PERFORMANCE ANALYSIS OF MIMO-OFDM SYSTEM

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Abstract - Mobile communication is one of the important technologies in wireless communication. In Mobile communications face lot of many technical challenges. Fading, attenuation, channel Interference, Propagation path loss, multicarrier interference etc, occurs during the transmission of signals on a wireless channel. So need an efficient channel to transmit the signal without any distortions. High quality service has to be provided for the greater demand of capacity. Orthogonal frequency division multiplexing (OFDM) is a current and known technique for high efficient data transmission and high bandwidth data transmission; it can be achieved by converting the wideband signal into narrow band signals. In this paper, analyzed the performances of Bit Error Rate (BER) and spectral analyzes using Mat lab Software, and also predict the performance of Gaussian Noise channel (AWGN). It is suitable for long distance transmission without any distortions.

Keywords- Wireless Communication, OFDM, Bit Error Rate, AWGN

1. Introduction

In earlier days the networks are mostly comprised of electrical cables like telephone, co–axial etc, and the area is restricted in terms of information losses and long transmission distance. Optical network uses optical cables; it is totally differ from normal cable wire. It conducts the signal in-terms of light signal. Mostly is used for long distance communication. OFDM system uses wireless communication to transfer the signal from sender to receiver. In-between the sender and receiver air is act as the medium, named as wireless channel. During the transmission noise will affect the original signal, it can be recovered it receiver side. OFDM is applicable for 4G technology to seep-up the transmission. MIMO (multiple input-multiple outputs) scheme is used for multiple transmissions. This has lead to the appearance of Orthogonal Frequency Division Multiplexing (OFDM), where it is often used in future optical networks. Orthogonal Frequency Division Multiplexing or OFDM is a modulation format that is being used for many of the latest wireless and in telecommunication standards. OFDM high spectral potency is the main cause behind its use in current radio standards. Wireless communication systems are expected to provide a range of high data rate services with different Quality of Service (QoS). In the Orthogonal Frequency Division Multiplexing (OFDM) system as a multicarrier system is useful to deal with wideband service demands due to its capability of exploiting both time and frequency resources as well as its interference property. OFDM based multi-carrier transmission

is the main technology for many existing and upcoming wireless communication systems, such WiMAX, Wireless LANs and LTE for 3GPP.

2. Related Works

Mobile communication technology has been tremendous growth in a very short time period. Digital wireless transformation based communication systems have been replaced the Analog communication systems. Voice transformation services are more complicated than data transmission services and support high-speed and data transfer rate in terms of Giga-bits per second. Worldwide Inter-operability for Microwave Access (WiMax) and Long Term Evaluation (LTE) based wireless communication systems provide a comprehensive internet protocol (IP) solution for streamed multimedia and voice transformation services, wherever it needs higher data rates in the order of 200 Mbps to 2.5 Gbps.

Now a day MIMO-OFDM has been tremendous growth in the current wireless communication systems in order to perform high-speed data transmission [Chen, C et al 2007]. It is a multi-carrier transmission technique in which higher data rate single streams is splited into multiple lower rate data streams and each data streams has been modulated by a different high frequency data stream.

In OFDM based wireless data transmission scheme, modulation of multiple signals can be transmitted by multiplexing them over a large number of frequency ranges. OFDM frequency multiplexing signals are orthogonal to each other. Different types of modulation techniques such as Quadrature Phase Shift Keying Modulation (QPSK), Binary phase shift keying (BPSK), Orthogonal QPSK and Quadrature Amplitude Modulation (QAM) are widely used for performing modulation of MIMO-OFDM.

Modulation is the process of varying the characteristics of information signals according to high-frequency carrier signals. In frequency modulation technique, frequency of message signals varying according to frequency of carrier signals. The modulation process has identical performances at identical power levels. In OFDM data transmission, the effects of interference and noise are modelled by Additive White Gaussian Noise (AWGN). In addition, finite bandwidth can be modelled by a filtering operation. In most of the MIMO-OFDM transceiver, channel can be modelled by multi-path Rayleigh fading channel. Quadrature Amplitude Modulation (QAM) technique is preferred in this research work for its feasibility of 45^0 phase shift synchronization.

3. OFDM System Model

OFDM is a Frequency Division Multiplexing scheme used as a digital multi-carrier modulation scheme. A number of closely spaced orthogonal sub-carrier signals are used to carry data on several parallel data streams or channels. Each sub-carrier is modulated with a

conventional modulation scheme such as quadrature amplitude modulation or phase-shift keying at a low symbol rate and same bandwidth. The sub-carrier frequencies are chosen so that the sub-carriers are orthogonal to each other meaning that cross-talk between the sub-channels is completely eliminated and inter-carrier guard bands are not required. Different types of modulation techniques such as Quadrature Phase Shift Keying Modulation (QPSK), Binary phase shift keying (BPSK), Orthogonal QPSK and Quadrature Amplitude Modulation (QAM) are widely used for performing modulation of MIMO-OFDM.

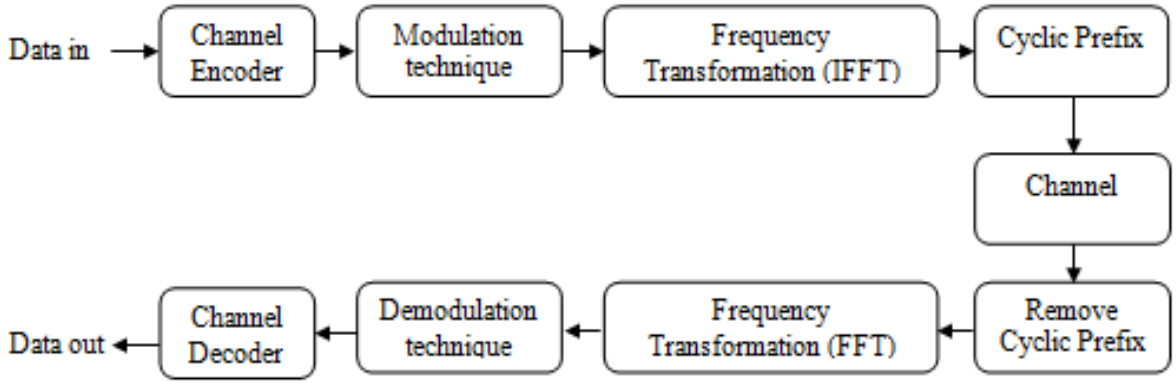

Figure.1 Block Diagram of OFDM system

4. OFDM Transmitter

OFDM Transmitter consists of channel encoder,modulation technique,frequency transmission. Error control is accomplished by the channel coding operation that consists of adding extra bits to the output of the source code. These extra bits do not tell any information but helps the receiver to detect and correct some of the errors in the information bearing bits. There are two methods of channel coding: Block Coding and Convolution Coding. Modulation technique used is QAM (Quadrature Amplitude Modulation). Quadrature Amplitude Modulation or QAM is a form of modulation which is widely used for modulating data signals onto a carrier used for radio communications. Quadrature Amplitude Modulation appears to increase the efficiency of transmission for radio communications systems by utilizing both amplitude and phase variations. The cyclic prefix used in Orthogonal Frequency Division Multiplexing provides an essential element of the overall signal acting as a guard band between each OFDM symbol. Use of cyclic prefix is a key element of enabling the OFDM signal to operate reliably.

5. OFDM Receiver

The addition of the cyclic prefix in the transmitter block removed in the receiver side. The QAM demodulator is very much the reverse of the QAM modulator. The signals enter the system, they are split and each side is applied to a mixer. One half has the in-phase local oscillator applied and the other half has the quadrature oscillator signal applied. Hamming codes can be computed in linear algebra terms through matrices because Hamming codes are linear codes. For the purposes of Hamming codes, two Hamming matrices can be defined: the code generator matrix G and the matrix H. The connection between transmitter and receiver is established through a communication channel. The communication can take place through wired, wireless or fiber optic channels. The other media such as optical disks, magnetic tapes and disk etc may also be called as a communication channel since they can also carry data through them. In digital communication the wireless channels are used. It eliminates the use of wires but the chance of error occurrence is more. But each and every communication channel has some inherent problems; these are Signal Attenuation, Amplitude, phase distortion, Additive noise interference and Multi-path distortion etc.

6. Performances Analyzes

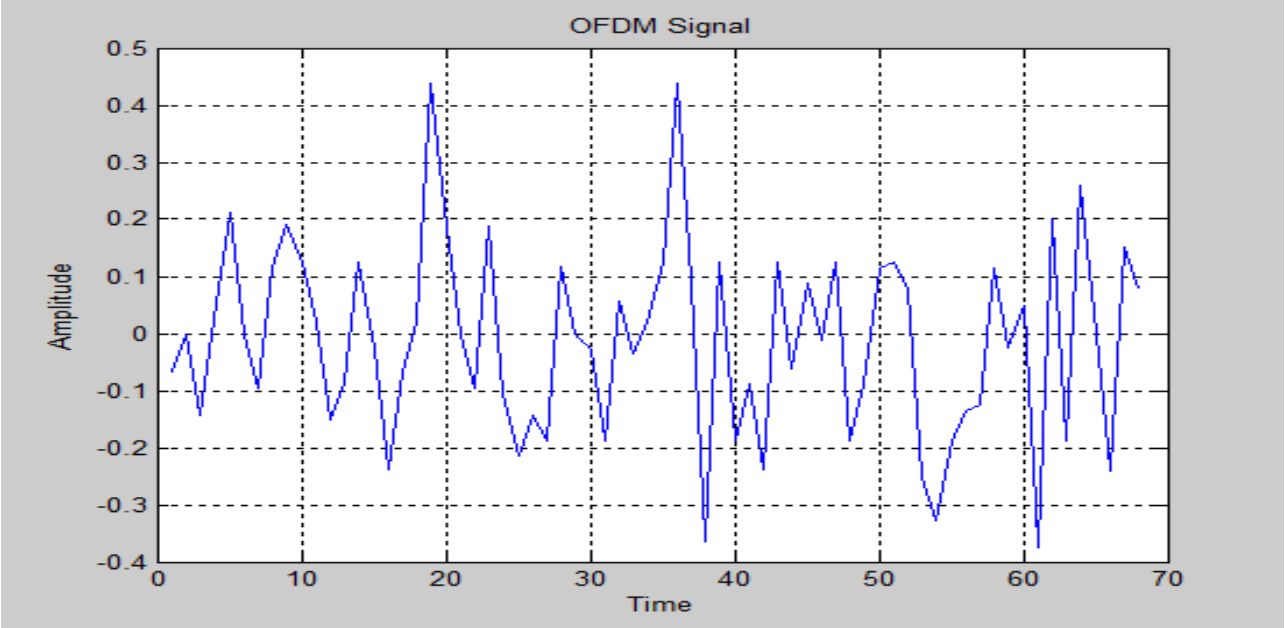

Figure.2 Spectral Analyzes of Modulated OFDM Signal

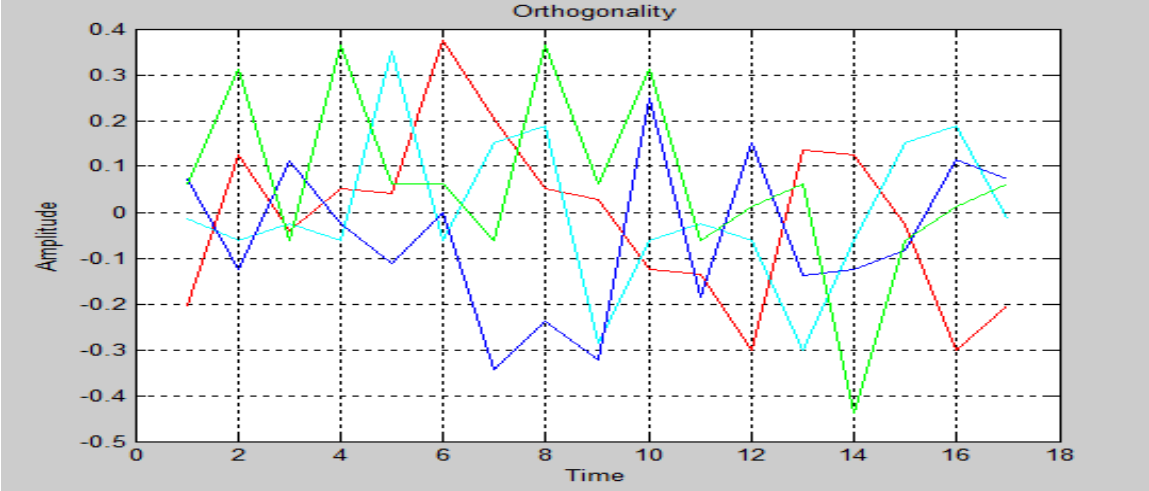

Figure.3 Orthogonality between different modulated OFDM signals

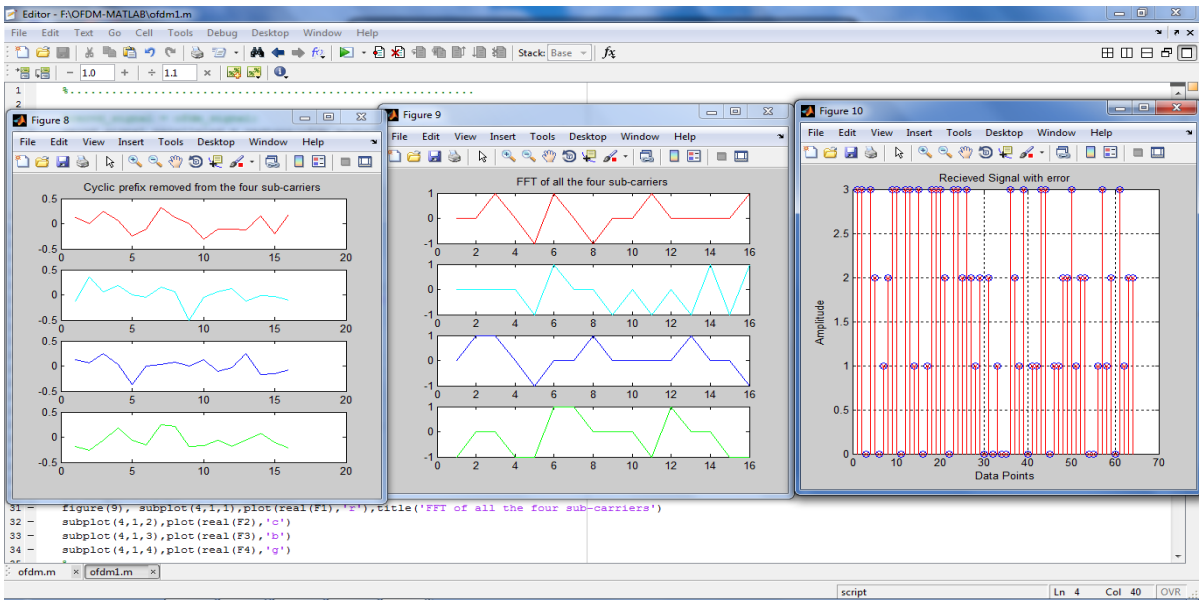

Figure.4 Simulation Results of MIMO-OFDM system

MATLAB simulation result of digital MIMO-OFDM receiver signal is shown in Figure 4. Sub-Figure 2 of Figure 11 is the cyclic prefix removed method from sub-carriers; Sub-Figure 3 of Figure 11 is the FFT transmission technique to convert the time domain signal into frequency domain signal.

7. Conclusion

This paper presents the analyzes of basic characteristic of OFDM signal transmission. The system clearly shows the spectral characteristic and bit error rate of the signal. It provides less amount of distortion in the signal, it is useful to transfer the signal in long distance without any errors. It also provides orthogonality to the signal during the transmission in the channel. Performance was measured by using Matlab simulator.

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