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PERFORMANCE ANALYSIS OF VISIBLE LIGHT COMMUNICATION (VLC) SYSTEM BY DIFFERENT MODULATION TECHNIQUES

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ABSTRACT

Visible light communication (VLC) has drawn additional attention in recent years. it's because of the explanation that the prevailing light-weight sources for lighting application in home, workplace and streets have vast quantity of information measure and that they will deliver electronic communication at higher bit rates. During this paper, analyzed the visible radiation communication performance with mach Zehnder Modulation and Orthogonal frequency division multiplexing (OFDM) modulation exploitation Opti system simulation tool. The performance of the visible radiation Communication system is calculable through Quality issue and Bit Error Rate (BER) values for various link distances. Orthogonal frequency division multiplexing modulation has additionally important impact on communication sector now-a-days because of its physiological condition to the signal distortion and support for higher rate. White light-emitting diode is employed as supply for our VLC system and it's driven by OFDM modulated signal. OFDM modulation performance is best compared to MZ modulation in terms of link distance and knowledge rates.

Key words: Visible Light Communication, Mach Zehnder Modulation, Orthogonal Frequency Division Multiplexing (OFDM) modulation, Quality factor, Bit Error Rate

1. INTRODUCTION

Early forms of VLC included heliographs, beacons and morse code. The first demonstrated VLC was Bell's photophone, which used sunlight as the light source and an oscillating mirror for modulation. LEDs have emerged as an ideal light source for VLCs due to their low cost, good availability, good efficiency, low power requirements, and ease of use. They can also be formed into arrays for transmission over larger cross-sections, thus exhibiting tremendous scalability. In addition to p–i–n and avalanche photodiodes for detection with VLC, bidirectional LEDs acting as transceivers are also available.

In a optical communication system, modulation of the transmitted signal can be accomplished in a number of ways, including: B. Phase/frequency, polarization or intensity modulation. Intensity modulation is advantageous because it is easy to implement. Direct acquisition methods used to acquire intensity-modulated signals are less sensitive and more susceptible to noise compared to their counterparts. Commonly used modulation schemes associated with wireless LED systems include On-Off Keying, PCM (Pulse Code Modulation), and SC-BPSK (Subcarrier Binary Phase Shift Keying). For low data rate applications using bidirectional LEDs, a low power, low complexity system based on on/off duty cycle modulation has been designed. VLC results obtained using the on-off keying methods have a data rate of 3 Gbps. An uncomplicated LED-to-LED communication system for VLC is demonstrated using radio frequency modulation. Interestingly, real-time video streaming with data rates up to 130 Mbit/s using white LEDs has been reported. This project explores his VLC system using OFDM- and MZ-modulated white LEDs as sources for the free-space channels that were actually measured. The performance of this VLC system is measured at various bit rates and connection distances.

2. LITERATURE REVIEW

Now, another concept work following lighting, based on visible light as a means of data transmission, instead of using traditional wireless communication Wi-Fi, data via light "Li-Fi" Huh term A new technique for transmission has been discovered. The technology was discovered at the University of Edinburgh's Communication Engineering Department and was ranked as one of the innovations in 2011 by Time Magazine[1]. One of the highlights of this technology is the high speed of data transfer. "Li-Fi" is known to have his high frequency more than 10,000 times [2]. This process of data transmission depends on the space received by the light. Clean energy and the integration of LED lamps with this technology is widely used in 4,444 government agencies, homes and hospitals, inspiring researchers in the field [3]. It was during this period that the technology was discovered, which was called vehicle-to-vehicle communication, and was called vehicle-to-vehicle communication (v2v) [4]. A component of this technology is his Vehicle Light Sensor, which detects light from brake lights, so your car's headlights can also be a sensor. The system prevents collisions, stops traffic lights, assists rollovers, and warns traffic sign and cornering speeds [5]. All high priority applications require reliable access and very low latency. Examples of the practical use of this technology include systems that indicate to the driver the optimum speed for overtaking, warnings of road works and repairs, and warnings of sudden vehicle deceleration and possible breakdowns. [6]. The principle of this spectral light display technology is that the LED is very broad at a specific frequency and exhibits very fast intermittent opening and closing that is invisible to the naked eye [7]. One advantage of these stops in the formation of the so-called binary code is 1's and 0's. It is the basic unit by which builds signals and is the original form of data in computer science and communications. This technique does not harm the generation of harmful signals such as radio communications [8]. In addition, we do not interfere with sunlight or other external sources of data transmission to ensure that data does not affect transmission [9], but the possibility of references to external sources affecting data is lower. The advantage of this system is that it does not require a special lamp, it can only integrate a chip that controls the transmission and reception of data when entering the lamp, and the industry is not expensive, so it needs to process white LED lamps [10].

Usually p-i-n and avalanche photodiodes acts as detectors in optical communication however in VLC duplex LEDs are used as transceivers. A less complicated, lowpower system for low rate applications will be made [11] by victimisation these LEDs for bidirectional communication victimisation On-Off Keying modulation. A LED-to-LED

communication system for VLC has been demonstrated [12] during which the system modulates light intensity with high frequencies and still the human eye isn't suffering from the sunshine communication. an interior wireless VLC with a panel of red, green, and blue LEDs was rumoured to achieve transmission rates of nineteen.2 kb/s [13]. Numerous analysis activities centered on VLC area unit being allotted by COWA, Byte Light, Inc., Smart Lighting Engineering Centre, Omega Project, D-Light Project, UC-Light Centre, and Oxford University. Researchers from CICTR at Penn State, in 2006, planned a mixture of power line communication (PLC) and white lightweight

LED to produce broadband access for indoor applications [14]. Further, period of time video streaming employing a white LED has been rumoured at knowledge rates up to 130Mbps [15]. The VLC standardization method is conducted among IEEE Wireless Personal space Networks unit (802.15).

3. PROPOSED SYSTEM

In telecommunications, a non-return-to-zero (NRZ) line code is a binary code where 1 is represented by one significant state (usually positive voltage) and 0 is represented by another significant state (usually negative voltage). is represented by There are no other neutral or hibernate states. NRZ pulses have more energy than return-to-zero (RZ) codes, which have 1 and 0 conditions plus additional pauses. NRZ is not inherently a self-clocking signal, so additional synchronization techniques must be used to avoid bit slips. Examples of such techniques are run length limit constraints and parallel sync signals. The NRZ level itself is not a synchronous system, but an encoding that can be used in synchronous or asynchronous transmission environments. H. With or without an explicit clock signal. Because of this, it is not necessary to strictly discuss how NRZ level encoding works "on the clock edge" or "during the clock cycle". This is because all transitions occur within a given amount of time representing an actual or implied integer clock cycle. The real problem is sampling. A high or low state is correctly received if the transmission line is stable for that bit when the physical line level is sampled at the receiver. Return-to-Zero (RZ or RTZ) refers to line codes used in communication signals where the signal drops to zero (return) between pulses. This also happens when the signal has multiple consecutive zeros or ones. The signal is self-clocking. This means that there is no need to send a separate clock along with the signal, but uses twice the bandwidth to achieve the same data rate compared to non-return-to-zero formats. There is a problem. The "zero" between each bit is the neutral or idle state as follows: Zero amplitude for pulse amplitude modulation (PAM), zero phase shift for phase shift keying (PSK), or center frequency for frequency shift keying (FSK). This "zero" state is usually halfway between the significant state representing a 1 bit and the other significant state representing a 0 bit. Although return-to-zero (RZ) includes synchronization provisions, it still has a DC component that causes "baseline wander" during long strings of 0 or 1 bits, similar to the non-return-to-line code -Zero.

3.1 DESIGN METHODOLOGY

The proposed experimental setup for the VLC system is shown in Figure 3.1. An input pseudo-random data sequence is converted into NRZ or RZ electrical pulses, and this signal directly leads to a white LED. The white LED emits modulated power with an optical output power of 7 W and an average luminance value of 358 lm. Then modulate with Mach-Zehnder modulation. Mach-Zehnder modulators are used to control the amplitude of light waves. This also connects it to the receiver (silicon photodiode) through free space (air) at room temperature. The white LED used for the actual measurement has an emission of 120-160 lm, a light output of 600 mW/LED, and a viewing angle of 120°. The radiant light output is measured or recorded by the HTC LUX Meter. Typical parameters for white LEDs and photodiodes are shown in Table 3.1. The VLC system is designed using Optisystem 16. OFDM and MZ modulation are used to modulate the input signal. OFDM specifications are shown in Table 3.2 FSO (Free Space Optics) components are used for VLC channels and channel parameters are taken from actual measurements. A line-of-sight (LOS) model is recorded. Table 3.3 shows the measured FSO parameters without side wall diffusion (LED lit in the center of the room). A system configuration for analyzing the influence of external light on visible light communication. External white light (noise) is coupled with the modulated white LED signal in front of the FSO transmission line.

Table 3.1 LED Specification

LED SPECIFICATION	
Centre frequency	550nm
LED color	White
Responsivity type	Silicon
Power	5mw
Shot noise distribution	Gaussian

It can also estimate the effect or interference of ambient light on the performance of the designed VLC system. Finally, the electrical signal detected from the photodiode is filtered by a low pass Bessel filter. This filtered signal is regenerated using a 3R regenerator and analyzed for bit error rate (BER) and Q-factor with a BER analyzer.

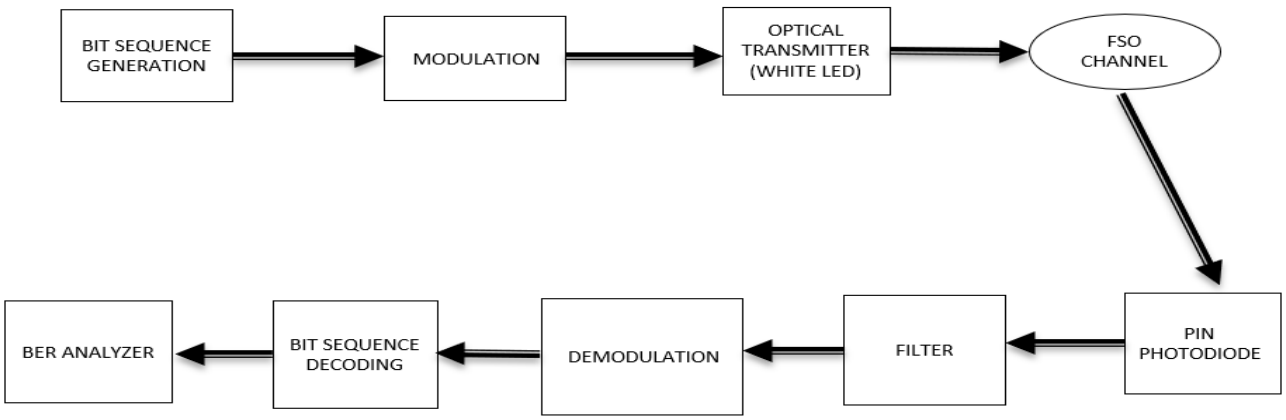

Figure 3.1 VLC System Block Diagram

Table 3.2 OFDM Specification

OFDM SPECIFICATION	
No of subcarriers	516
FFT points	1024
Position array	256
Cyclic prefix	Symbol extension
DAC	Enable

Table 3.3 FSO Specification

FSO SPECIFICATION	
Transmitter aperture diameter	7cm
Receiver aperture diameter	10cm
Range	1m to 10m

4.RESULTS AND DISCUSSION

4.1 OUTPUT OF MZ MODULATION (SILICON AND LITHIUM NIOBATE)

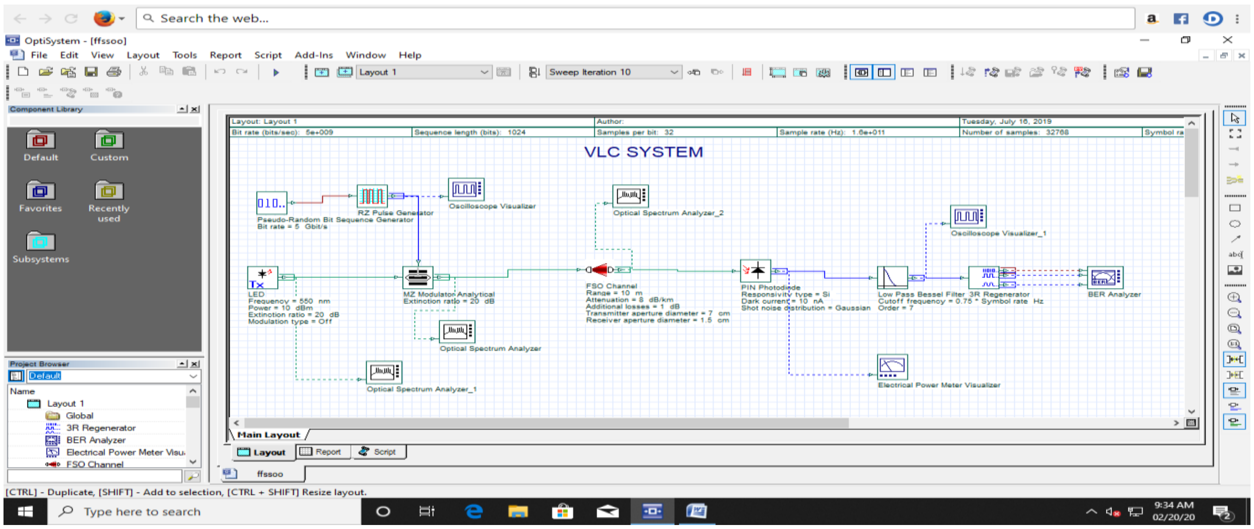

Figure 4.1 Layout diagram of MZ modulation

Figure 4.1 shows that the layout diagram of MZ Modulation in optisys 16.0 software. For the deigned VLC system without consider the external light using MZ modulation silicon substrate having the white LED operated at the frequency is 550nm. Examine the designed VLC system without consider the external light for different link distance from 1m to 10m at various data rate. Figure 4.2 implies that the graph of quality factor at various link distance from 1m to 10m. At 1m the maximum quality factor is 37.38 and it is transmitted up to 10m. From 1Gbps to 5Gbps the transmitted signal is passed and above the 5Gbps the signal quality was decreased as shown in Figure 4.3. Upto 5m the quality factor of received signal from 1Gbps to 5Gbps are well and above 5m the signal strength is decreased rapidly.

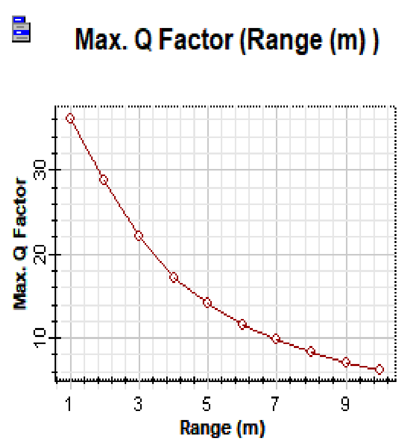

Figure 4.2 Q Factor of MZ modulation(silicon)

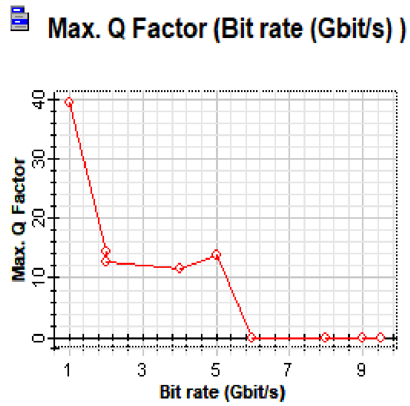

Figure 4.3 Bit Rate of MZ modulation(silicon)

In the deigned VLC system with consider the external light using MZ modulation silicone substrate having the white LED operated at the frequency is 550nm and the external light operated at the frequency of 1550nm. Examine the designed VLC system with consider the external light for different link distance from 1m to 10m at various data rate. Figure 4.4 implies that the graph of quality factor at various link distance from 1m to 10m. At 1m the maximum quality factor is 18 and it is transmitted up to 10m. From 1Gbps to 3.5Gbps the transmitted signal is passed and above the 3.5Gbps the signal quality was decreased as shown in Figure 4.5. Upto 3m the quality factor of received signal from 1Gbps to 3.5Gbps are well and above 3m the signal strength is decreased rapidly.

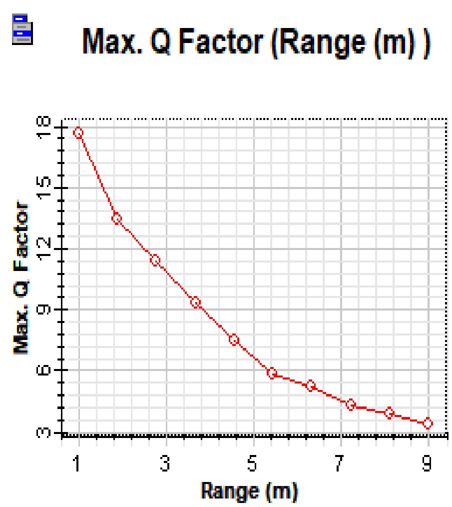

Figure 4.4 Q Factor of MZ modulation with external light (silicon)

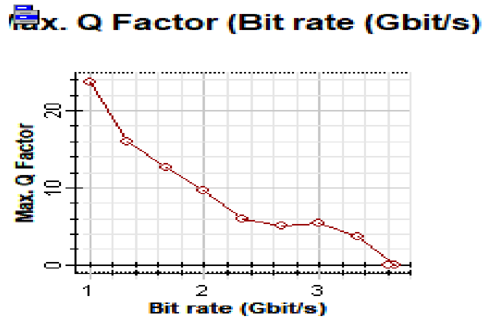

Figure 4.5 Bit Rate of MZ modulation with external light(silicon)

For the deigned VLC system without consider the external light using MZ modulation lithium niobate substrate having the white LED operated at the frequency is 550nm. Examine the designed VLC system without consider the external light for different link distance from 1m to 10m at various data rate. Figure 4.6 implies that the graph of quality factor at various link distance from 1m to 10m. At 1m the maximum quality factor is 30.38 and it is transmitted up to 10m. From 1Gbps to 3.5Gbps the transmitted signal is passed and above the 3.5Gbps the signal quality was decreased as shown in Figure 4.7. Upto 4m the quality factor of received signal from 1Gbps to 3.5Gbps are well and above 5m the signal strength is decreased rapidly.

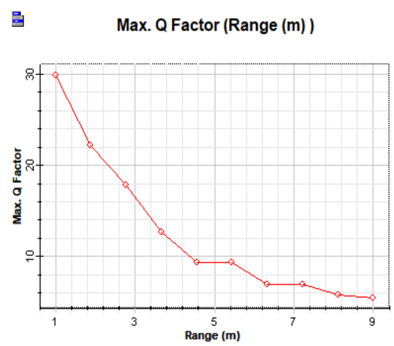

Figure 4.6 Q Factor of MZ modulation (lithium niobate)

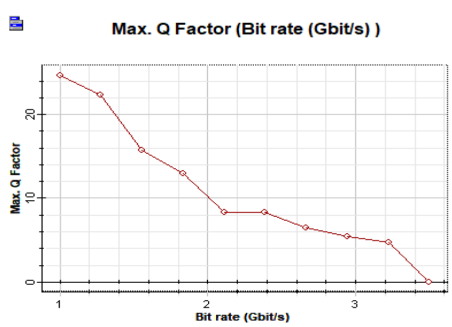

Figure 4.7 Bit Rate of MZ modulation (lithium niobate)

4.2 OUTPUT OF OFDM MODULATION

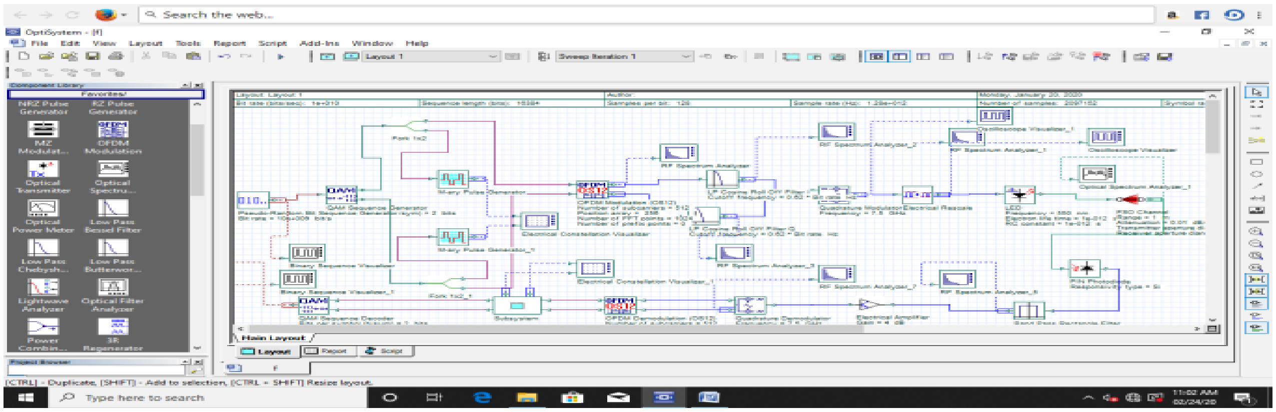

Figure 4.8 Layout diagram of OFDM modulation

For the deigned VLC system without consider the external light using OFDM modulation having the white LED operated at the frequency is 550nm. Examine the designed VLC system without consider the external light for different link distance from 1m to 10m at various data rate. Figure 4.9 implies that the graph of quality factor at various link distance from 1m to 10m. At 1m the maximum quality factor is 13.89 and it is transmitted up to 10m. From 1Gbps to 13Gbps the transmitted signal is passed and above the 13Gbps the signal quality was decreased as shown in Figure 4.10. Upto 9m the quality factor of received signal from 1Gbps to 13Gbps are well and above 9m the signal strength is decreased rapidly.

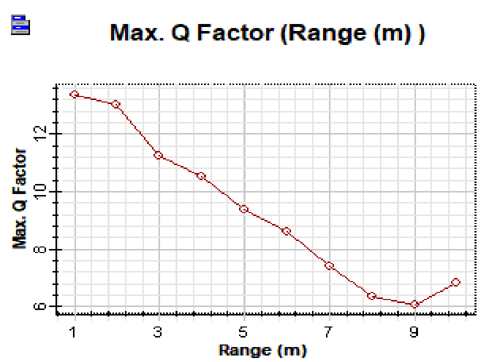

Figure 4.9 Q Factor of OFDM modulation

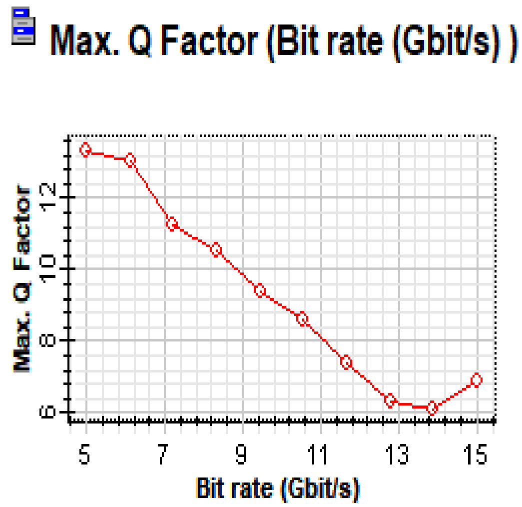

Figure 4.10 Bit Rate of OFDM modulation

For the deigned VLC system with consider the external light using OFDM modulation having the white LED operated at the frequency is 550nm and the external light operated at the frequency of 1550nm. Examine the designed VLC system with consider the external light for different link distance from 1m to 10m at various data rate. Figure 4.11 implies that the graph of quality factor at various link distance from 1m to 10m. At 1m the maximum quality factor is 10 and it is transmitted up to 10m. From 1Gbps to 10Gbps the transmitted signal is passed and above the 10Gbps the signal quality was decreased as shown in Figure 4.12. Upto 5m the quality factor of received signal from 1Gbps to 10Gbps are well and above 5m the signal strength is decreased rapidly.

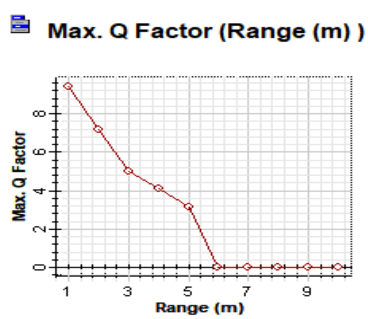

Figure 4.11 Q Factor of OFDM modulation with external light

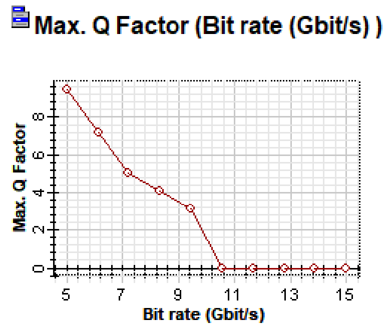

Figure 4.12 Bit Rate of OFDM modulation with external light

Figure 4.13 shows that the RF Spectrum analyzer output of the OFDM Modulation. This modulation output is passed to the FSO channel and this signal is detected by the appropriate detector. Then the demodulation of the OFDM is performed and the output is analyzed by the BER analyzer. Figure 4.14 Optical spectrum analyzer output of the VLC system.

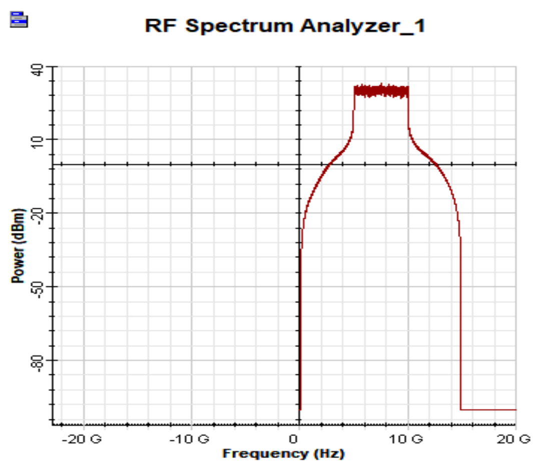

Figure 4.13 OFDM modulation output

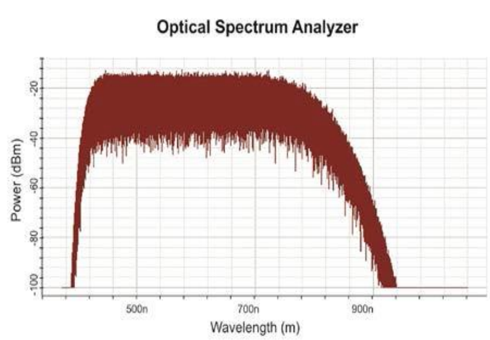

Figure 4.14 Optical spectrum analyzer output

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4.3 COMPARISON OUTPUT OF DIFFERENT MODULATION TECHNIQUES

The proposed VLC system without consider the external noise for MZ modulation of silicone substrate supports up to the range of link distance 5m at 5Gb/s and consider the external noise for MZ modulation of silicone substrate supports up to the range of link distance 2m at 3.5Gb/s. The VLC system without consider the external noise for MZ modulation of lithium niobite substrate supports up to the range of link distance 4m at 3.5Gb/s and consider the external noise for MZ modulation of lithium niobite substrate supports up to the range of link distance 1m at 2.5Gb/s. The proposed VLC system without consider the external noise for OFDM modulation of silicone substrate supports up to the range of link distance 9m at 13Gb/s and consider the external noise for OFDM modulation of silicone substrate supports up to the range of link distance 5m at 10Gb/s. Figure 4.15 and 4.16 shows that the comparison graph of different modulation techniques.

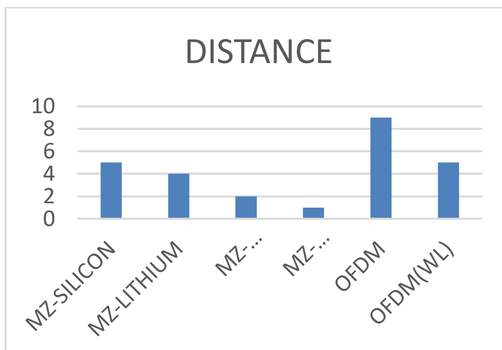

Figure 4.15 Comparison of different modulation techniques in terms of distance

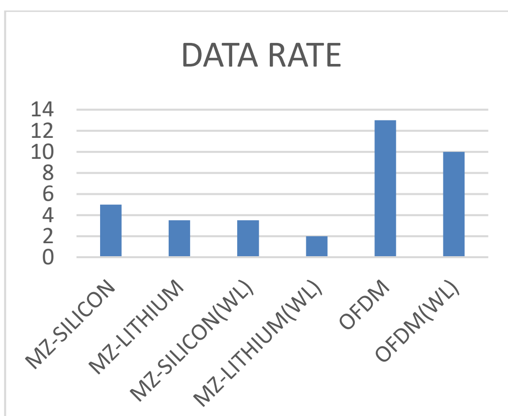

Figure 4.16 Comparison of different modulation techniques in terms of data rate

5.CONCLUSION AND FUTURE WORK

5.1 CONCLUSION

We have planned an analysis of visible light communication with and without consider the external light through Mach Zehnder modulation and OFDM modulation in optisys software. The proposed VLC system without consider the external noise for MZ modulation of silicone substrate supports up to the range of link distance 5m at 5Gb/s and consider the external noise for MZ modulation of silicone substrate supports up to the range of link distance 2m at 3.5Gb/s. The VLC system without consider the external noise for MZ modulation of lithium niobite substrate supports up to the range of link distance 4m at 3.5Gb/s and consider the external noise for MZ modulation of lithium niobite substrate supports up to the range of link distance 1m at 2.5Gb/s. The proposed VLC system without consider the external noise for OFDM modulation of silicone substrate supports up to the range of link distance 9m at 13Gb/s and consider the external noise for OFDM modulation of silicone substrate supports up to the range of link distance 5m at 10Gb/s. OFDM modulation has a better performance compared to the MZ modulation.

5.2 FUTURE WORK

The proposed method and the study can improve future Visible light communication performance metrics, and provide higher data rates and better-Quality factor to the end user. To improve the performance, using hybrid modulation of silicon MZ and lithium niobate MZ modulation.

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