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Implementation and Analysis of Performance of OFDM-MIMO Hybrid System

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Abstract: In this article a hybrid OFDM-MIMO system has been implemented. The objective of the paper is to integrate the MIMO and OFDM and make a program for this hybrid system. MATLAB and other common graph plotters will be used for the result analysis. A performance analysis has been discussed by taking bit error ratio as main parameter. The results of hybrid system will be compared with individual performance of each technique.

Keywords: MIMO, OFDM, Bit Error Ratio

INTRODUCTION

Multiple Input Multiple Output [1] is the system created as a result of the communication channel with multiple trans-receiver antennas to improve the operation of a given communication system. MIMO is considered as one of the emerging technologies using created by smart antenna systems. MIMO is currently being implemented in different IEEE standards around the globe.

MIMO offers upsurge in the data throughput and link range without any transmitting or bandwidth power. MIMO systems achieve these advantages through distributing transmit power onto antennas. Orthogonal Frequency Division Multiplexing (OFDM) is another technique which offers advantage in terms of low inter symbol interference (ISI) and inter carrier interference (ICI). Due to the benefit of overlapping subcarriers, data rate can be improved significantly. Many closely spaced subcarriers, which are orthogonal in nature, are implemented using fast Fourier transform. The block diagram of OFDM based MIMO system is shown in figure 1. The block diagram showing a MIMO based system is given in figure 2.

SYSTEM MODEL

As per the block diagram the first step is generating the input bit stream. As we are designing the system with 4 sub channels each having 64 bits. So the total number of bits that needs to be transmitted are 256 bits. A random data is generated with ‘m’ rows and ‘n’ columns which is known as bit stream. The original data generated is as in figure 4

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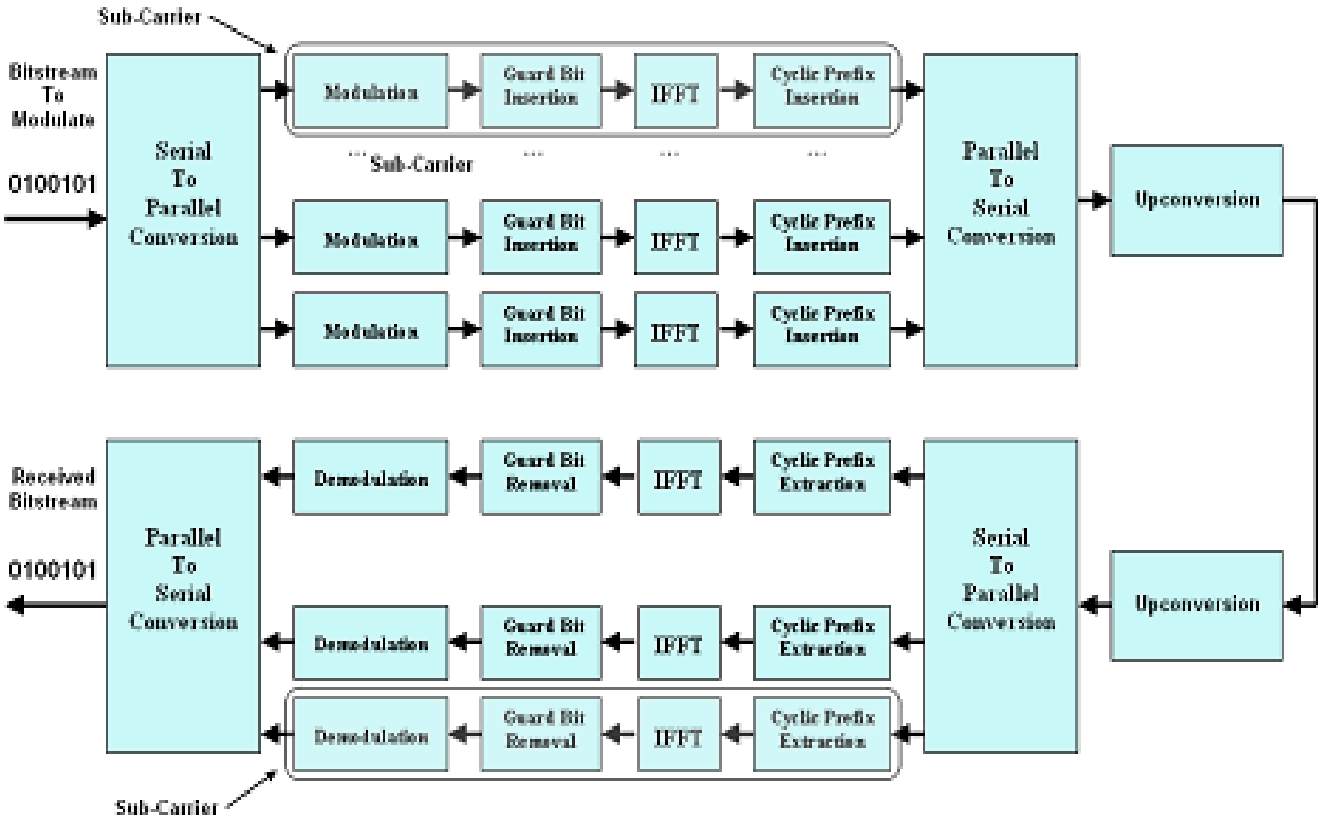

Figure 1: Block diagram of OFDM based MIMO system

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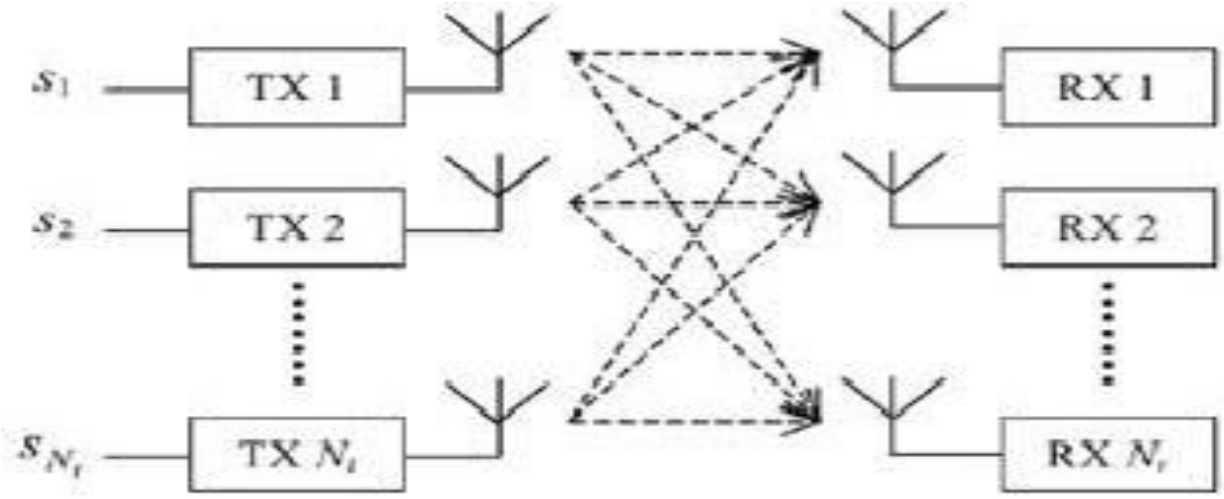

Figure 2: MIMO System

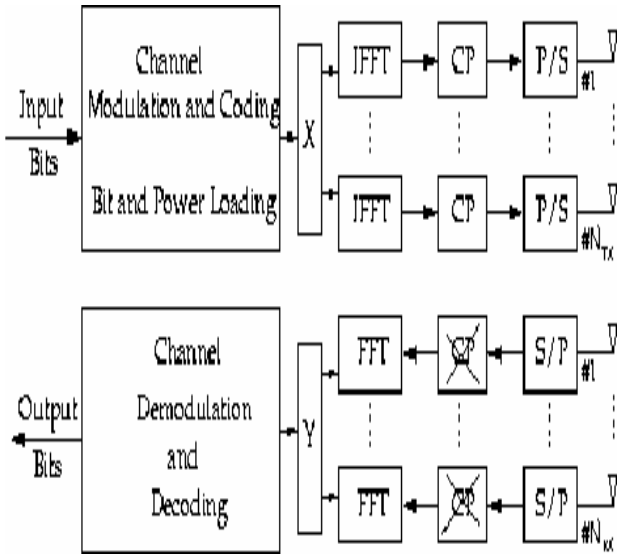

Figure 3

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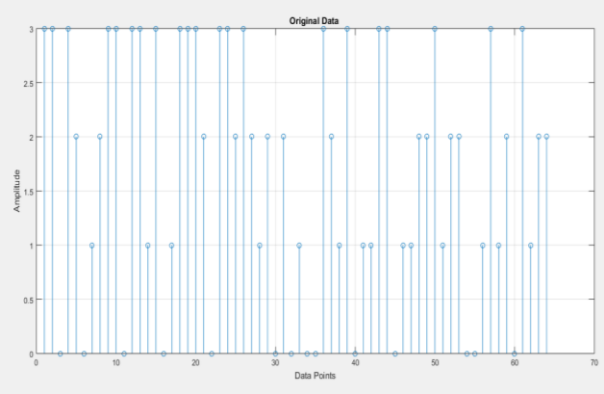

Figure 4

After the generation of the original data which desires to be transmitted, it is then modulated. Here we had used is Quadrature Phase Shift Keying Modulation technique with the data generated and number of channels as an input and it gives a modulated signal as an output in figure 5.

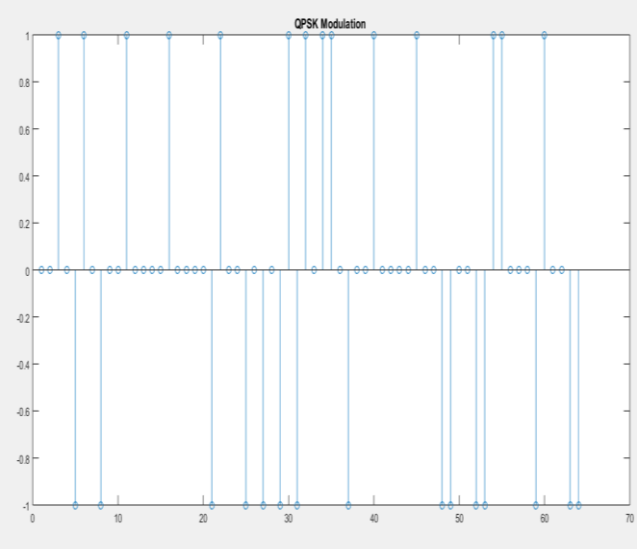

Figure 5

After the modulation of the data, it is the converted into parallel streams from the serial stream of data. This is done by using an inbuilt command in MATLAB called reshape. Redesign function yields a new array with m rows and n columns, where m*n must equal the number of elements in the given array. The new array has the same elements as the original reshaped array. The reason for conversion of serial data into parallel is that serial data is used for long distance communication and one bit follows another in serial transmission where as in parallel communication we can transmit multiple bits at a time. After the conversion of serial data into parallel data for four channels as shown in figure 6. The subcarriers after the application of IFFT looks as in figure 7.

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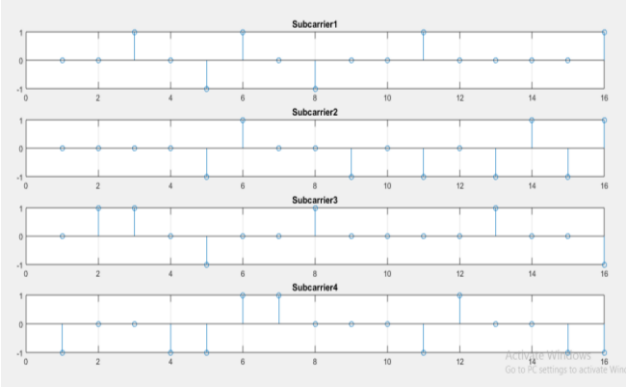

Figure 6

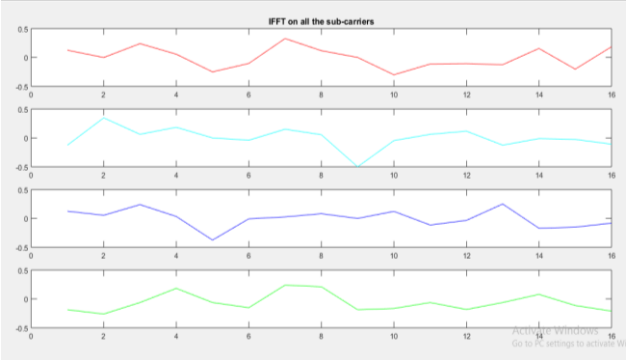

Figure 7

The next step after addition of IFFT to the subcarriers, it is then subjected to the cyclic prefix addition. The application of cyclic prefix is a key element of allowing the OFDM signal to operate consistently. The cyclic prefix performances like a buffer region or guard band interval to protect the OFDM signals. After the cyclic prefix is added to the OFDM subcarriers, it looks as in figure 8.

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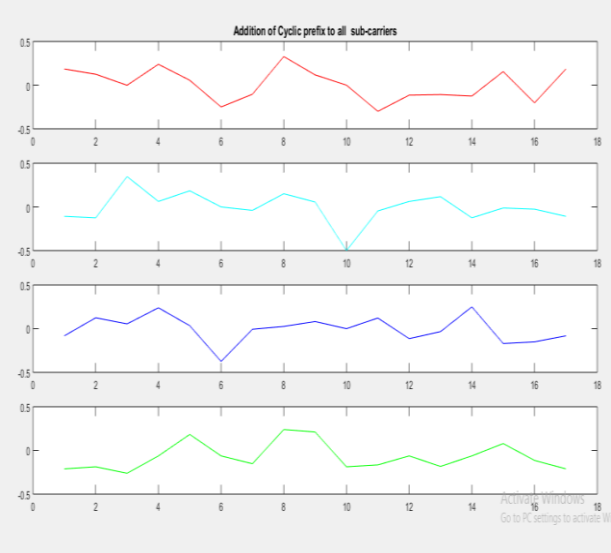

Figure 8

After addition of t cyclic prefix to the all sub carriers the parallel data is converted to the serial data transmission, again. The converted serial data transmission is now divided as two OFDM signals at two transmitters. The two OFDM signals are as shown in figure 9. Now the transmitted signals are received through the channel with the noise in them. So, the OFDM signals after passing through the AWGN noise channel looks as in figure 10.

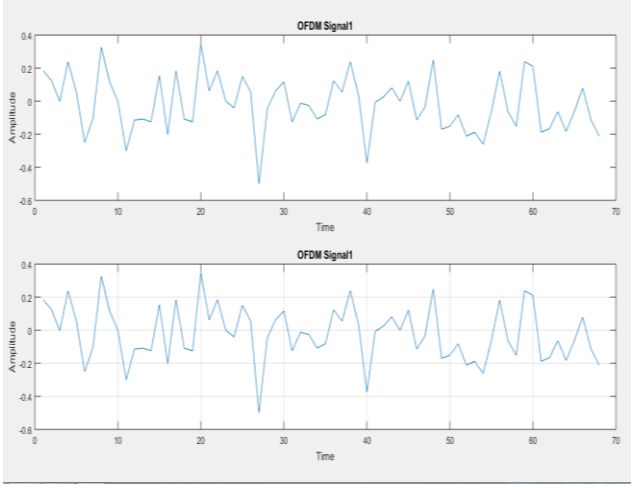

Figure 9

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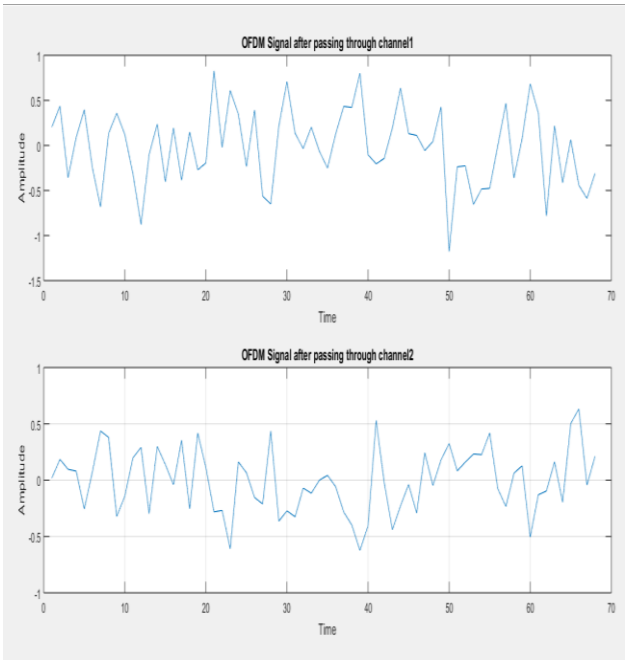

Figure 10

The serial data transmission is now converted as a parallel data transmission. Then the parallel data is now subjected for the removal of cyclic prefix from the subcarriers which is added at the receiver end which also acts as a guard bands.

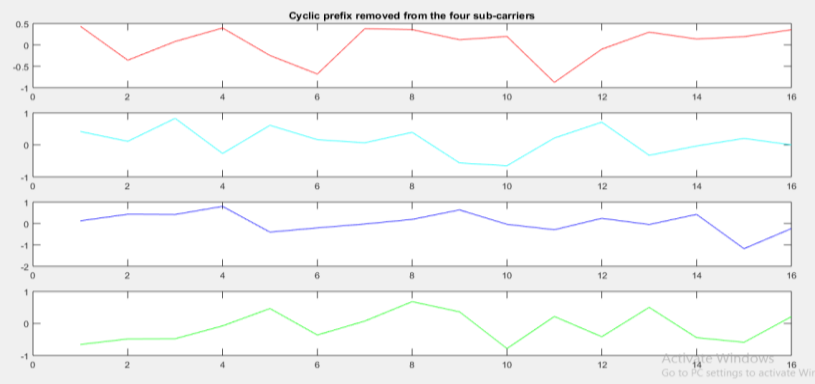

Figure 11

The transmitted signal is subjected to the FFT which is Fast Fourier Transform. After the FFT application the signal looks like as in figure 12

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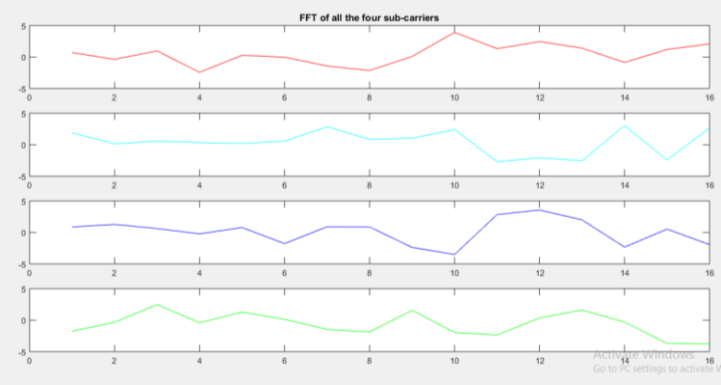

Figure 12

Till the application of the FFT the data is in the parallel transmission, so for the serial transmission it needs to be converted from parallel to serial transmission. After obtaining the serial data, then it is demodulated to recover the original signal.

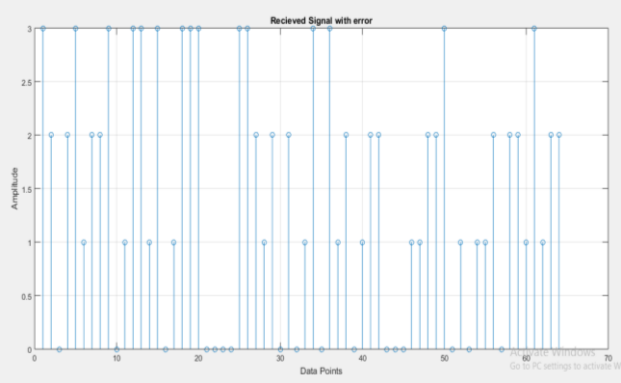

Figure 13

RESULT AND DISCUSSION

The QPSK modulated signal is compared with the BER technique. The BER is calculated in this paper for an OFDM based MIMO system using QPSK as baseband modulation. The ABER v/s SNR plot for the system is shown in Fig. 14.

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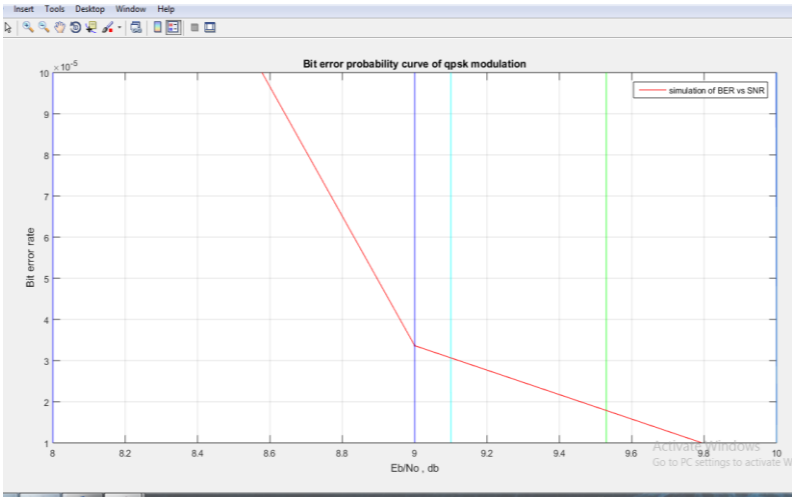

Figure 14

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