Performance Analysis of Multi-carrier CDMA with 2 by 7 MIMO diversity techniques in Different Modulation Technique

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Abstract- *In this thesis we estimate the performance analysis of Multi-carrier modulation of CDMA with 2 by 7 MIMO technique systems in Rayleigh fading channel in multiple numbers of modulation techniques using MATLAB to determine optimized BER. Code Division for Multiple Access (CDMA) is a multiple user method that performs the spread spectrum system in which spreading of sequence done from PN sequence generator that will be designed in through random number generation. This system then combined with OFDM called multi-carrier system in which multiple number of broadband frequency selective carrier signals is transformed into parallel flat fading narrowband multiple sub-carriers to raise the performance of system, additionally their amalgamation of systems forms MC-CDMA system. Now collection further improved by means of implementing 2 by 7 MIMO system which means two transmit as well as seven receive antennas respectively that utilizes the ZF decoder at the receiver to decrease the bit-error-rate throughout transmit diversity of ½ rate convolutionally encoded Alamouti Space Time Block Code is consume which optimized the performance of the 4G in addition to 5G communication system throughout reducing BER as well as improving gain in 8-PSK, 8-QAM, QPSK, 16-QAM, 32-QAM along with 64-QAM modulation techniques.*

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

I. INTRODUCTION

MIMO MC-CDMA systems undergo from the MAI persuaded through the loss of orthogonality of multiplexed users in addition to inter-antenna interference (IAI) due to multiple antennas. In MIMO MC-CDMA systems, the multiplexed signals cannot subsist openly separated at the receiver because there are no orthogonality limitations for the sent signals. Consequently the combining methods like MRC, EGC or MMSEC, which are used for dropping only MAI, for single-antenna MC-CDMA systems cannot be openly applied to MIMO MC-CDMA systems [4]. Because, in MIMO MC-CDMA systems, the recipient has to handle the IAI while MAI, it requires an additional equalization process to eradicate the interference among multiple antennas in addition to joint process.

For dependable MIMO MC - CDM A signal detection, a variety of detection algorithms have been planned. Traditionally, there are two grouping which consist of linear detections in addition to decision feedback (DF) detections called interference termination detections. Of course, maximum likelihood (ML) detection can be employed for MIMO MC-CDMA, although, here we just believe two detections system. This is because, differing to ML detection having exponential complication the linear in addition to DF detectors can make use of spatial filtering by means of lower as well as affordable complexity. Primary, the linear detector in general based on two standard ZF as well as MMSE, that consists of symbol-level as well as chip-level linear detector. In [4], symbol-level as well as chip-level linear detectors depends on MMSE criterion exist fully derived. The symbol-level linear detector, as well called linear multi-user detection, that has a fine performance, however it has high computational complexity at what time the system load is not complete and it in addition needs the information on the amount of active users in addition to the corresponding spreading code. Linear chip-level detector dependent on single-user detection offers more or less the equivalent performance as the symbol-level detector in a completely loaded system by means of lower complexity.

For DF detections as well as in the ZF/MMSE ordered successive interference cancellation (OSIC) detector, in addition known as chip-level ZF/MMSE V-BLAST detector, that has been projected in[13]. The projected OSIC detector performed on the basis of per subcarrier is applied to MIMOMC-CDMA systems through simple modification of OSIC detector in [14] intended for conformist MIMO systems. Because the interference cancellation is achieve before dispreading designed for MIMOMC-CDMA systems in addition to it cannot be perfectly terminate the other users' data symbol, it go through from MAI in addition to error propagation problem significantly. As a result the chip-level V-BLAST detector has inferior quality presentation than linear MMSE detector. In, MMSE nulling partial parallel interference cancellation (PIC) recipient was planned to diminish the error propagation trouble of chip-level OSIC detector. For additional enhancement in performance, an iterative symbol-level MMSE depends on detectors through parallel / serial interference cancellation (PIC / SIC) by means of soft-decision symbol get hold of from the channel decoder output be presented for coded MIMOMC-CDMA systems [4].

In this chapter, primary we give details on the linear detections as well as analyze the presentation of ZF as well as MMSE linear detections. Depends on derivations in preceding chapter, we shows an exact BER expression for MIMOMC-CDMA systems through ZF detection. Subsequent we propose the detection technique for MIMO MCCDMA systems. To diminish the high computational complexity of the symbol-level linear detection, we counsel a DF detector depends on noise-prediction technique. Also, we propose a partial MMSE-OSIC dependent multi-user detection.

II. THEORETICAL BACKGROUND

2.1. MIMO MC-CDMA

Within the spatial multiplexing architecture, MIMO systems can accomplish very towering data rates devoid of additional bandwidth or power consumption.

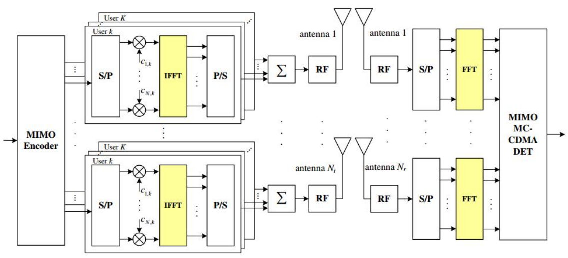

Figure1: The building block diagram of MIMO MC-CDMA systems.

MC-CDMA has the compensation such as elevated spectral efficiency in addition to robustness to frequency selectivity, as declared before. As collective multi-antenna through multi-carrier techniques, MIMO MC-CDMA systems accomplish supplementary bandwidth efficiency [15].

Figure 1 illustrate the building block diagram of a MIMO MC-CDMA system.

In the outline, MIMO encoder block can executed by space-time encoder otherwise MIMO spatial multiplexing coding.

2.2. System model

Figure 2 demonstrate the block diagram of the spatially layered MIMO MC-CDMA $\mathbf{n} = [n_1^{(1)} \cdots n_1^{(N)} \cdots n_{N_r}^{(1)} \cdots n_{N_r}^{(N)}]^T$ organization by means of Nt transmit antennas in addition to Nr receive antennas in the frequency domain. At the transmitter, all individual data of K dynamic users is primary modulated as well as spatially multiplexed. The spatially multiplexed information symbols of K users are spread through their specific spreading code by means of length N, ck for which Walsh Hadamard code is employed. The spatially multiplexed as well as spread signal vector can be able to be signify as

y=Hs+n=Hx+n (1)

by means of spatial code matrix as well as data symbol vector are defined, correspondingly as

$$\mathcal{C} = \mathbf{I}_{N_t} \otimes \mathbf{C}$$
$$\mathbf{x} = [\mathbf{x}_1^T \ \mathbf{x}_2^T \ \cdots \ \mathbf{x}_{N_t}^T]^T. \quad (2)$$

sl=[sl,1sl,2•••sl,N]T is the K – dimensional vector by means of sln representing the multiplexed data symbol by the side of n-th chip for the l-th transmit antenna, as well as xl=[x1,lx2,l•••xK,l]T refers the K – dimensional vector by means of , which consists of K active-users' symbol designed for the l-th transmit antenna. C=[c1,c2,•••,cK] refers to the spreading code matrix of size N×K through the column vector ck=[ck,1,ck,2,•••,ck,N]T, in which ckn refers to the n-th chip. Subsequent to spreading, the entire multiplexed information symbol is initially OFDM modulated as well as transmitted through multiple antennas.

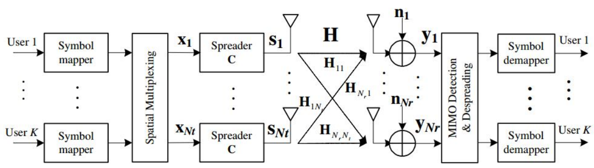

Figure2: The block representation of MIMO MC-CDMA systems by means of Nt transmit antennas as well as Nr receive antennas.

At the recipient side the incoming signal is primary sampled through period Ts in addition to the cyclic prefix is removed. The discrete Fourier transform (DFT) output signal vector $\mathbf{y} = [\mathbf{y}_1^T \mathbf{y}_2^T \cdots \mathbf{y}_{N_r}^T]^T$ is signify as

y=Hs+n=Hx+n (3)

by means of the channel matrix of dimension NrK×NtK, H, representing as

$$\mathbf{H} = \begin{bmatrix} \mathbf{H}_{11} & \cdots & \mathbf{H}_{1N_t} \\ \vdots & \ddots & \vdots \\ \mathbf{H}_{N_r1} & \cdots & \mathbf{H}_{N_rN_t} \end{bmatrix} \qquad (4)$$

Where ym =[ym1ym2•••ymN]T be the N-dimensional vector by means of ymn in place of the spatially multiplexed information symbol by the side of n-th chip for the Nr-th receive antenna,

$\mathbf{H}_{ml} = \mathrm{diag}\{H_{ml}^{(1)} H_{ml}^{(2)} \cdots H_{ml}^{(N)}\}$ is a N×N diagonal matrix by means of H(n), the complex channel frequency response intended for the n-th chip stuck between the transmit antenna l as well as the receive antenna m, as well as H=HC refers to the channel-spreading matrix of extent NrN×NtK. Lastly,

$\mathbf{s} = [\mathbf{s}_1^T \;\; \mathbf{s}_2^T \;\; \ldots \;\; \mathbf{s}_{N_t}^T]^T = \mathcal{C}\mathbf{x}$ – is the NrN dimensional vector where the element

refers to the complex Gaussian noise by means of zero mean in addition to variance N0 on n-th subcarrier for the m-th received antenna.

In accumulation, the received signal vector on the meticulous subcarrier equivalent to the k-th spreading chip at every one of the receive antenna is

y(n)=H(n)s(n)+n(n), (5)

where

$$\mathbf{y}^{(n)} = [y_{1n} \; y_{2n} \; \cdots \; y_{N_rn}]^T$$
$$\mathbf{H}^{(n)} = \begin{bmatrix} H_{11}^{(n)} & \cdots & H_{1N_t}^{(n)} \\ \vdots & \ddots & \vdots \\ H_{N_r1}^{(n)} & \cdots & H_{N_rN_t}^{(n)} \end{bmatrix}$$
$$\mathbf{s}^{(n)} = \left[\sum_{k=1}^{K} c_{k,n}x_{k,1} \sum_{k=1}^{K} c_{k,n}x_{k,2} \cdots \sum_{k=1}^{K} c_{k,n}x_{k,N_t}\right]^T$$
$$\tilde{\mathbf{n}}^{(n)} = [n_1^{(n)} \; n_2^{(n)} \; \cdots \; n_{N_r}^{(n)}]^T. \qquad (6)$$

III. SIMULATION RESULTS AND DISCUSSION

Table 1 describes the simulated model constraint of MIMO-MC-CDMA within QPSK, 8-PSK, 8-QAM, 16-QAM, 32-QAM and 64-QAM modulation practice. Figure.1. prove the recital examination of MIMO-MC-CDMA in 8-PSK, QPSK, 8-QAM, 16-QAM, 32-QAM in addition to 64-QAM modulation scheme, Table 2 prove the BER in addition to gain contrast in 64-QAM outcome demonstrate that QPSK have very near to the ground BER in addition to high gain in assessment to all supplementary modulation practice. This gain assessment is finished at -3-dB SNR since at 0-dB BER of QPSK accomplish to zero so elevated performance is accomplish in QPSK. Figure.1 prove MIMO-MC-CDMA in a variety of number of modulation practice. For 3G and 4G wireless communication to advance system recital we employ MIMO-MC-CDMA practice for accomplish high performance in QPSK modulation technique.

Table.1. Summary of simulated model constraint.

No. of bits transmitted by user	1560
No. of transmitting and receiving antennas	2*7
Modulation Schemes	QPSK, 8-PSK, 8-QAM, 16-QAM, 32-QAM and 64-QAM
Signal detection scheme	Zero forcing
Channel	Rayleigh Fading Channel
Signal to Noise Ratio	-10dB to 20 dB
CP Length	1280
OFDM Sub-carriers	6400

Table.2. Performance psychotherapy of 2 by 7MIMO-MC-CDMA in number of modulation technique in conditions of gain w.r.t 64-QAM with reference to fig.5.7 at -5dB SNR:

Modulation	BER	Gain w.r.t 64-QAM
QPSK	0.00384 6	36.178d B
8-QAM	0.04167	15.482d B
8-PSK	0.09026	8.768dB
16-QAM	0.1158	6.604dB
32-QAM	0.1955	2.055dB
64-QAM	0.2477	0dB

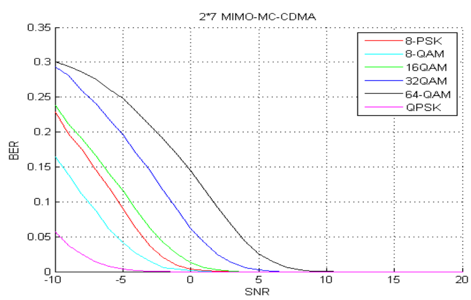

Figure.1. Performance psychotherapy of 2by7 MIMO-MC-CDMA in 8-PSK, 8-QAM, 16-QAM, 32-QAM, 64-QAM and QPSK.5.

IV. CONCLUSION

Fig.1 prove the qualified examination of MIMO-MC-CDMA in a variety of number of modulation methods that correspond to the comparative analysis for altered modulation techniques which shows that as modulation order is greater than before after that there is enlarge in BER. This hypothesis aims to minimize bit error rate which is correspond to QPSK modulation plan at the gain of 36.178 dB with reverence to 64-QAM that prove that the gain of QPSK is elevated as contrast to other modulation technique with a smaller amount of error. For 3G, 4G and 5G communication 64-QAM modulation format is utilized that enclose BER up to 10dB, that means errors are separated in 64-QAM at 10dB of SNR that marks by using 2 by 7 MIMO-MC-CDMA system. Finally 2 by 7 MIMO-MC-CDMA offer optimized output as match up to to other diversities in 64-QAM modulation technique that is primarily employed for 3G & 4G wireless communication.

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