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A study of new technology of communication system

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Abstract
In this paper, we are going to build a new simulation model of OWC differs from the former studies by considering the performance of the mm-wave and phase modulation. Using a single laser source with 1550 nm wavelength is a cost-effective solution regarding the complexity and processing. The proposed system of OWC has not applied an expensive component such as an optical or electrical amplifier and optical filter to prove that the simulation can give a better at the output of Photo detector.

Keywords: Psychiatric disorders, suicide, suicide attempt, first admission, recurrent admission

Introduction

The improvement and the implementation of the millimeter wave spectrum for 5G communication networks have encouraged due to the overcrowded microwave band and the lack of global bandwidth for wireless communications. The available radio spectrum becomes insufficient below 10 GHz (cm-wave communication). In responding to this challenge, the wireless communication industry takes into consideration the radio spectrum above 10 GHz (mm-wave communication) [1].

The optical spectrum can be served as a reliable spectrum resource for wideband wireless communications. The benefits of optical wireless communications (OWC) primarily lie in two aspects: due to the high carrier frequency, the transmission bandwidth will be potentially significant, and because of there is no radio frequency radiation, the security of communication requirements will be a simple issue. Thus, OWC can apply in the scenarios where the radio silence is essential, or the radiation of radio frequency may cause explosions [2]. OWC is propagating signals through at a wavelength between 380nm to 740nm for VLC and 750nm to 1600nm for laser through open and freespaces. OWC is considered as a promising solution for the “last mile” bottleneck in wireless communications because it requires no licenses of the spectrum, and consequently saving acquiring cost [3, 4]. Comparing with radio frequency (RF), it is facing a soon to be a full spectrum, evolving terrorism and security issues, the excessive cost of installation and low data rate. As for optic fiber technology, although it provides good QoS however, it unable to reach everyone specifically in the countryside areas and since it is a wired technology, the mobility advantage is not available [5]. The applications of the OWC system are varying from short range to ultra-long range. Presently, space and military operations are used OWC systems. Vendors have begun providing OWC system to commercial and industrial players as well. It anticipates that by 2020, RF technologies power consumption will be controlled by the global network. However, the best data rate and the lowest normalized energy consumption are provided byoptical link compared to the rest of RF wireless communication standards [6].

Significant advantages have offered by the OWC system to the communication landscape. However, several challenges it poses. According to Debbie Kedar and Shlomi Arnon [7], they have recognized that OWC system affected by problems such as the LOS alignment with the transmitter and the receiver module because of external weather conditions like wind sway or weak earthquakes.

Also, Ahmed Nabih [8] stated that weather conditions such as fog rain, snow, or even clouds might absorb the light wave propagation and small water particles from the storm can also cause particles scattering. These conditions will cause that the performance of the OWC system to be affected like particle scattering will result in signal attenuation and distortions.

Nakagawa *et al*. improved a data transmission system utilizing white LEDs that can be used in the indoor environment.

A novel scheme for short-range optical wireless audio signal communication utilizing white LED lighting system is described in [9]. In [10] the researcher explains the optical wireless communication system by building a simulated and an experimental model using a laser diode as the propagation medium.

In this paper, we are going to build a new simulation model of OWC differs from the former studies by considering the performance of the mm-wave and phase modulation. Using a single laser source with 1550 nm wavelength is a cost-effective solution regarding the complexity and processing. The proposed system of OWC has not applied an expensive component such as an optical or electrical amplifier and optical filter to prove that the simulation can give a better at the output of photodetector.

System principle and architecture

Here the operating principle of the proposed a 60 GHz mm-wave/ 320 Mbps Signal transmission based on 1550 nm over OWC is presented, and the evaluation of the system performance is discussed. Figure 1 explains the schematic block diagram of the proposed system design. The system consists of two central part: transmission and reception parts. The transmission part includes of a directly modulated laser (DML), which is operated by data signals, a phase modulator, which is operated by RF/mm-wave signals of the local oscillator.

In our system, we use a phase modulator because it has many benefits as follows: it can work without the need to an electrical circuit to the D.C base control; it has a small insertion loss. This leads to making the communication system has more significant margin. As aforementioned, the phase modulator is driven by an RF/mm-wave signal, in turn, points to achieve a small modulation depth. As a result, the cost-effective operation can achieve by reusing the rest of the optical carriers. Furthermore, the noise bins signals have not been affected by the phase modulator. From the technical perspective, the phase modulator uses the concept as a Mach-Zehnder modulator (MZM), but it has one arm. It has a switching voltage (V_π) and feed via laser power (P_{in}), thus, the output optical field of the phase modulator can be calculated by Equation (1).

$$E_p(t) = e^{j\frac{\pi V(t)}{2V_\pi}} \sqrt{2P_{in}e^{jw_c t}} \tag{1}$$

Where w_c is the mm-wave frequency, and V (t) denotes the electronic modulating signal. The electrical modulating signal is modulated on an optical carrier by a phase modulator. So, the output optical signal describes via Eq. (2).

$$E_{out} = E_{in}(t).e^{j.\Delta\emptyset.modulation(t)} \tag{2}$$

Where, E_{in} (t) is the input optical signal, $\Delta\emptyset$ is the phase deviation and modulation (t) represents the electrical input signal.

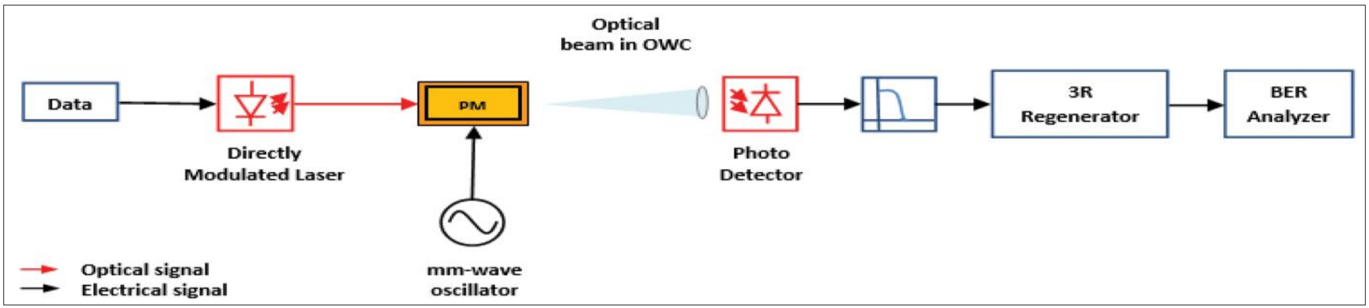

Fig 1: A schematic diagram of our proposed system for OWC.

The generated optical signals from the phase modulator are then launched into the optical wireless channel. After transmission of the signal carrier, the Photodetector at the receiver will receive laser signals from the transmitter and then filtered by low pass Bessel filter to reject undesired signals. As the received signals produce voltages, then it will be converted back to the initially transmitted data by using bit sequence regenerator. It is easy to calculate the BER to the received signal via BER analyzer component to examine the quality of our system [11]. In our system, there is no requirement to use expensive elements such as an optical filter, optical amplifier, and electrical amplifier. Also, the using of the direct modulator can reduce the complexity and cost of the optical communication system. Therefore, our proposed scheme can reduce the installation cost and RF interference for faster data transmission.

Simulation set up

The proposed OWC system using non-return to zero (NRZ)-DML with mm-wave-phase modulation is simulated via Optisystem-14.1 evaluation software. The Optisystem is an excellent platform to simulate the optical wireless communication system to analyze the performance with minimum effort, cost and time. Our scheme that is shown in Fig. 2 has the following configurations. The pseudo random binary sequence (PRBS) signal with 320 Mbps data rate enters the NRZ to generate the digital form of the data signal, which is fed the directly modulated laser with 1550 nm wavelength and 10 dBm power level. The phase modulator with 90-degree phase deviation ($\Delta\emptyset$) is driven by an mm-wave sinusoidal signal with a 60 GHz frequency carrier and a 0-degree phase. The OWC channel with 1550 nm wavelength and 10 m distance range, and the transmitter and receiver aperture diameters are 0.2 cm and 0.8 cm, respectively. The optical signal falls on the lens of the Photodetector surface to produce the electrical signal, where PIN photodiode is chosen as Photodetector due to low voltage operation, low cost, linear response properties over wide ranges and tolerance to huge temperature fluctuations [11].

The PIN photodiode configures with 0.223 A/W responsivity and 10 nA dark current. The detected signal has a noise to be added by the channel. The desired signal must extract from the detected signal via an electric allow pass

Bessel filter with cut-off frequency = 0.01* Symbol rate (Hz).The 3R generator regenerator works as a demodulator, and BER analyzer component are applied on the demodulated signal to find the BER, Q-Factor and eye diagram. Figure 2 depicts the block diagram of the proposed OWC system design.

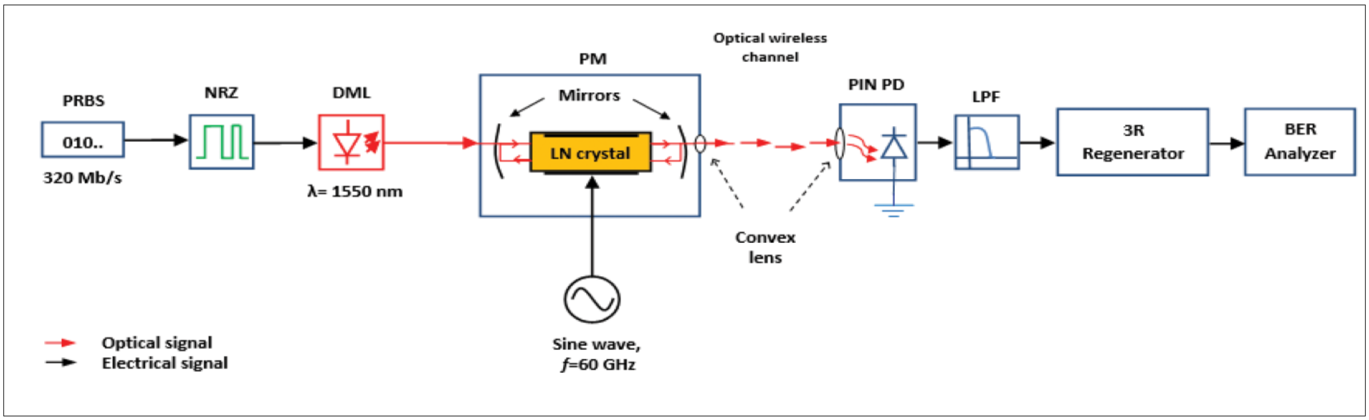

Fig 2: A block diagram of proposed OWC system using NRZ-Phase modulation.

Conclusion

It is clearly seen that the phase modulated optical signal is lunched from the transmitter aperture of the optical phase modulator to travel through the air, so, the signal is susceptible to the noise, interference and attenuation as a discussed in next section.

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