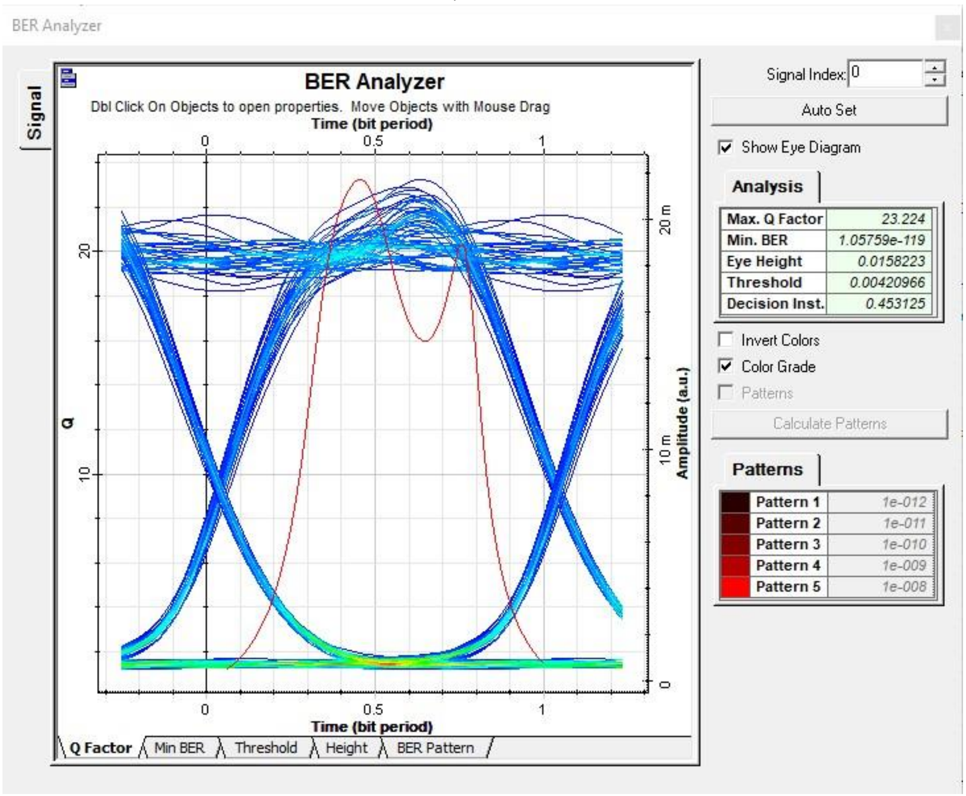

Fig. 6: Eye Diagram analyzer

As shown in Fig. 6. Data was successfully sent using the connecting mechanism. In BER, the eye chart has a distinct appearance, and this is evidence that the data has been fully received. Also, the Q factor, the result is (23.224).

4. Conclusions

OPTI Systems software was used to develop and simulate a free-space optical and Radio over Fiber and Differential Phase Shift Keying system, and its properties such as Q-factor and BER were compared for several modulation schemes such as DPSK and ROF, FSO1, and ROF, FSO2. As the length of both channels increases, so does the value of the penal energy. Simulated results indicate that the integration of the two ROF and FSO systems will be the next generation of optical communications system integration because of their data signal performance. Due to the large enhancement in the correlation length and minimal BER value, as well as the optical power penalty, interpretation, ROF, and FSO with multi-power FSO channel control, the influence of influencing factors is greatly reduced.

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