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PERFORMANCE IMPROVEMENT OF CONVOLUTION CODED OFDM SYSTEM WITH TRANSMITTER DIVERSITY SCHEME

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Abstract

The higher speed of communication without compromising in the accuracy is the prime focus of research work in wireless communication. The space time coding is one of the techniques which enable the higher speed with maintaining the error rate. In this paper, the analysis and study of the ber performance and capacity analysis is given. The OFDM system which is space time coding. The simulation has been performed with different modulation scheme . The comparative result has been given in this paper.

Keywords: OFDM,STBC,AMC,WLAN etc.

Introduction

Wireless communication services, such as long-range communications. In this impossible or impractical to implement with the use of wired communication. The term is commonly used in the telecommunications industry to refer to telecommunications systems for example radio transmitters and receivers or remote controls etc. the information is transmitted in this manner over both short and long distances for without wire.

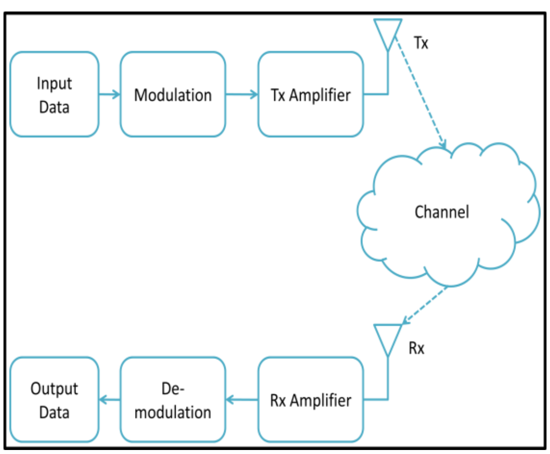

Fig: 1 Wireless Communication

Wireless network comprises of different nodes which communicate with each other over a wireless communication, this wireless channel may be in the form of radio wave or infra-red wave, which is responsible for establishment of wireless channel or wireless link between nodes [1].

Wireless access is demanded by many applications. However, due to spectral limitations, it is often impractical or sometimes very expensive to increase bandwidth. The using multiple transmit and receive antennas for spectrally efficient transmission is an alternative solution. The multiple transmit antennas can be used either to obtain transmit diversity, or MIMO channel.

Many researchers have studied using multiple transmit antennas for diversity in wireless communication. Transmit diversity may be based on linear transforms or space time coding. Space time coding is characterized by high code efficiency and good performance; hence, it is a promising technique to improve the efficiency and performance of orthogonal frequency division multiplexing (OFDM) systems. On the other hand, the system capacity can be significantly improved if multiple transmit and receive antennas are used to form MIMO channels. It is proven in that compared with a single-input single-output (SISO) system with flat Rayleigh fading or narrowband channels, a MIMO system can improve the capacity by a factor of the minimum number of transmit and receive antennas. For wideband transmission, space–time processing must be used to mitigate inter symbol interference (ISI). However, the complexity of the space–time processing increases with the bandwidth, and the performance

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substantially degrades when estimated channel parameters are used.

OFDM is a multicarrier modulation technique used for high data rate in wireless applications that is suitable for eliminating ISI .The main merit of OFDM is the fact that the radio channel is divided into many narrow-band, frequency-nonselective sub-channels or subcarriers and low-rate, in multiple symbols can be transmitted in parallel, maintaining a high spectral efficiency. For each subcarrier may deliver information for a different user, and resulting in a simple multiple access scheme known as Orthogonal Frequency Division Multiple Access (OFDMA). This enables different media such as speech, text, video, graphics, or other data to be transmitted within the same radio server, depending on the specific types of services and their Quality-of-Service (QoS) requirements. An Orthogonal Frequency Division Multiplexing (OFDM) is a special case of multicarrier transmission, in a single data stream is transmitted over a number of lower rate subcarriers. They have single carrier system if signal get fade or interfered then entire link gets failed where as in multicarrier system only a small percentage of the subcarriers will be affected. An main reason to use OFDM to increase the robustness against the selective fading or narrowband interference.

MIMO SYSTEM MODEL

Multi-antenna systems can be classified into three main steps. For first step multiple antennas at the transmitter side are usually applicable for beam forming process. The n second step in Transmitter or receiver side multiple antennas for realizing different diversity schemes process. For last and third step class includes systems with multiple transmitter and multiple receiver antennas realizing spatial multiplexing.

In radio communications multiple inputs multiple outputs (MIMO) means multiple antennas both on transmitter and receiver side of a specific radio server communication. The case of spatial multiplexing different data symbols are transmitted on the radio link by different antennas on the same frequency within the same time interval communication. In Multipath propagation is assumed in order to ensure the correct operation of spatial multiplexing and since MIMO is performing better in terms of channel capacity in a rich scatter multipath environment than in case of environment with LOS. For achieves this by higher spectral efficiency (more bits per second per hertz of bandwidth) and link reliability or diversity. The properties of MIMO is an important part of modern wireless communication such as IEEE 802.16

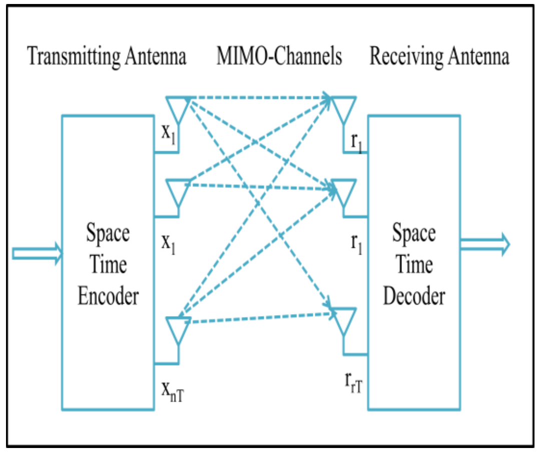

Fig 2. MIMO system

The main feature of MIMO systems is space-time processing. The Space-Time Codes (STCs) are the codes designed for the use in MIMO system. Space Time Block Codes signals are coded in both temporal and spatial domains. The different types of STCs, the orthogonal Space-Time Block Codes (STBCs) possess a number of advantages over other types of STCs and are considered in this book.

MIMO–OFDMA SYSTEM MODEL

Before introducing the signal detection and enhanced channel estimation technique, we briefly describe a MIMO-OFDM system and the statistics of mobile wireless channels.

MIMO–OFDMA is a combination of downlink MIMO transmission and OFDM based multiple accesses. In MIMO (Multiple-Input Multiple-Output) communication System exploits the degrees of freedom introduced by multiple transmitted and received antenna to offer high spectral efficiency. In narrow band channels, when channels state information is available at the transmitter and instantaneous adaptation is possible, the capacity achieving distribution is found by using the well known water filling algorithm.

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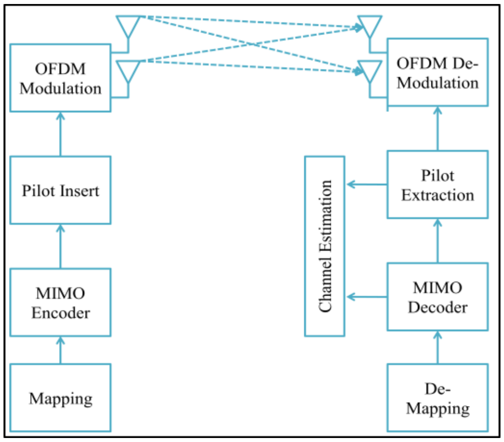

Fig: 3 MIMO-OFDMA System model

MIMO–OFDMA system capacity optimization-

For maximizing MIMO–OFDMA overall system capacity, it is reasonable to keep up regulations regarding the OFDMA subcarrier allocation, i.e. one particular subcarrier belongs to only one user.

The capacity optimization task can be generalized as follows:

Maximizing the overall MIMO-OFDMA system capacity, one particular subcarrier belongs to only one user however some modifications are needed in the technique of the subcarrier allocation at the same time.

The capacity optimization can be taken care by as follows-

$$argmax_{R,P} \ \sum_{k=1}^{K}\sum_{n=1}^{N}\rho k,n\left[\sum_{i=1}^{M_{k,n}}\log_2\left(1+\frac{\lambda_{k,n}^{(i)}p_n}{N_o}\right)\right] \quad (1)$$

Where $\rho_{k,n}$ represents the generic elements of the k×n subcarrier assignments matrix R.

$$\rho_{k,n} = 1$$

Now according to the figure first three points to be considered which are as follows-?

The three main steps appearing, which a suboptimal solution is able to realize with are detailed in the following.

1) Subcarrier Allocation- In case of MIMO-OFDMA access, In terms of the maximization of overall system Capacity. The n-th subcarrier is assigned to user K_n according to-

$$K_n = argmax_K \prod_{i=1}^{M_{k,n}}\left(1+\frac{\lambda_{k,n}^{(i)}p_n}{N_o}\right) \quad (2)$$

The formula above follows the subcarrier allocation in OFDMA systems, Allocated Subcarrier are characterized by a scalar value. The value of k_n depends on $\lambda_{k,n}^{(i)}$ Eigen values. The capacity of OFDMA access can be multiplied by a factor of

$$M_{k,n} = rank(H_{k,n}) = \min(N_t.N_r). \quad (3)$$

Radio resource allocation can lead to suboptimal solution

$$K_n^p = argmax_k \prod_{i=1}^{M_{k,n}}\lambda_{k,n}^{(i)} \quad (4)$$

$$K_n^s = argmax_k \sum_{i=1}^{M_{k,n}}\lambda_{k,n}^{(i)} \quad (5)$$

The above criteria are called product and sum criterion. Product criterion is much better in high signal to noise (SNR) domain then the sum criterion, and vice verse. High SNR values are much suitable to MIMO technique applications. Product criterion is of higher importance in case of MIMO radio resource management.

2) Transmit power control- Maximizing the overall system capacity that allocates p_n transmit power values for the particular subcarriers is as follows-

$$\sum_{i=1}^{M_{k,n}}\frac{\lambda_{k,n\,n}^{(i)}}{\lambda_{k,n}^{(i)}p_n+N_o}+\alpha = 0, \ \ n = 1,2,\ldots\ldots N \quad (6)$$

Here k_n is the index of user, carrier n and α fulfill the requirement $\sum_{n=1}^{N}p_n = P_{total}$

The above referred method is called as multi dimension water filling. So called we get by substituting 1 for $M_{k,n}$ the common form of water filling solution.

3) Antenna selection- In MIMO system the number of antenna RF (radio frequency) circuits can be also a resource aspect by capacity optimization. MIMO radio device mainly reduces the number of necessary radio circuits.

This consideration gives the reason for existence of so called antenna selection algorithms. If L RF chains are given but the number of antennas is NT such that NT > L, the scheduler should evaluate and choose the best L out of the NT antennas for transmission.

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Modulation Techniquce

Quadrature Amplitude Modulation (QAM)

ASK is also combined with PSK to create hybrid systems such as amplitude and phase shift keying or Quadrature Amplitude Modulation (QAM) where both the amplitude and the phase are changed at the same time. The Quadrature Amplitude Modulation (QAM) is a modulation scheme which conveys data by changing (modulating) the amplitude of two carrier waves. These are two waves, usually sinusoids, out of phase with each other by 90° and are thus called Quadrature carriers hence the name of the scheme.

$$v(t) = Vsin(2\boldsymbol{\pi}.f(t) + \theta)..... \quad (7)$$

As for many digital modulation schemes, in constellation diagram is a useful representation. In Quadrature Amplitude Modulation (QAM) the constellation points are usually arranged in a square grid with equal vertical and horizontal spacing. The number of points in the grid is usually a power of 2 (2, 4, 8, 16.........). The since QAM is usually square, and the most common forms are 8-QAM, 16-QAM, and 64-QAM schemes. By moving to a higher-order constellation and it's possible to transmit more bits per symbol. For the mean energy of the constellation is to remain the same (by way of making a fair comparison) and the points must be closer together and are thus more susceptible to noise and other corruption; this results in a higher bit error rate and so higher-order QAM can deliver more data less reliably than lower-order QAM.

Binary Phase Shift Keying (BPSK).

Binary Phase Shift Keying (BPSK) modulation is a special case of the general Mary phase shift keying with M = 2. In particular, the binary data selects one of the two opposite phases of the carrier. This is modulated signal can be written mathematically as.

$$BPSK = Acos(2\pi ft + \phi(t)) \quad (8)$$

Where A is the amplitude and ω is the angular frequency of the RF carrier. The phase shift φ(t) is given by:

$$\varphi(t) = i\pi$$

Withi = 0 or 1 corresponding to the binary data value.

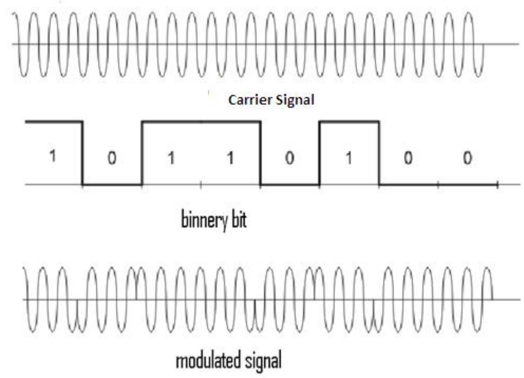

Fig: 4 PSK modulations

Results and discussion

System discription

The system description for the simulation is given in fig 5. The input data are transmitted through the MIMO-OFDM with AMC system.

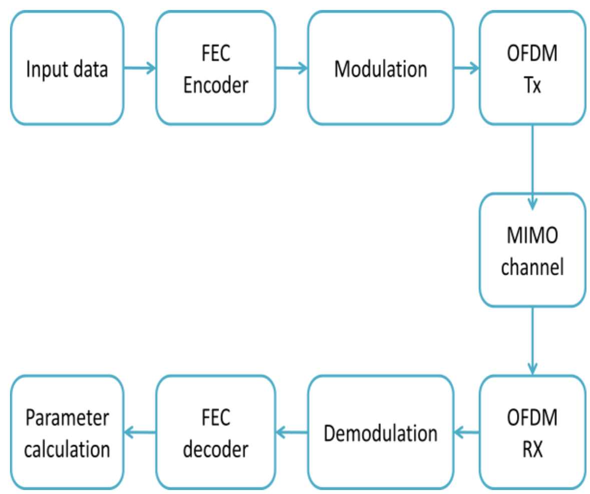

Fig: 5.System block diagram

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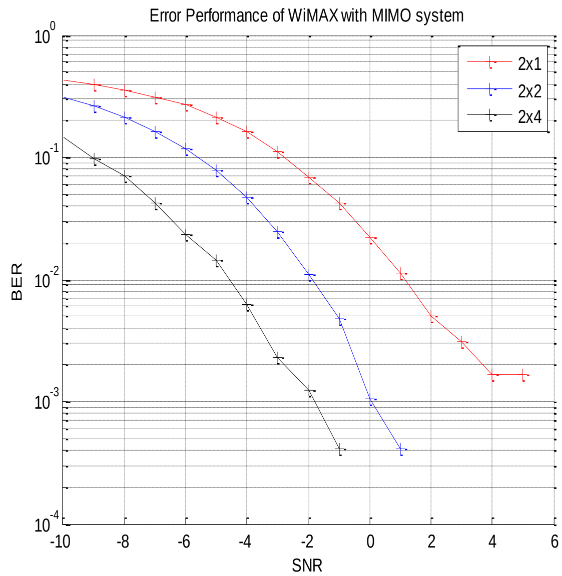

Fig: 5 Performance of WiMAX with MIMO

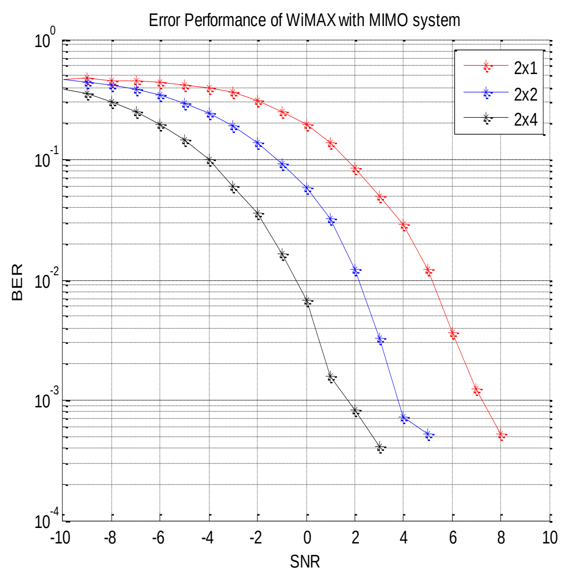

Fig: 6 Performance of WiMAX with MIMO

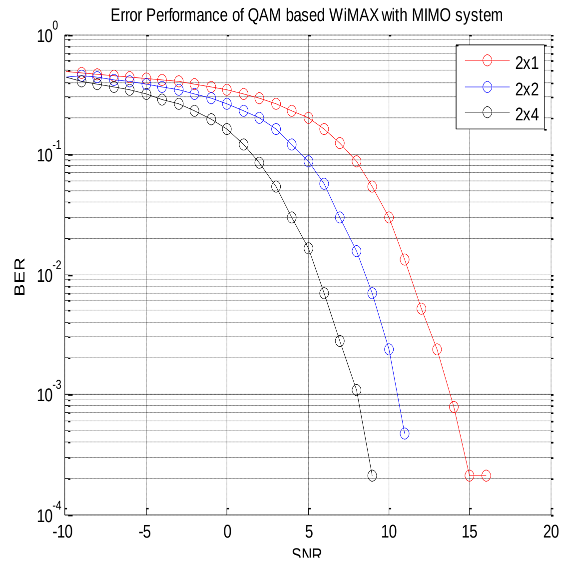

Fig: 7 Performance of QAm based WiMAX with MIMO

The BER performance graphs for the simulated MIMO-OFDM with the implementation of communication channel coding under QAM, BPSK, and QPSK digital modulation schemes over AWGN channel,

Conclusion

The OFDM-MIMO system simulation setup with STBC Alamouti scheme has been developed. In during simulation study various modulation schemes which support the high data rate are used for simulation, and performance enhancement with different receiver diversity. The space time coding is one of the techniques which enable the higher speed with maintaining the error rate. The zero forcing equalizer improves the performance over channel response and BER performance is further improved by finding maximum likelihood sequence. The BER performance will perform better.

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