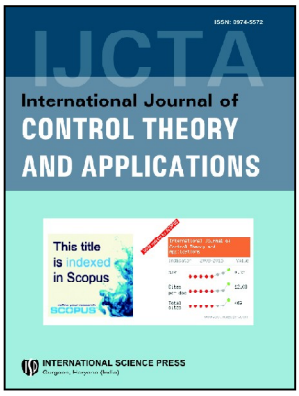

International Journal of Control Theory and Applications

ISSN : 0974-5572

Volume 10 • Number 22 • 2017

Performance Analysis of Multi-Carrier CDMA system using Convolution Code

P. Sreesudha[1] and B. L. Malleswari[2]

[1]*Assistant Professor, ETM Department, Hyderabad, India, E-mail: sree.sudha38@gmail.com*
[2] *Principal, SWEC, Hyderabad, India, E-mail: blmalleswari@gmail.com*

***Abstract*:** Multi-Carrier Code Division Multiple Access (MC-CDMA) system performance is evaluated with Convolutional error control coding in this paper. Multiple antennas are used at transmitting and receiving side to improve the performance. Various types of equalization schemes are examined. 2x2 antennas considered and code rate of convolutional encoder is ½. AWGN and Rayleigh fading channel is considered for simulation. The system is implemented with different types of receivers. Viterbi decoding is performed to retrieve the data. And simulation results show that error control coding provides better performance.

Keywords: MC-CDMA; MIMO; ZF-SIC; MMSE-SIC; Convolutional code;

1. INTRODUCTION

As the demand for wireless services increasing then single antenna not sufficient to fulfil the customer requirements. So multiple antenna system has been introduced to increase the data rate. MIMO has functions of spatial multiplexing, space time coding and precoding [1]. In spatial multiplexing schemes the data is simultaneously transmitted through multiple antennas thus increases the data rate. And as the numbers of receiving antennas are increasing that increases the receive diversity. So that receiver decides the better signal in multipath fading environment. And in this paper 2x2 antennas system considered.

And in order to reduce the number of errors interference cancellation receivers are designed for CDMA system. Multi-Carrier CDMA system includes OFDM (orthogonal frequency division multiplexing) which is promising technology for 4G and beyond 4G technologies. As CDMA system is resilient to fading. Due to spreading only intended receivers can able to receive and for others it appears like noise.

Channel coding techniques are used to reduce errors, one majorly used coding scheme is convolutional coding [2]. Multi user detection schemes in CDMA increases not only capacity but also performance, one such detector is successive interference detector [3],[4].

In the paper, In section 2, MC-CDMA system model discussed and designed with different schemes. In Section 3, Simulation results are discussed, and the paper is concluded in Section 4.

2. PROPOSED SYSTEM

The following figures 1 and 2 illustrate the system with 2 antennas at transmitting and receiving side.

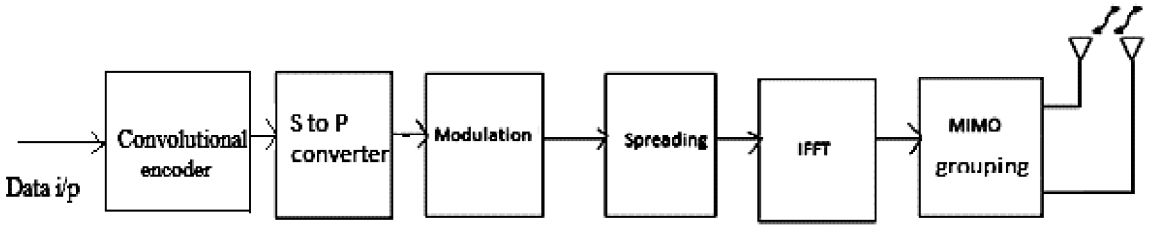

Figure 1: Transmitter

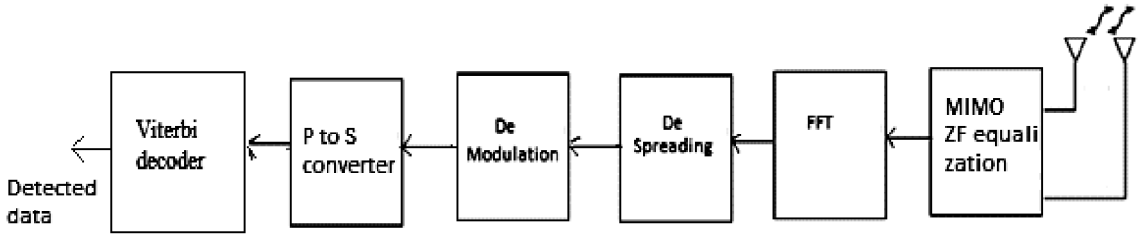

Figure 2: Receiver

Here the parallel data modulated with bpsk modulation and Walsh code is used for spreading. Then ifft applied for getting multi carrier modulation after that the data is transmitted through antennas.

At the receiver side the receiver equalizes the multipath fading effects with various types of equalizations schemes and finally performs reverse operation to retrieve the ordinal data.

(A) ZF-SIC with SNR based ordering

Simple Zero Forcing (ZF) technique is simple to implement and useful only when noise is zero and it is linear equalization scheme [5], [8], [9]. But practical systems noise can never be zero. Because ZF simply equalizes the received signal. As it simply multiples the received signal with inverse channel coefficient thus removes the channel response. So to remove the noise effects interference cancellation schemes are introduced.

In Successive Interference Cancellation (SIC) Receiver, after detecting the signal it is subtracted from the received signal at each stage, so that reduces the interference. The subtraction takes place the signal having highest signal energy called SNR based ordering. This technique further improves the BER performance.

(B) MMSE-SIC with SNR based ordering

Minimum Mean Square Error (MMSE) also one of the equalization techniques [6],[7],[10]. Where MMSE combats the effects of fading with the help of noise factor for equalization. So compared to ZF noise and interference levels are less. This method providing better performance.

(C) Error Control Coding

Finally the system is included with convolutional coding of constraint length 3 and 1/2 code rate. The transmitted data is encoded at the transmitter side, and viterbi decoding is performed at the receiver side, BER performance is further improved with this.

Viterbi decoding is most widely used decoding method compared to others since it uses the Euclidian distance principle.

3. SIMULATION AND RESULTS

In this paper the following parameters shown in Table 1, are considered for simulation. Result graphs are shown in the graphs. Single user is considered for implementation. Rayleigh fading channel along with AWGN is considered for simulation, and the results are simulated in MATLAB.

Walsh Hadamard sequence is considered for spreading the data. And it is an orthogonal spreading sequence. BER performance is measured for different Eb/No values.

Table I
Simulation Parameters

Parameters	*Values*
Modulation	BPSK Modulation
Antenna Configuration	N_t=2,N_r=2
No of input bits	2000
Spreading codes used	Walsh Hadamard Sequence
Channel	AWGN & Rayleigh fading channel
No of users	1
Encoder	Convolutional encoder with ½ code rate

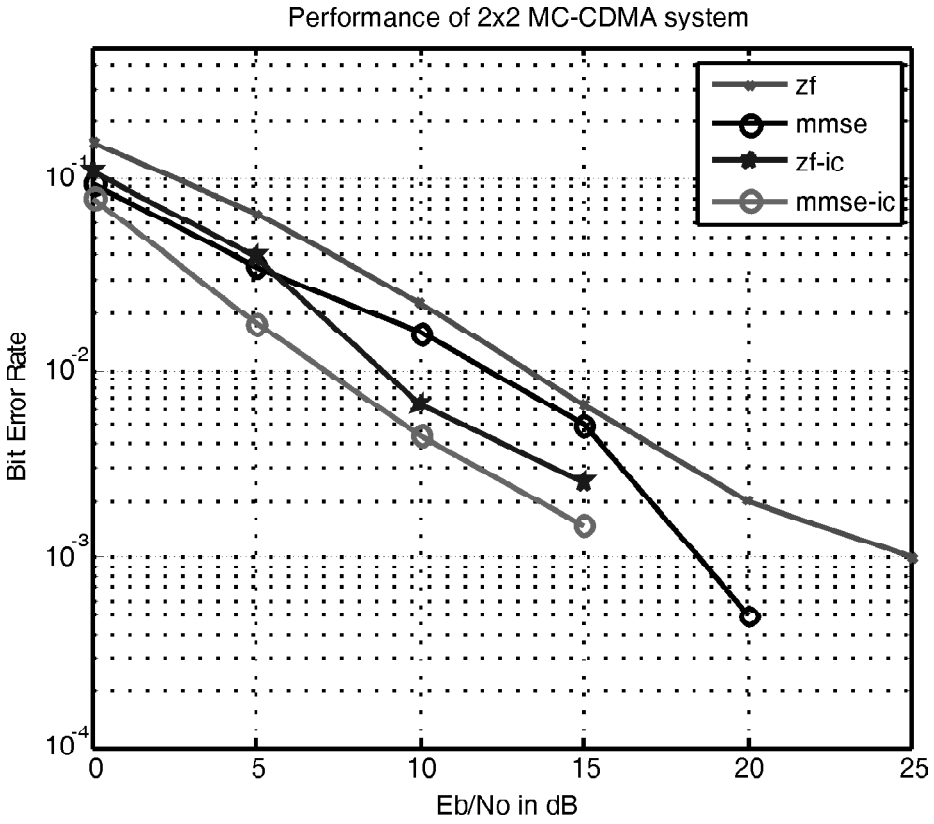

Figure 3: BER performance with 4 combined schemes

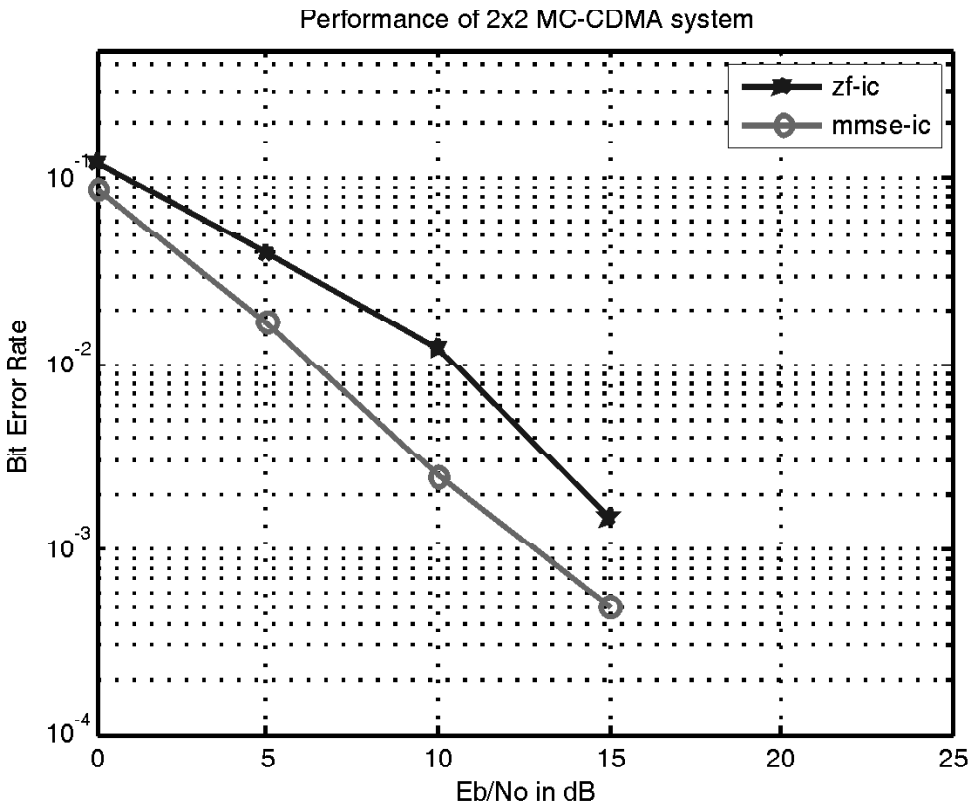

Figure 4: Comparison of ZF and MMSE with SIC And SNR ordering

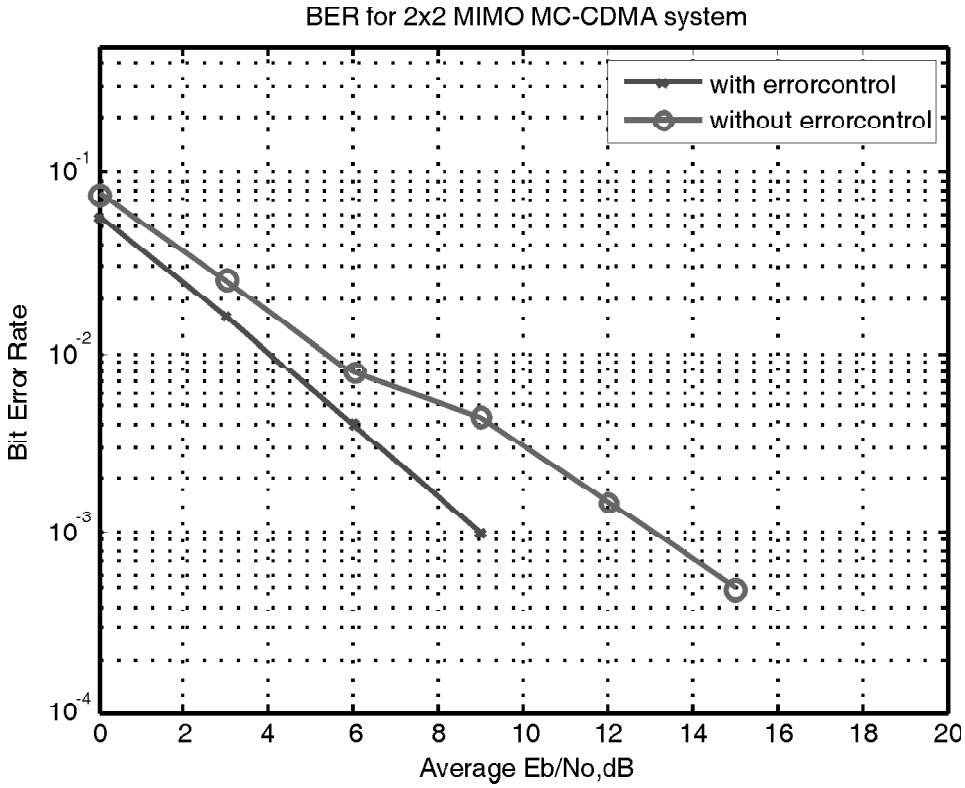

Figure 5: BER performance with convolutional encoder for MMSE-SIC SNR based ordering

In figure 3, ZF and MMSE with successive interference cancellation with SNR ordering receiver BER performance is shown, and in this graph traditional ZF and MMSE also shown. Among all MMSE with SIC and SNR based ordering receiver is giving better performance. Since MMSE combats noise.

In figure 4, only ZF and MMSE along with Interference cancellation separately shown. And in figure 5, convolutional encoder with MMSE SIC is shown. Since MMSE SNR ordering giving the better performance, so still to reduce the errors error control coding is included here.

Constraint length of convolution encoder is 3 and code rate is ½. As the fig 5, we can conclude that with coding still better BER curve obtained. Any how we need to transmit redundant bits that reduce the bandwidth efficiency. But better performance can be obtained.

4. CONCLUSION

MC-CDMA is one of 4G promising technology allows more number of users due to its multi-carrier concept. In this paper different types of receivers are designed. And assuming that the receiver has channel information. In the future, channel estimation needs to be done. And the equalization schemes are linear, as mobile radio system are dynamic nature so adaptive equalization schemes need to be considered in the future.

ACKNOWLEDGEMENT

The proposed work was supported by G.Narayanamma Institute of Technology and Science for Women, Hyderabad.

REFERENCES

[1] Blostein S.D, and Leib H, "Multiple Antenna Systems: Their Role and impact in future wireless access", IEEE communication Letters, Vol. 41, July 2003, Page No. 94-101.

[2] Alireza Mirzaee, and Amours C.D, "Soft output Detector for MIMO-CDMA systems with parity bit selected and permutation spreading", IEEE Communication Letters, Canadian Conference-23, May. 2010, Page No. 1-4.

[3] Prashanth Rao, "A Successive Interference Cancellation Multiuser Detector for MIMO CDMA systems", Proc. IEEE VTC 2003-Fall, Oct. 2003, Page No. 1075-1079.

[4] R. Lupas and S. Verdh, "Linear multi-user detectors for synchronous code-division multiple-access channels," IEEE Trans. Inform. Theory, vol. 35, pp. 123-136, Jan. 1989.

[5] Chalise B.K. Vandendorpe L, "Performance analysis of linear receivers in a MIMO relaying system", Communication letters IEEE, vol 13, 2009.

[6] Upamanyu Madhow and Michael L. Honig, "MMSE Interference Suppression for Direct- Sequence Spread-Spectrum CDMA", IEEE transactions on communications, vol. 42, no. 12, december1994.

[7] M. Latva-aho and M. J. Juntti, "LMMSE detection of DS-CDMA systems in fading channels," IEEE Trans. Commun., vol. 48, pp. 194–199, Feb.2000.

[8] Sun Liang, Wang Yafeng, Zhang Junfeng, Yang Dacheng, "Novel Layered Space-Frequency Architecture for Uplink Multi-User MIMO-CDMA Systems", Vehicular Technology Conference, pp. 2425 – 2429, 2007.

[9] Antonis Phasouliotis and Daniel K.C. So, "A Novel OSSMIC Receiver for Downlink MIMO MC-CDMA Systems", Vehicular Technology Conference, pp. 1271-1275, May 2008.

[10] Zhendong Luo and Dawei Haung, "Iterative Soft Multiuser Detection for MIMO MC-CDMA Systems", Vehicular Technology Conference, pp. 1-5, Sept 2008.

[11] William Stallings, Wireless Communications & Networks, 2nd edition, Pearson Education, pp. 236-246.