Performance of Digital Modulation Schemes For Under Water Optical Wireless Communication

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Abstract

This paper basically focuses on the different modulation scheme use for under water optical wireless communication. The performance of Amplitude Shift keying (ASK), Phase Shift Keying (PSK) and Frequency Shift Keying (FSK) has been proposed .Currently ,it is uses with oceanography research. All data collected by these platforms is usually internally save and then transmitted via wireless communication. Others digital modulation schemes offer the bandwidth limited to low rates . Optical communication are well posed to provide an solution for high bandwidth communications in under water communication . Here different modulation techniques proposed for under water environment application. Evaluating the error performance of said (ASK,PSK & FSK) schemes is best suited for undersea communication .

Keywords: Amplitude shift keying (ASK),Frequency shift keying(FSK).Phase shift keying(PSK)

I. Introduction

The digital communication brought many advantages over digital that of analog. These advantages can be represented in many features, as easy storage and faster processing. By using this, a huge amount of information can be carried. By using optical fiber, we may improve the transmission fidelity, increase in data rate and increase in transmission distance between transmitter and receiver. Its main advantages are very low attenuation and noise and a large bandwidth. Optical fiber gives higher bit rate in long distance transmission. This strength can be further achieved utilizing the advanced modulation formats. There are many benefits of using optic-fiber system over electric system and the main advantages of using fiber are its very low losses which allows long distances between repeaters, and its high data carrying capacity. By using single high bandwidth fiber, thousands of electric wires can be replaced. Unlike electrical transmission, optic-fiber experience no cross-talk. The fiber-optic system gives broadband services and advanced internet applications at high speed because this system has high capacity transport infrastructure. This system also drive for low costs per transmitted bit with high spectral efficiency. Advance modulation formats improve the channel utilization and capacity. By using different modulation formats, We can achieve better performance of optical fiber. In this paper, we are discussing the ASK, FSK, and there comparisons [1-3]

II. Modulation Schemes

An important advantage of using the coherent detection techniques is that both the amplitude and the phase of the received optical signal can be detected and measured. This feature opens up the possibility of sending information by modulating either the amplitude, or the phase, or the frequency of an optical carrier.

In the case of digital communication systems, the three possibilities give rise to three modulation formats known as amplitude-shift keying (ASK), phase-shift keying (PSK), and frequency-shift keying (FSK) [1]–[6].the three modulation formats for a specific bit pattern. In the following subsections we consider each format separately and discuss its implementation in practical light wave systems [1-4]

a. Amplitude Shift Keying (ASK)

$$E_s(t) = A_s(t)\cos[\omega_0 t + \phi_s(t)]. \quad (1)$$

In case of ASK , the amplitude *As* is modulated while keeping w_o and ϕs constant. For binary digital modulation, *A s* takes one of the two fixed values during each bit period, depending on whether 1 or 0 bit is being transmitted. In most practical situations, *As* is set to zero during transmission of 0 bits. The ASK format is then called *on–off keying* (OOK) and is identical with the modulation scheme commonly used for noncoherent digital light wave systems [7-16].

The implementation of ASK for coherent systems differs from the case of the direct-detection systems in one important aspect. Whereas the optical bit stream for direct-detection systems can be generated by modulating a light-emitting diode (LED)or a semiconductor laser directly, external modulation is necessary for coherent communication systems.

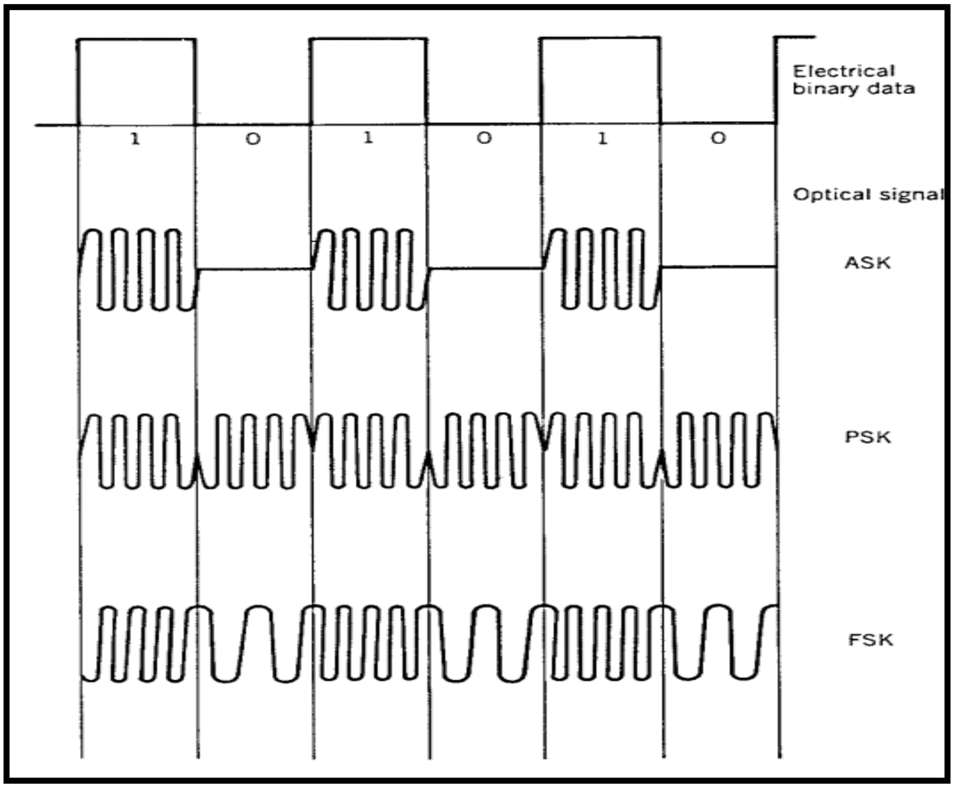

Figure 1. ASK, PSK, and FSK modulation for a specific bit pattern [7-14]

***b*. Phase Shift Keying (PSK)**

In the case of PSK format, the optical bit stream is generated by modulating the phase ϕs in Eq. (1) while the amplitude *As* and the frequency w0 of the optical carrier are kept constant. For binary PSK, the phase ϕs takes two values, commonly chosen to be 0 and π. Figure 1 shows the binary PSK format schematically for a specific bit pattern. An interesting aspect of the PSK format is that the optical intensity remains constant during all bits and the signal appears to have a CW form. Coherent detection is a necessity for PSK as all information would be lost if the optical signal were detected directly without mixing it with the output of a local oscillator The implementation of PSK requires an external modulator capable of changing the optical phase in response to an applied voltage. The physical mechanism used by such modulators is called electro refraction. Any electro-optic crystal with proper orientation can be used for phase so that phase information can be extracted at the receiver without ambiguity [7-14].

c. Frequency Shift Keying (FSK)

Carrier frequency ω_0 itself . For a binary digital signal, ω_0 takes two values, $\omega_0 + \Delta\omega$ and $\omega_0 - \Delta\omega$, depending on whether a 1 or 0 bit is being trans mitted. The shift $\Delta f = \Delta\omega / 2\pi$ is called the frequency deviation . The quantity $2\Delta f$ is sometimes called tone spacing, as it represents the frequency spacing between 1 and 0 bits. The optical field for FSK format can be written as

$$E_s(t) = A_s \cos[(\omega_0 \pm \Delta\omega)t + \varphi_s], \tag{2}$$

Where + and − signs correspond to 1 and 0 bits. By noting that the argument of cosine can be written as $\omega\ t + (\varphi s \pm \Delta\omega t)$, the FSK format can also be viewed as a kind of 0 where + and - signs correspond to 1 and 0 bits. the FSK format can also be viewed as a kind of PSK modulation such that the carrier phase increases or decreases linearly over the bit duration [7-13]

III. Demodulation Schemes

The digital demodulation schemes are either homodyne or heterodyne . Which can be used to convert the received optical signal into an electrical form. In the case of homodyne detection, the optical signal is demodulated directly to the baseband. Although simple in concept, homodyne detection is difficult to implement in practice, as it requires a local oscillator whose frequency matches the carrier frequency exactly and whose phase is locked to the incoming signal. Such a demodulation scheme is called synchronous and is essential for homodyne detection. Although optical phase-locked loops have been developed for this purpose, their use is complicated in practice. Heterodyne detection simplifies the receiver design, as neither optical phase locking nor frequency matching of the local oscillator is required. However, the electrical signal oscillates rapidly at microwave frequencies and must be demodulated from the IF band to the baseband using techniques similar to those developed for microwave communication systems [1]–[6]. Demodulation can be carried out either synchronously or asynchronously. Asynchronous demodulation is also called incoherent in the radio communication literature. In the optical communication literature, the term *coherent detection* is used in a wider sense [7-13]

IV. Results

This section is devoted to result analysis of the said modulation schemes . The ASK, PSK and FSK message modulation and demodulation has been has been examine . All the scheme performance analyzed through matlab 2015. Figure no. 02 depicted the result performance of ASK PSK &FASK with the input bit stream as 0110110111 total 10 bit transmitted through the channel .their pattern are shown in figure no. 02 respectively .Figure no. 3 shown the result about the reception level in terms of voltage level also with AWGN channel. Figure no. 04 depicted the error rate (BER) comparison of all three sachems. Here the performance of PSK is shown better than others .The performance of ASK FSK near about same. By reviewing this result it can concluded that these schemes can be used for high data rate transmission for the application of under water optical communication.

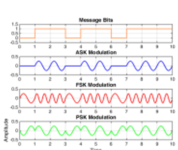

Figure 2. ASK,FSK & PSK Message Transmission

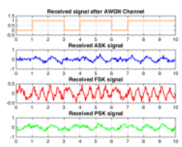

Figure 3. Received signal of ASK,FSK & PSK

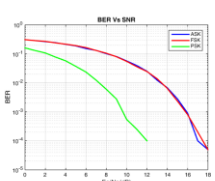

Figure 2.BER Comparison of ASK,FSK & PSK

V. Conclusion

The error performance of all digital scheme has been examine and it is to be founded that the PSK has good error performance as compare to other . this scheme can achieve the goal of high data rate information transmission with minimum bandwidth this can also concluded that it has improve the channel capacity also. This schemes are best suited for the underwater optical communication with high data rate capacity

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