Performance Analysis of MIMO-OFDM System using Turbo Coding

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Abstract

MIMO-OFDM (multiple inputs and multiple output orthogonal frequency division multiplexing) system is a new wireless broadband technology which has gain great popularity for its capability of high rate transmission and its strength against multipath fading. In this paper turbo and Minimum Mean Square Error equalization techniques are presented for reduction in bit error rate for the PSK (BPSK, QPSK, QAM) modulation technique. The performance is evaluated in terms of BER versus SNR. The performance of MIMO-OFDM system is evaluated by using convolution and turbo coding.

Keywords — *MIMO, OFDM, BER, MMSE*

I. INTRODUCTION

In wireless communication technology the main objective is to provide high quality of data. Orthogonal frequency division multiplexing (OFDM) has become a more popular technique for transmission of signals over wireless channels. In OFDM, signals are transmitted in sub channel of different frequency in parallel way. The frequency of sub-channel are so selected that these frequencies are orthogonal to each other and therefore do not interfere with each other. This phenomenon makes it possible to transmit the data in overlapping frequency and hence reduces the bandwidth requirement considerably. OFDM is beneficial in many aspects such as high spectral efficiency, robustness, low computational complexity, frequency selective fading, and easy to implementation using IFFT/FFT [3]. PSK modulation technique is used in MIMO-OFDM system to evaluate the BER performance.

II. OFDM-MIMO TECHNIQUE

A. OFDM

Orthogonal frequency division multiplexing (OFDM)is a combination of modulation and multiplexing. Insome respects, OFDM is similar to conventional frequency-division multiplexing (FDM). The difference lies in the way in which the signals are modulated and demodulated. Priority is given to minimizing the interference, or crosstalk, among the channels and symbols comprising the data stream. OFDM system Architecture has shown in Figure 1, which include transmitter and receiver parts. In transmitter, binary data take as a input which is in serial form, it can be covert serial into parallel form using S/P converter then apply on it Inverse Fast Fourier Transform, in that all signal get orthogonal to each other, its output con be convert parallel into serial form using P/S converter and it is transmitter output. It gives to receiver through wireless channel, in that noise can be added. In receiver part input can be taken from Tx in serial form which can be convert into parallel using S/P converter, then on its output apply Fast Fourier Transform. Some amount of Noise can be remove using FFT. After that again it can be convert parallel into serial form using P/S converter. Finally output data can be obtained without noise.

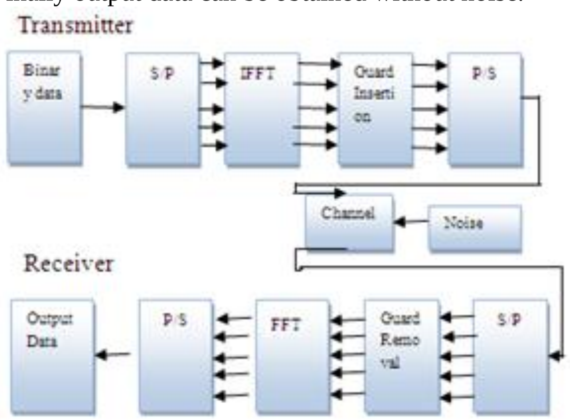

Figure 1: OFDM System Architecture

B. MIMO

Multiple antennas are put at both the transmitter and the receiver; this system is referred to as Multiple Input Multiple Output (MIMO). A MIMO system with similar count of antennas at both the transmitter and the receiver in a point-to-point (PTP) link is able to multiply the system throughput linearly with every additional antenna. For example, a 2x2 MIMO will double the throughput.

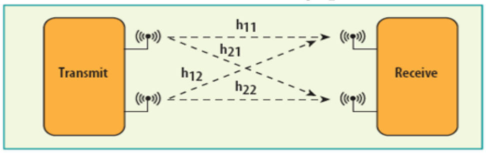

Figure 2: MIMO Channel model

Where, y1 and y2 are output getting at receiver end including noise n1 and n2

C. OFDM MIMO

The main motivation for using OFDM in a MIMO channel is the fact that OFDM modulation turns a frequency-selective MIMO channel into a set of parallel frequency-flat MIMO channels.

This renders multi-channel equalization particularly simple, since for each OFDM-tone only a constant matrix has to be inverted [2,3].

In a MIMO-OFDM system with N subcarriers (or tones) the individual data streams are first passed through OFDM modulators which perform an IFFT on blocks of length N followed by a 5 parallel-to-serial conversion. A cyclic prefix (CP) of length Lcp ≥ L containing a copy of the last Lcp samples of theparallel-to-serial converted output of the N-point IFFT is then prepended. The resulting OFDM symbols of length N + Lcp are launched simultaneously from the individual transmit antennas. The CP is essentially a guard interval which serves to eliminate int- erference between OFDM symbols and turns linear convolution into circular convolution such that the channel is diagonalized by the FFT. In the receiver the individual signals are passed through OFDM demodulators which first discard the CP and then perform an N-point FFT. The outputs of the OFDM demodulators are finally separated and decoded.

III. PHASE SHIFT KEY (PSK)

Phase Shift Keying (PSK) was developed during the early days of the deep space program; psk is now widely used in both military and commercial communications system. The general analysis expression for psk is

Phase Shift Key (PSK) is one of the best Communication System in which image can be transfer from one place to another through a communication channel. Hence the channel plays a very important role in Communication System. Sometimes ideal image cannot be received by receiver because of an Additive White Gaussian noise (AWGN) channel. In short image can be affected by communication Channel. The following simple system model shows the communication process.

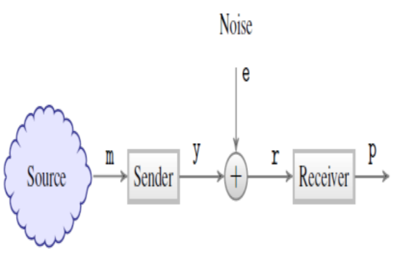

Figure 3: Communication Model

IV. RESULTS

In wireless channel, Performance of BPSK system using convolution code and turbo code shown in figure 5. As the snr increases bit error rate decreases. It shows performance improvement by turbo as compared to convolution coding. Table 1 shows snr verses ber of a BPSK system.

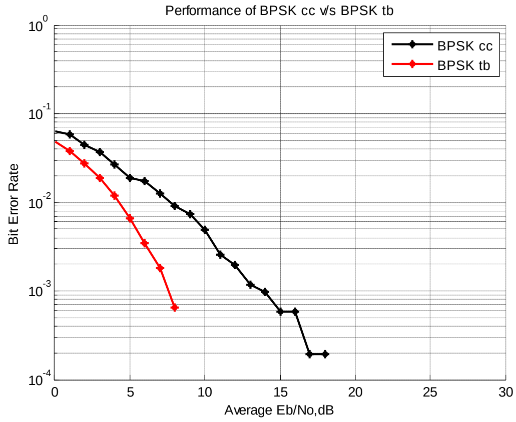

Figure 5: Performance of BPSK System using Turbo Coding Over Convolution Coding

SNR BPSK	BERBPSK	BERBPSK TURBO
0	0.08106	0.0497416
1	0.0625	0.03036176
2	0.05957	0.03100775
3	0.04004	0.01744186
4	0.02148	0.00904393
5	0.01855	0.00387597
6	0.01367	0.00322997
7	0.00781	0
8	0.00391	0.00193798

Table 1: snr v/s ber(bpsk cc &bpskturbo) of a BPSK System

In wireless channel, Performance of QPSK system using convolution code and turbo code shown in figure 6. As the snr increases bit error rate decreases. It shows performance improvement by turbo as compared to convolution coding. Table 2 shows snr verses ber of a QPSK system.

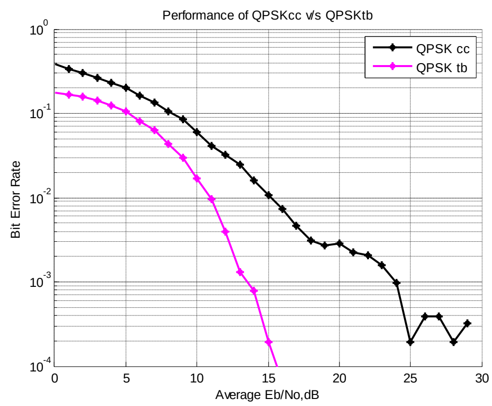

Figure 6: Performance of QPSK System using Turbo Coding over Convolution Coding

SNR QPSK	BERQPSK	BERQPSK TURBO
0	0.33643	0.169591
1	0.37305	0.159519
2	0.30811	0.154971
3	0.27734	0.123132
4	0.22266	0.11306
5	0.17676	0.09909
6	0.16016	0.0718
7	0.13281	0.0705
8	0.09863	0.04321
9	0.07031	0.035088

Table 2: snr v/s ber(qpsk cc &qpskturbo) of a QPSK system

In wireless channel, Performance of QAM system using convolution code and turbo code shown in figure 7. As the snr increases bit error rate decreases. It shows performance improvement by turbo as compared to convolution coding. Table 3.shows snr verses ber of a QAM system.

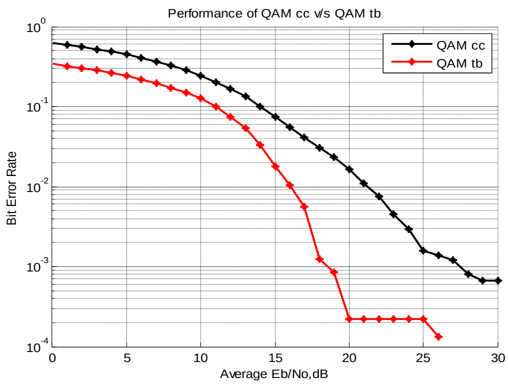

Figure 7 : Performance of QAM System using Turbo Coding over Convolution Coding

SNR QAM	BERQAM	BERQAM TURBO
0	0.612	0.329929
1	0.56967	0.3168295
2	0.55533	0.2959591
3	0.56233	0.2990675
4	0.48333	0.2662078
5	0.48233	0.2380107
6	0.43333	0.2220249
7	0.334	0.1973801
8	0.298	0.1847247
9	0.29667	0.142984

Table 3: snr v/s ber(qam cc &qamturbo) of a QAM System

V. CONCLUSION

From Figure 5, 6 and 7, it can conclude that BER performance can be improved by turbo coding as compare to convolution coding.

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