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Comparison Of MIMO-OFDM System By Using Different Equalizer

Priyanka Chauhan[*1], Shri Santosh Sharma[2]

[*1,2] Dept. of Electronic & Communication, MPCT College, Gwalior, India

id-priyanka.ch2007@yahoo.com

Abstract

This paper proposes a simple and efficient method to study the MIMO OFDM using adaptive equalizer. This paper described about bit error rate with energy bit to noise ratio on MIMO OFDM channel. This paper shows that the addition of equalizer reduce the bit error rate and the channel output becomes more pronounced though the total channel is frequency selective channel. In this paper we compare the theoretical and simulation result by comparing the bit error rate and energy bit to noise ratio .OFDM is reduce to ISI problem Two of most equalization algorithm are minimum mean square error(MMSE) equalizer and maximum likelihood sequence estimation(MLSE) equalizer Finally simulation of OFDM signals are carried with Rayleigh faded signal to understand the effect of channel fading and to obtain optimum value of BER and SNR.

Keywords- MIMO system, channel, ofdm, Equalizer ,Adaptive equalizer,

Introduction

A general problem found in high speed communication is ISI. This paper will focus on OFDM simulation and implementation and also compare the output result of BPSK modulation technique with OFDM. MIMO stands for multiple input and multiple output. It is a system that uses several anteen as at the transmitter and receiver links. The combination of MIMO-OFDM is very likely and beneficial since ofdm enables support of more anteena and larger bandwidth. It simplify equalization in mimo system..MIMO channel uses the fading to increase the capacity of entire system. Fading of the signal can be mitigate by different diversity technique.

MIMO System

The MIMO system transmits different signals from each transmit element so that the receiving antenna array receives a superposition of all the transmitted signals. All signals are transmitted from all elements once and the receiver solves a linear equation system to demodulate the message. Multiplexing (MIMO-OFDM) system is an effective solution to improve communication quality, performance, capacity, and transmission rate. MIMO-OFDM is under intensive investigation by researchers.

In fig. Direct connect from transmitter Antenna 1 is connected to receiver antenna 1 is specified with h11 .The indirect connected from, antenna 1 to antenna 2 identified as cross component h21.

We consider the system where the transmitter has n antennas and the receiver has nr antennas. Let hmn , be a complex number corresponding to the channel gain between transmit antenna n and the receive antenna m. If at a certain time instant complex signals (x1,x2……..xn) are transmitted via the nt antennas, the received signals at antenna m can be expressed as

$$y_m=\sum h_{mn}x_n+e_m$$

where e_m is a noise signal. Y_m is a received signal. X_n is a transmitted signal. h_{mn} is a channel response.

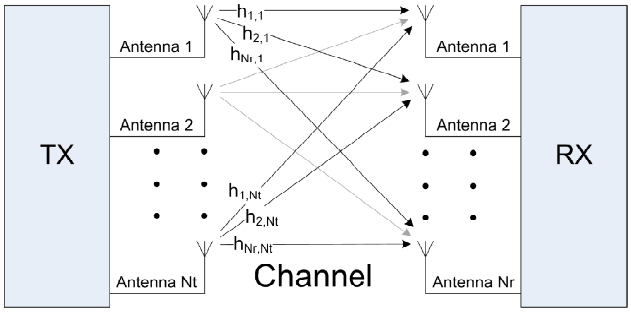

Fig 1. Block diagram of MIMO Y=HX+e

OFDM System

OFDM stands for orthogonal frequency division multiplexing. OFDM is a combination of modulation and multiplexing. Multiplexing refers to independent signal those produse by different sources. In OFDM the question of multiplexing is applied to independent signals but these independent signals are a subset of one main signals. It is a multicarrier modulation

technique. It is used for multiple carrier signal at different frequency. OFDM modulation divides a broadband channel into many parallel sub channel(Narrowband channel).

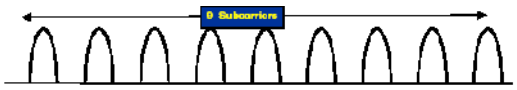

Fig.2 FDM MODEL

OFDM is similar to FDM but much more spectrally efficient by spacing the sub channel much more spectrally efficient by spacing much closer together. This is done by finding frequencies that are orthogonal.

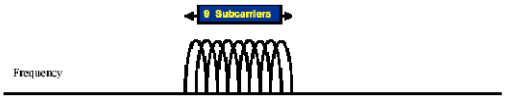

Fig.3 OFDM MODEL

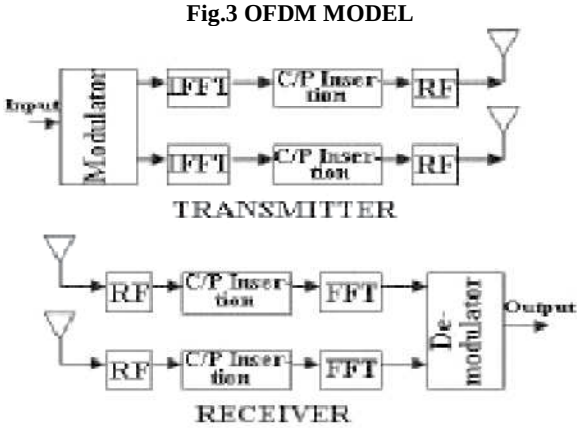

Fig.4 Block diagram of MIMO-OFDM

OFDM transmitter include IFFT operation and cyclic prefix insertion. OFDM receiver are include cyclic prefix removal and FFT.MIMO-OFDM based on the IEEE 802.11 provide very high throughput data rates and the original data rates 54mb/s.

CYCLIC PREFIX

CP maintain orthogonality of subcarrier's can be used in timing and frequency synchronization's is used for synchronization some calculation are performed on cp to check the starting point of frame. cp is a periodic extension of the last part of an OFDM symbol i.e added to the front of the symbol in transmitter and is removed at the receiver before demodulation's is used to ISI adding a cp convert linear convolution between h(n) and x(n) into circular convolution.

EQUATION OF FFT & IFFT-

$X(K)=\sum x(n)\sin(2\prod kn/N)+J\sum x(n)\cos(2\prod kn/N)$ here x(n) are the coefficient of sine & cosine of frequentation $2\prod k/N$.k is the index of frequency over the N frequency & n is time index.X(K) is the value of spectrum for the Kth frequency & x(n) is the value of signal at time n

IFFT equation-

$X(n)=\sum x(k)\sin(2\prod kn/N)-J\sum x(k)\cos(2\prod kn/N)$ here x(n) are the cofficient of sine & cosine of frequentation $2\prod k/N$.k is the index of frequency over the N frequency & n is time index.X(K) is the value of spectrum for the Kth frequency & x(n) is the value of signal at time n.

Overview Of Equalizer

The equalizer is a device that attempt to reverse the distortion incurred by a signal transmitted through a channel. Its purpose to reduce inter symbol interference to allow recovery of the transmit symbol .It may be a simple linear filter or a complex algorithm. Equalization is the process of adjusting the balance between frequency component within an electronic signal. The most well known use of equalization is sound recording and reproduction but there are many other application in electronic and telecommunication. The circuit or equipment used to achieve equalization is called an equalizer. The equalizer filter used for audio & similar signal. These are used in telecommunication. In this technique are used in improved received signal quality & link performance over small scale time and distance.

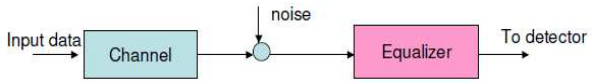

Fig.5 Channel Equalization

Adaptive Equalizer

Adaptive equalizer compensate for signal distortion attributed to inter symbol interference (ISI) ,which is caused by multipath with in time dispersive channel.

Typically employed in high speed communication system, which do not use differential modulation scheme or frequency division multiplexing.

The equalizer is the most expensive component of a data demodulator and can consume over 80% of the total computation needed to demodulate a given signal. An adaptive equalizer is an equalizer automatically adapts to time varying properties of the communication channel. It is frequently used with coherent modulation such as phase shift key ,mitigating the effect of multipath propagation and Doppler spreading

MMSE Equalizer

We had discussed a 2x2 MIMO transmission using BPSK modulation in Rayleigh channel with a Zero forcing equalizer. The simulated result with the 2x2

MIMO system with zero forcing equalizer shows matching results as obtained in for a 1x1 system for BPSK modulation in Rayleigh channel. We will discuss a different equalization approach called MMSE equalization. We will assume that the channel is a flat fading Rayleigh multipath channel and the modulation is BPSK.

Simulation Result

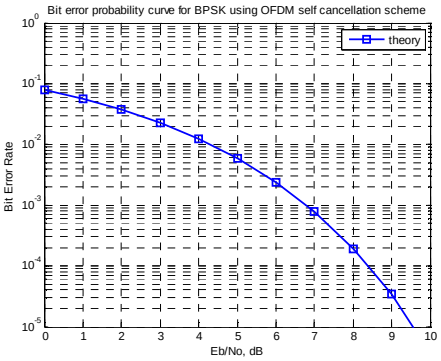

Fig.6 BER Vs E_b/N_O for BPSK using OFDM

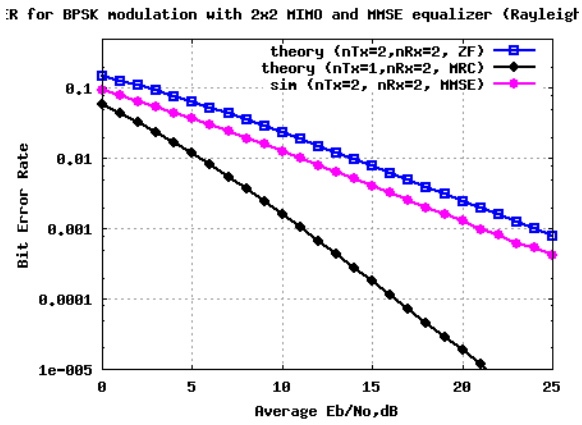

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Fig.7 BER plot for 2x2 MIMO with MMSE equalization for BPSK in Rayleigh channel.

Compare to zero forcing (ZF) equalizer case at, 10^{-3} BER point , it can be seen at the Minimum Mean Square Error (MMSE) equalizer result in around 3 db.

References

[1] Paulraj, A.J., Gore, D.A., Nabar, R.U., Balckei,H(2004),An overview of MIMO communication,-a key to gigabit wireless, proceedings of the IEEE international conference on communication, v.92,p. 198-218,Feb.

[2] D.Agrawal, v. Tarokh, A. Naguib, and n, seshadri "space time coded OFDM for high data rate wireless communication over wideband channel", in proc. of the 48.h IEEE Vehicular Technology conference(VTC) 1998, vol. 3,1998, pp.2232-2236

[3] Krishna sankar, "BER for BPSK in OFDM with Rayleigh multipath channel" on August 26, 2008

[4] S.Haykins. (1996) .Adaptive filter theory .(3rd edition).prentice hall.

[5] "Adaptive Equalization " by SHAHID U.H QURESHI SENEOR MEMBER IEEE,