Performance Evaluation of Filtered Conjugate Coded MIMO Wireless System

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Abstract - Modern wireless communication system is getting popular day by day and the involvement of it is now presents in all over the world covering commerce, technical, non-technical and financial sectors. This technology is almost in everybody's hand. They utilizing it fully to automate our routine tasks and connect to each other from one end of the world to another end. The excess demand of the technology needs perfection in quality of services provided and researchers keep working on it to improve it. In this paper we are working on the improvements in the performance of the MIMO wireless system. To do this, we work in the existing system we have proposed the system in which the OFDM architecture is facilitate with the spatial diversity of 2 transmitter and 2 receiver antennas. To reduce the error rate due to interferences and fading effect, Complex Conjugate Coding is utilized. The proposed system has achieved the bit error rate about $8x10^{-9}$ for the 256 number of symbols which is better than the existing system.

Keywords - 4G, Wireless Communication, Complex Conjugate Encoding, BER, 1-D Digital Filter, Spatial Diversity, OFDM.

I. INTRODUCTION

OFDM is robust in adverse channel conditions and allows a high level of spectral efficiency. Multiple access techniques which are quite developed for the single carrier modulations (e.g. TDMA, FDMA) had made possible of sharing one communication medium by multiple number of users simultaneously. The sharing is required to achieve high capacity by simultaneously allocating the available bandwidth to multiple users without severe degradation in the performance of the system. FDMA and TDMA are the well known multiplexing techniques used in wireless communication systems. Orthogonal Frequency Division Multiplexing (OFDM) is a special form of multi carrier modulation technique which is used to generate waveforms that are mutually orthogonal. In an OFDM scheme, a large number of orthogonal, overlapping, narrow band sub-carriers are transmitted in parallel. These carriers divide the available transmission bandwidth. The separation of the sub-carriers is such that there is a very compact spectral utilization. With OFDM, it is possible to have overlapping sub channels in the frequency domain, thus increasing the transmission rate. In order to avoid a large number of modulators and filters at the transmitter and complementary filters and demodulators at the receiver, it is desirable to be able to use modern digital signal processing techniques, such as fast Fourier transform (FFT).

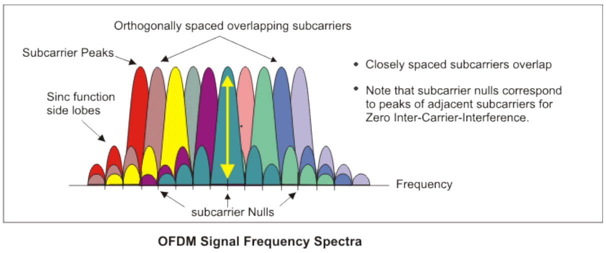

Fig. 1.1 Frequency spectrum of OFDM

After more than forty years of research and development carried out in different places, OFDM is now being widely implemented in high-speed digital communications. OFDM has been accepted as standard in several wire line and wireless applications. Due to the recent advancements in digital signal processing (DSP) and very large-scale integrated circuits (VLSI) technologies, the initial obstacles of OFDM implementations do not exist anymore. In a basic communication system, the data are modulated onto a single carrier frequency. The available bandwidth is then totally occupied by each symbol. This kind of system can lead to inter-symbol-interference (ISI) in case of frequency selective channel. The basic idea of OFDM is to divide the available spectrum into several orthogonal sub channels so that each narrowband sub channels experiences almost flat fading. Many research centers in the world have specialized teams working in the optimization of OFDM systems. The attraction of OFDM is mainly because of its way of handling the multipath interference at the receiver.

Multipath phenomenon generates two effects (a) Frequency selective fading and (b) Intersymbol interference (ISI). The "flatness" perceived by a narrowband channel overcomes the frequency selective fading. On the other hand, modulating symbols at a very low rate makes the symbols much longer than channel impulse response and hence reduces the ISI. Use of suitable error correcting codes provides more robustness against frequency selective fading. The insertion of an extra guard interval between consecutive OFDM symbols can reduce the effects of ISI even more. The use of FFT technique to implement modulation and demodulation functions makes it computationally more efficient. OFDM systems have gained an increased interest during the last years. It is used in the European digital broadcast radio system, as well as in wired environment such as asymmetric digital subscriber lines (ADSL). This technique is used in digital subscriber lines (DSL) to provides high bit rate over a twisted-pair of wires.

The major advantages of OFDM are its ability to convert a frequency selective fading channel into several nearly flat fading channels and high spectral efficiency. However, one of the main disadvantages of OFDM is its sensitivity against carrier frequency offset which causes attenuation and rotation of subcarriers, and intercarrier interference (ICI) [1,2]. The undesired ICI degrades the performance of the system.

II. PROPOSED METHODOLOGY

In this proposed model we are using complex conjugate coding with m-PSK modulation. AWGN channel is used for transmission with cyclic prefixing. Here first of all complex conjugate coding is done followed by modulation then data. After OFDM modulation it comes the filtering of the data, which provides the orthogonality to the subcarriers. IFFT will convert time domain signal to the frequency domain. After passing through the channel on the signal FFT will be performed with complex conjugate encoding and decoding process. Demodulated data is converted to binary form and decoded and filtered with 1-D digital filtering to obtain the original data transmitted. The Block Diagram in the transmitter section very firstly the data is modulated by 2-PSK and 4-QAM modulator followed by complex conjugate coding process and then Inverse Fast Fourier Transform (IFFT) is applied for multiplexing then after addition of cyclic prefix is done with data signal through the channel the noise is mixed in the receiver section then cyclic prefix is removed Fast Fourier Transform (FFT) is applied for de-multiplexing followed by complex conjugate decoding then m-PSK demodulation has been then after 1-D digital filtering have been adopted to reduce the BER.

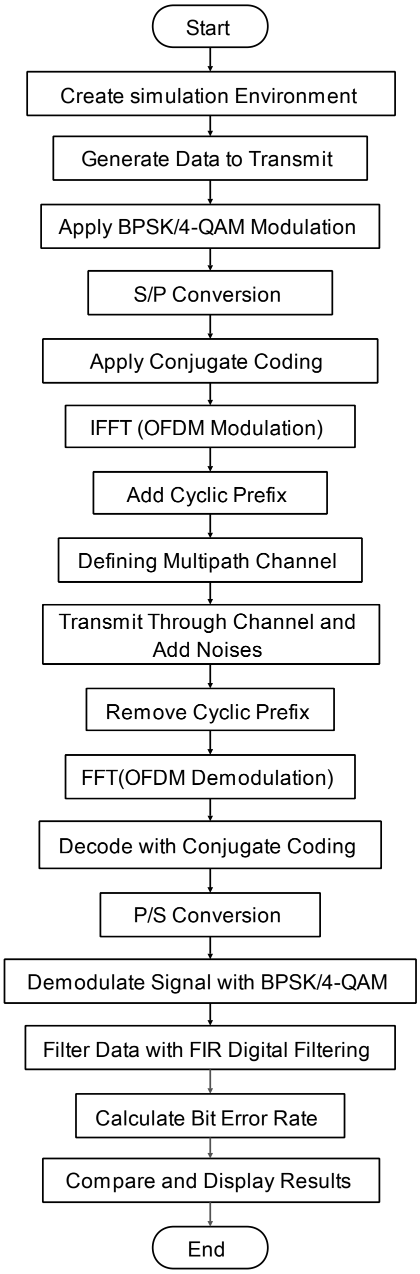

Fig. 2.1 Flow Chart of the Proposed System

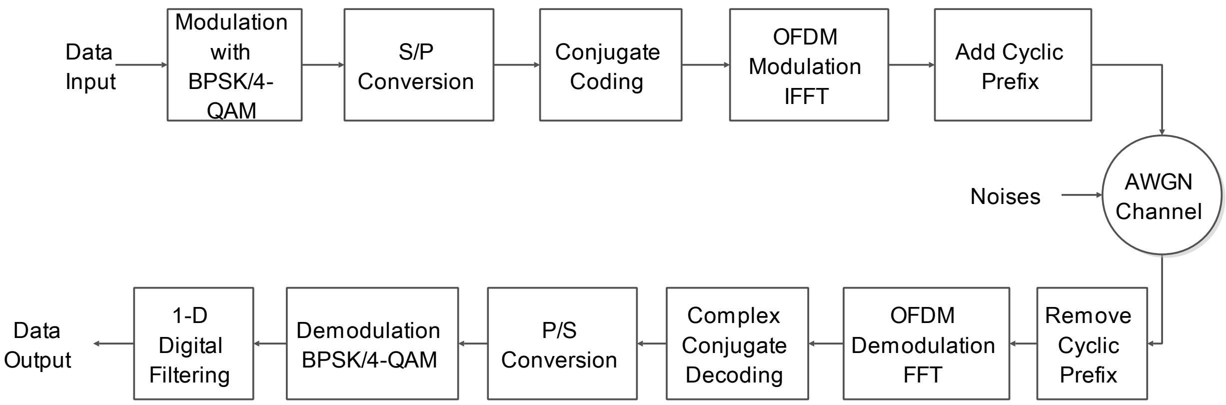

Fig. 2.2 Block Diagram of the Proposed System

As the above flow graph shows the whole simulation flow of proposed methodology in this firstly, the environmental variables initialized the then data is generated, m-PSK Modulates followed by complex conjugate encoding then IFFT Technique is used after that addition of cyclic prefix done then noise mixed with data signal. Then cyclic prefix is removed FFT is adopted and m-PSK demodulator is implemented with 1-D digital filter for minimizing the BER.

III. SIMULATION OUTCOMES

The proposed system is discussed and explained in the previous section. In this section the outcomes of simulations performed on the proposed system is discussed. The system in evaluated under different data lengths and with 2-PSK and 4-QAM modulation. The results is compared for different symbol sizes with 1-D FIR digital filter. The simulation outcomes are shown in below figures.

In Fig. 3.1 the simulation results with 128 symbols is displayed, and the performance of the proposed with m-PSK modulation and complex conjugate encoding.

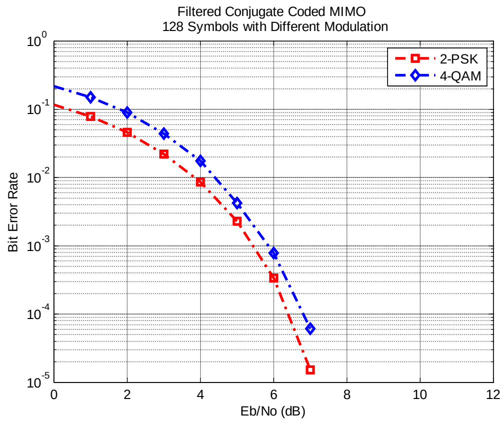

Fig. 3.1 Estimation of Coded-MIMO Spatial Diversity OFDM System using Complex Conjugate Encoding with 128 Symbols

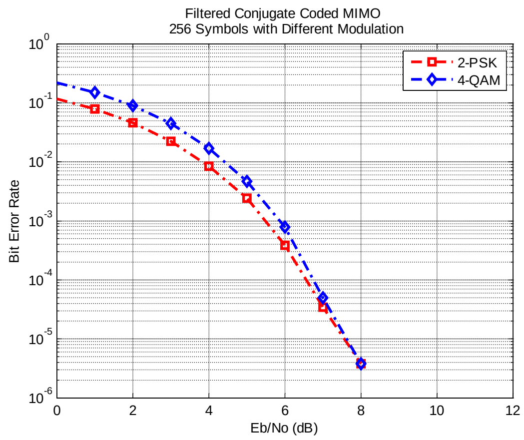

Fig. 3.2 Estimation of Coded-MIMO Spatial Diversity OFDM System using Complex Conjugate Encoding with 512 Symbols

So here complex conjugate encoding proposed technique adopted for efficient Coded MIMO system and optimum BER achieved is $5x10^{-5}$ with 4-QAM Modulation.

In Fig. 3.2 the simulation results with 256 symbols is displayed, and the performance of the proposed with m-PSK modulation and complex conjugate encoding. So here complex conjugate encoding proposed technique adopted for efficient Coded-MIMO system and optimum BER achieved is $3.7x10^{-6}$ with 4-QAM Modulation.

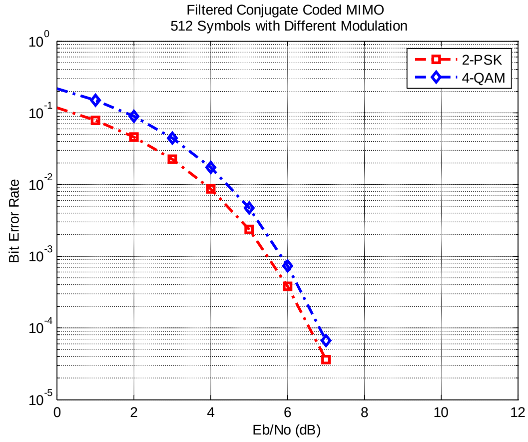

Fig. 3.3 Estimation of Coded-MIMO Spatial Diversity OFDM System using Complex Conjugate Encoding with 512 Symbols

In Fig. 3.3 the simulation results with 512 symbols is displayed, and the performance of the proposed with m-PSK modulation and complex conjugate encoding. So here complex conjugate encoding proposed technique adopted for efficient 4G system and optimum BER achieved is $6.5x10^{-5}$ with 4-QAM Modulation.

IV. CONCLUSION AND FUTURE SCOPE

The proposed Coded-MIMO wireless system is simulated and the outcomes are find out in terms of BER. The BER achieved is $3.7x10^{-6}$ better than the existing work. The values of BER is varying with the changes in modulation techniques as well as symbols and can be say that the with 256 symbols and m-PSK modulation scheme the wireless complex conjugate encoding based spatial diversity OFDM system outperform, the error rate is better than the previous techniques. As the symbol size increases the system also start performing better and better but more than 512 symbols the performance is equal for 2-PSK and 4-QAM modulation. Now there are several scopes for improvements in the Coded MIMO wireless communication system work towards making this system better and better with the utilization of the detection methodologies at the receiver side. The detection methods are better shield against the interferences and noises introduced during transmission.

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