Comparative Analysis of 2*2 MIMO-MC-CDMA In Different Modulation Technique In Rician Fading Channel

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Abstract- *In this paper we estimate the performance analysis of 2*2 MIMO-MC-CDMA systems in Rician fading channel in different modulation techniques using MATLAB to compare BER. Code Division form Multiple Access is a multi-user technique that uses spread spectrum system for which spreading of sequence be done by means of PN sequence generator. This system then merged with OFDM (multi-carrier system) in which distinct broadband frequency selective carrier is altered into parallel narrowband flat fading multiple sub-carriers to raise the performance of system, also their combination of systems forms MC-CDMA system. Now system further enhanced through implementing 2*2 MIMO system that means 2 transmit two receive antennas respectively which uses ZF decoder at the receiver to reduce bit-error-rate with transmit diversity of ½ rate convolutionally encoded Alamouti Space Time Block Code is implemented, which maximize the performance of the 3G and 4G communication system by reducing BER and increasing gain in QPSK, 8-PSK, 16-QAM and 32-QAM modulation techniques.*

Keywords- CDMA, OFDM, MISO, MISO-MC-CDMA and MC-CDMA.

I. INTRODUCTION

The third generation partnership project (3GPP) wireless communication tool for mobile communication expanding rapidly larger than the earlier period. The concluding aim of elevated data rate in addition to small error probability in the course to convene the increased inevitability of users like mobile internet, video telephony as well as high quality multimedia streaming, novel principles like wideband code division multiple access and high speed packet access (HSPA) for long term evolution (LTE) is developed. The above mentioned aim remains the identical for the future technologies. The recent research of multiple input multiple output (MIMO) scheme that utilizes multiple transmit and receive antennas to represent the capacity of MIMO systems has increased linearly by means of the various transmit antennas in addition to the various receive antennas that the number of receiving antennas are larger than or equal to the sum of transmit antennas for received diversity technique. This contrivance provides high data rate that can be designed for communication without improve the transmission bandwidth or the overall transmitted power. In the previous years a lot of study was performed for increasing the performance of system in limited bandwidth. The main problem in wireless communications is the outcome of multipath fading that is challenging for high data rate communication. Fading is created by means of destructive or constructive interference produced at the same time as different transmitted signals arrives at the receiver through multiple numbers of paths having diverse time delays, attenuations and phases. Frequency selective fading is single type of channel in which inter symbol interference is formed by time dispersion of the transmitted symbols enclosed by the channel. ISI causes competent for performance degradation and for this reason in order to achieve high data rates.

Multi-Carrier Code Division Multiple Access (MC-CDMA), is technology that utilized, performs well under the frequency selective channels. It also permits multiple users in to access the wireless channel at the same time via modulating and spreading data signals transversely the frequency domain in different spreading sequences.

MC-CDMA come together the strength of multipath fading proficient via orthogonal frequency division multiplexing, by means of enhanced frequency diversity so as to be achieved through code division multiple access (CDMA). When incorporated with MIMO system through MC-CDMA can grant very far beyond the ground data transmission rates in wealthy multipath scattering environments devoid of escalating the communication bandwidth of the system.

II. THEORETICAL BACKGROUND

2.1. MULTIPLE INPUT MULTIPLE OUTPUT (MIMO)

MIMO is fundamentally dependent on the work developed by Teletar as well as Foschini. The innermost fraction of this thought is to make use of multiple antennas for both transmission as well as reception. This increases the capability of the wireless channel. Capability is represented as the maximum attainable data rate for arbitrarily short probability of error. So the constrain towards the growth of codes for the schemes that would make the systems to progress toward their Shannon capacity limit. This proficiency received an significance when Tarokh et al. form their space-trellis coding process for Alamouti that established his space-time block coding methods in the direction to improve link-level performance based on the diversity. It recognized various

Developments when Bell Laboratories forms its Bell Laboratories Layered Space-Time (BLAST) encoding method, shows the spectral efficiencies as high as 42 bit/s/Hz. This shows an incredible expansion in spectral competence as differentiated by existing 2–3 bit/s/Hz received into cellular mobile as well as wireless LAN systems. There is, therefore an requirement for communication engineers to acquire this remarkable technology.

We will presently natter about a MIMO technique established by AT&T Labs-Research in Middletown, New Jersey. They carry field tests to show the mobile MIMO radio channel. The conglomerate calculated the capacity of a system from four antennas on a laptop as well as four antennas on the top of a rooftop of base station. The field tests represents the results are close to the theoretical fourfold supplement in capacity over a introverted antenna system that can be supported in a 30-KHz channel from dual polarized spatially divided base station and the mobile terminal antennas [4]. From reading they get results that the base location of rooftop antenna array make use of dual-polarized antennas alienated through 11.3 feet, which is around 20 wavelengths next to a distance and multi-beam antenna. The laptop-mounted antenna included vertically polarized array and the dual-polarized array from elements spaced half of wavelength at an expanse. Different signals sent through each antenna at the similar time in the comparable bandwidth as well as alienated through the receiver. Through the four antennas at the spreader side and at the receiver side, this increases the efficiency to provide four times the information rate as compared to single antenna system instead of increase in broadcast power or bandwidth, for the propose of multipath environment is prosperous. This means that the capacity of system enlarged at superior rate in which the scheme is NLOS scheme. We discover that 4G is an IP-dependent and we observe briefly so as to important as wireless IP that will be a initially consequential of MIMO [4].

2.2. MULTI CARRIER CODE DIVISION MULTIPLE ACCESS (MC-CDMA)

MC-CDMA is an alliance of organization of OFDM in addition to CDMA technologies. This system allows the multiple users to access the wireless channel alongside by modulating as well as spreading their input data signals in frequency domain through the different spreading sequences. MC-CDMA merges the multipath fading of OFDM through the multi-user access of CDMA.

III. SYSTEM MODEL

System model of MIMO-MC-CDMA is revealed in fig.1. In this model we are assumed that transmitter sends random sequence to the receiver so we employ random PN sequence generator by MATLAB. Currently spreading of sequence is completed by PN sequence generator. Then in modulator block different modulation schemes is employed in modulator block. MC-CDMA system which is described in section 3, now MIMO (multiple Input Multiple Output) encoder ½ rate convolutionally encoded Alamouti's STBC block code is utilized which will be explained in section 3 in Multiple Input Multiple Output (MIMO). Amalgamation of MC-CDMA and MIMO form MIMO-MC-CDMA as revealed in fig.1. Now signal is transmitted through Rician Fading Channel [7]. Then receiver collect the signal in reverse manner by means of ZF decoder for the restoration of transmitted signal by the side of receiver and BER calculation is completed for determining the system performance. In MIMO two transmit and two receive antennas are utilize. In this manuscript we are transmitting message bits which is arbitrary in nature or in addition dependent on user then this data is passed in the course of spreader using PN sequence which forms 8 bits designed for each input bits that is input bits*8 then resulting bits are formed subsequent to the spreading of Encoded sequence. Subsequently these spreaded sequences of bits are conceded by modulator in which its modulation depends on the form of modulation used. Then these modulated data is reframed into parallel structure for OFDM then IFFT is prepared to convert frequency selective wide-band carriers keen on parallel narrowband flat-fading carriers which are orthogonal within character after that this data is reshaped in the direction of parallel to serial after that CP cyclic prefix addition is prepared to remove ISI which complete the procedure of OFDM transmission then this data afterward passed through MIMO encoder which employ Alamouti STBC code for different diversity techniques i.e. 2*2 in which 2*2 channel matrix is shaped by using MIMO diversity, in addition to ZF detection scheme is used at the receiver after that reverse operation is prepared for receiving the input bits.

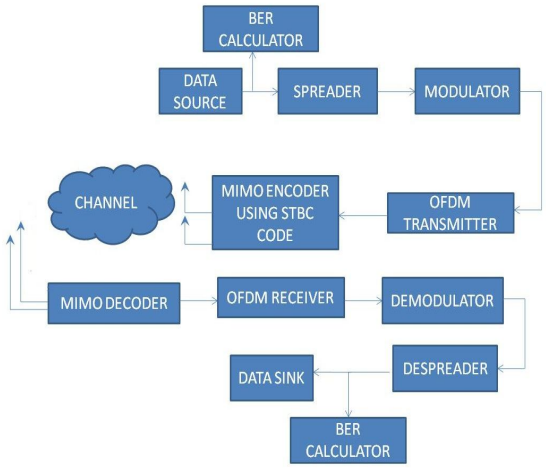

Fig.1. System Model OF 2*2 MIMO - MC-CDMA

IV. SIMULATION RESULTS AND DISCUSSION

Table.1 represents the simulated model considerations of MIMO-MC-CDMA in 2*2 antenna diversity in different modulation technique. Figure.2 results the performance analysis of MIMO-MC-CDMA in different modulation scheme, Table 2 represents the BER and gain comparison with respect to 64-QAM from that we can depict that QPSK modulation technique have very low BER and high gain as compared 64-QAM modulation technique. This gain comparison is done at -2-dB SNR because at 0-dB BER of 2*2 antenna diversity in QPSK modulation techniques reaches to zero i.e high performance is received at QPSK modulation technique in Rician Channel. Figure.2 shows results of MIMO-MC-CDMA in different modulation techniques. Consequently for 3G in addition to 4G wireless communication for improving system performance we can utilize MIMO-MC-CDMA technique for getting high performance in QPSK modulation technique but as for as data rate consideration we can also use 64-QAM techniques using convolution code as we get result in Figure2.

Table.1. Summary of simulated model parameters.

No. of bits transmitted by user	1560
Channel Encoder	½ rate convolution encoder Alamouti STBC
FEC Encoder	Convolution Encoder
Signal detection scheme	Zero forcing
Channel	Rician Fading Channel
Signal to Noise Ratio	-10dB to 20 dB
CP Length	1280
OFDM Sub-carriers	6400
No. of transmitting and receiving antennas	2*2
Modulation Schemes	QPSK,8-PSK,16-QAM,32-QAM and 64-QAM

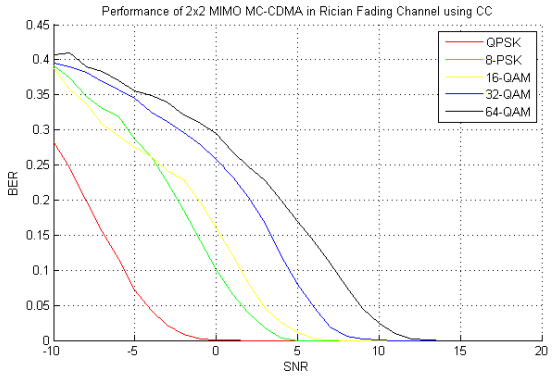

Figure.2. Performance analysis of 2by2 MIMO-MC-CDMA in different modulation scheme.

Table: 2. Performance analysis at -2db SNR w.r.t 64-QAM modulation technique.

Modulation	BER at -2dB	Gain w.r.t 64-QAM
QPSK	0.00846	-31.582dB
8-PSK	0.1854	-4.767dB
16-QAM	0.2296	-2.9106dB
32-QAM	0.2963	-0.6954dB
64-QAM	0.321	0dB

REFERENCES

[1] Shaikh Enayet Ullah and Md. Mahbubar Rahman "BER Performance Analysis of a FEC Encoded Multi-user MIMO MCCDMA Wireless Communication System", International Journal of Hybrid Information Technology, Vol. 4 No. 3, July, 2011.

[2] Sohag Sarker, Farhana Enam, Md. Golam Rashed, Shaikh Enayet Ullah " Performance Analysis of Two-Layer Spreading scheme based FEC encoded MC–CDMA

wireless communication system under implementation of various signal detection schemes" Journal of Emerging Trends in Computing and Information Sciences, VOL. 3, NO. 4, April 2012.

[3] Harutoshi Yamamoto , Takaya Yamazato , Hiraku Okada , and Masaaki Katayama, "Performance Analysis of MC-CDMA System with and without Guard Interval in Two-Path Channel", ISSSTA 2004,Sydney, Australia, 30Aug.-2Sep. 2004.

[4] Kai ZHANG and Zhisheng NIU "Multiuser MIMO Downlink Transmission Over Time-Varying Channels", IEICE TRANS. ??, VOL.Exx{??, NO.xx XXXX 200x

[5] Manjinder Singh, Karamjeet Kaur " BER Performance of MC-CDMA Using Walsh Code with MSK Modulation on AWGN and Rayleigh Channel", International Journal of Engineering Trends and Technology (IJETT) - Volume4 Issue7- July 2011.

[6] Mousumi Haque, Most. Farjana Sharmin and Shaikh Enayet Ullah, " Secured data transmission in a V-Blast encoded MIMO MCCDMA wireless communication system", International Journal of Information & Network Security (IJINS), Vol.2, No.3, June 2013, pp. 245~252.

[7] Karmjeet Singh, Rajbir Kaur " Performance Analysis of MIMO Multi-Carrier CDMA with QPSK Modulation in Rayleigh Channel" , International Journal of Engineering Research and Applications, Vol. 3, Issue 4, Jul-Aug 2013, pp.2562-2565.

[8] Antonis Phasouliotis "MULTICARRIER CDMA SYSTEMS WITH MIMO TECHNOLOGY", A thesis submitted to the University of Manchester for the degree of Doctor of Philosophy in the Faculty of Engineering and Physical Sciences, 2010.

[9] Sharmila and Srigitha S. Nath "Performance of MIMO Multi- Carrier CDMA with BPSK Modulation in Rayleigh Channel" International Conference on Computing and Control Engineering (ICCCE 2012), 12 & 13 April, 2012.

[10] Yong Soo Cho, Jaekwon Kim Yonsei, Won Young Yang and Chung G. Kang, MIMO Wireless Communication with MATLAB, 1st ed., August 2010, Wiley-IEEE Press.

[11] Mr. Atul Singh Kushwah "Performance Analysis of 2*4 MIMO-MC-CDMA in Rayleigh Fading Channel Using ZF-decoder" Digital Communication, Indore Institute of Science & Technology-II, Indore (M.P), India.

[12] Juyul Lee " Maximizing the Worst-User's Capacity for a Multi-User OFDM Uplink Channel" Department of Electrical and Computer Engineering, University of Minnesota.