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Performance Estimation of 2*1 MISO-MC-CDMA in Different Modulation Technique

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*In this research, we estimate the performance of a 2*1 MISO-MC-CDMA system in a Rayleigh fading channel using QPSK, 8-PSK, 8-QAM, 16-QAM, 32-QAM, and 64-QAM modulation schemes in MATLAB in order to lower the bit error rate (BER). CDMA is a multi-user technology that employs a spread spectrum system in which the transmitter's PN sequence generator is used to spread the sequence. This system is then integrated with OFDM (multi-carrier system), in which a single broadband frequency-selective carrier is converted into parallel narrowband flat-fading multiple sub-carriers in order to improve the system's performance, to form the MC-CDMA system. Implementing a 2*1 MISO system, consisting of two transmit antennas and one receive antenna, with a ZF decoder at the receiver to reduce bit error rate (BER) and transmit diversity 12 rate convolution ally encoded Altamonte STBC (Space Time Block Code) block code, optimises the performance of the 3G and 4G communication system by reducing BER and increasing gain.*

CDMA, OFDM, MISO, MISO-MC-CDMA, and MC-CDMA are terms of interest.

1. INTRODUCTION

By decreasing BER, the combination of CDMA, OFDM, and MISO enhances the system's performance. Therefore, the combination of OFDM and CDMA yields MC-CDMA, and the combination of MC-CDMA and MISO yields the highly optimised MISO-MC-CDMA system. This is a result of an increase in user demand for high data rates and low error probabilities in existing systems, so in this paper we use MISO, CDMA, and OFDM to enhance the technique by minimising error rate.

*Multiple Input Single Output (MISO) is a multiple antenna system that uses receive diversity and transmit diversity to synchronise the system and reduce ISI. The ZF equaliser is utilised to reduce mean square error and detect orthogonally. The 12 convolution ally-encoded Altamonte STBC block code is used for transmit diversity. Lastly, the above system is analysed in a Rayleigh fading channel using various modulation techniques [3].*2.

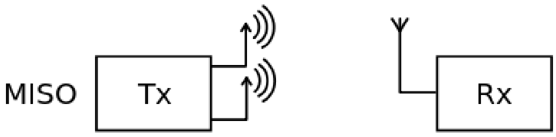
LITERATUE SURVEY

2.1. Multiple Input Single Outputs (MIMO)

MISO system consists of multiple transmitting and multiple receiving antennas for obtaining high data rates in multipath scattering settings with the existing transmission bandwidth or the existing total transmitted power of the system. Fig.1 depicts the MIMO channel of m transmit (Nt = m) and n receive (Nr = n) antennas.

MISO approaches give good data rates by spatial multiplexing by increasing the system's spectral efficiency, which is abundant in situations with abundant scattering, and by providing spatial diversity. The number of transmit-receive antenna pairs augments the capacity of a MIMO system. Consequently, this is known as spatial multiplexing architectures. The mathematically generalised received signal for the MIMO system is as follows:

$$\begin{bmatrix} r(1) \\ \cdot \\ \cdot \\ \cdot \\ r(Nr) \end{bmatrix} = \begin{bmatrix} h(1,1) & \cdot & \cdot & \cdot & h(1,Nt) \\ \cdot & \cdot & & & \cdot \\ \cdot & & \cdot & & \cdot \\ \cdot & & & \cdot & \cdot \\ h(Nr,1) & \cdot & \cdot & \cdot & h(Nr,Nt) \end{bmatrix} \begin{bmatrix} d(1) \\ \cdot \\ \cdot \\ \cdot \\ d(Nt) \end{bmatrix} + \begin{bmatrix} n(1) \\ \cdot \\ \cdot \\ \cdot \\ n(Nr) \end{bmatrix} \in C^{Nr*Nt} \quad \ldots\ldots(1)$$



Fig, 1: MISO channel.

The equation for the equivalent channel model to (1) is: r = He + n............................. (2) where e refers to the transmitted symbol of size Nt, n represents the noise vector of size Nr with zero mean and n2 variance, and H represents the Nr*Nt complex channel matrix with channel coefficient gains represented by hi,j, where j represents the transmit antenna and I represents the received antenna.

2.1.1 Spatial Multiplexing

Spatial multiplexing (SM) is a space-time multiplexing technology that uses symbol mapping. Before concurrent transmission over a wireless channel, spatial multiplexing divides a single bit stream into a number of concurrent sub streams that are translated into symbol streams using the proper constellation. The vertical vector represented by e = [e1 e2.............. eNt] is composed of many substreams. T € CNr*1...(3) holds the mapped symbols. This method depicts the vertical encoding scheme, often known as the encoding of input data into a vertical vector. Parallel transmit antennas are utilised for spatial multiplexing, and the transmission rate is higher than in systems with a single transmit antenna.

2.1.2 Linear Reconnaissance

Numerous antennas transmitting multiple substreams simultaneously can generate co-antenna interference, which can be masked using linear filtering (CAI). Using linear detection, we zero in on the signal of interest while suppressing all other symbols. This occurs for each substream. This article use a ZF filter to discover variety.

2.1.3 Spatial Variation

Using several transmitting and receiving antennas, the spatial diversity method transmits multiple copies of the same data over a fading channel. As indicated in Fig. 2, Space Time Code, i.e. Space Time Block Code (STBC), is combined with Alamouti 12-rate convolutionally encoded to improve system performance.

This study implements space-time block coding (STBC). In order to achieve spatial diversity and coding gain within the given bandwidth, STBC perform spatial correlation on signals delivered by numerous antennas.

Alamouti presented a transmit diversity scheme with low complexity for two transmit antennas. This technique is known as STBC and will eventually be generalised for any number of antennas. Multiple Access Code Division for Multiple Carriers (MC-CDMA) [1,6,4] is a hybrid of OFDM and CDMA. By modulating and distributing input data signals in frequency, this system enables multiple users to access the wireless channel simultaneously. MC-CDMA combines the advantages of multipath fading in OFDM and multi-user access in CDMA.

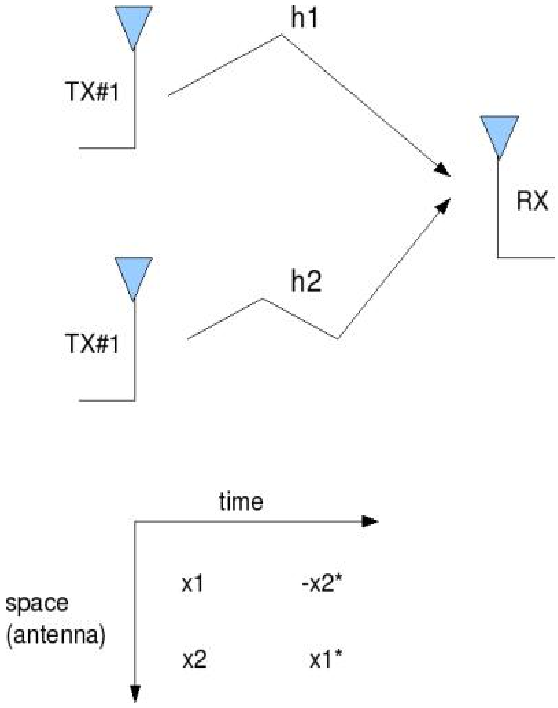


Fig. 2: Space-time coding (STC).

2.2.1 System Model

Figure 3 depicts the MC-CDMA [6,8] system transmitter for Nu users. The data are organised into Nu frames, with each frame containing P symbols. Therefore, the symbol matrix for nu user (nu = 1, 2,........Nu) is represented as dnu = [dnu,1 dnu,2............... dnu,P] T€ CP*1. Initially, the symbols of each user are transformed from serial to parallel before being spread with the equivalent user to build the chip-level transmit matrix, i.e. snu = [snu,1 snu,2.................... snu,PG]
= dnu ⊗ cnu € C1*PG...........................(14), where represents the Kronecker product and the signature sequence of user nu is expressed by cnu =[cnu,1 cnu,2......... cnu,G]. € C1*G …. C represents the alphabet of the spreading code chip, while G represents the length of the spreading sequence. To distinguish the users, each has a unique spreading code for maintaining orthogonality between users. The IFFT transforms the combination of chips from each user's frame and all parallel data sequences from the frequency domain to the time domain. i(p, g) = (p - 1)G + g................... (16) It should be noted that the subcarrier index I symbol index p, and chip index g are interconnected by i(p, g) = (p - 1)G + g................... (16). Therefore, the equivalent symbol and chip indexes for the i-th subcarrier are p(i) = I - 1)modG + 1..................(17) and g(i) = +1..................... where represents the largest positive integer that is less than a. The i-th multiplexed chip transmitted by all users is represented as xi = nu,i= nu,g(i)dnu,p (i) … .. (19) The CP is added following IFFT output prior to transmission via a wireless multipath fading channel. This channel is known as a quasi-static channel with a standard deviation of N0 and AWGN noise addition. CP is employed to eliminate ISI in MC-CDMA.

At the receiver, CP is eliminated using an FFT of size Ns. After FFT, the received signal model can be represented as ri = Hixi + ni. … ………………………. yi=Hi-1ri=Hi-1Hixi+Hi-1ni=xi+i yields orthogonality detection. … …….. The intended user then despreads the identified chips, whose spreading sequence can be analysed as znu,p = nu,gy(i)=dnu,p+ nu,g I (22) The symbol detection for the nu-th number of users is accomplished by slicing znu,p using the quantization operation Q(.) or the Q function, depending on the type of constellation in use dnu,p = Q(znu,p) (23)

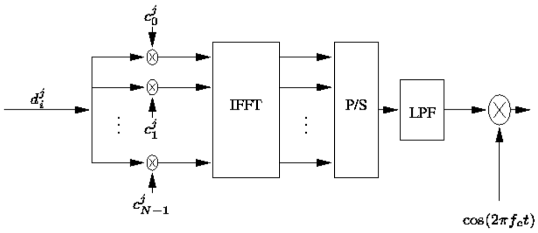


Fig. 3: Multiuser MC-CDMA transmitter.

SYSTEM MODEL 3.

Figure 4 depicts the MISO-MC-CDMA communication system model utilised in this paper.

In this system, the user provides random input to the system model, making this data source random. Now, due to the MC-CDMA system, spreading is accomplished by the creation of PN sequences, hence this spreader is utilised. The modulator block depicts the various modulation schemes currently in use, including QPSK, 8-PSK, 8-QAM, 16-QAM, 32-QAM, and 64-QAM. In section 2, the MC-CDMA system is presented in depth. Currently, the MISO encoder 12 rate convolutionally encoded Alamouti's STBC block code is in use, as described in section 2. 1.Multiple Input Multiple Output (MIMO). The block diagram for the formation of MISO-MC-CDMA is shown in Fig. 4. Now, the signal is transmitted via the Rayleigh Fading Channel [9]. After detecting the signal's orthogonality with a ZF receiver, the reverse process is performed at the receiver to regenerate the transmitted signal, and BER calculations are performed for system analysis. Two transmit antennas and one receive antenna are utilised in the MISO system. The STBC block code of Alamouti is used as transmit diversity at the transmitter. Now, results are compared using 64-QAM to determine gain for the various modulation techniques mentioned previously.

4. SIMULATION RESULTS AND DISCUSSION:

The input simulated model parameters of MISO-MC-CDMA [1,9,10,5] in various modulation techniques are displayed in Table 1.

Table 2 compares the BER and gain of 64-QAM at a signal-to-noise ratio of 3 dB, revealing that QPSK has the lowest BER and the highest gain compared to all other modulation techniques. This gain comparison is performed with a 3-dB SNR since the BER of QPSK modulation becomes zero at a 5-dB SNR, indicating that QPSK modulation achieves good performance. Figure 5 depicts MISO-MC-CDMA with various modulation techniques. For 3G and 4G wireless communications, if we want to improve system performance with a low error probability, we employ the MISO-MC-CDMA approach with QPSK modulation to achieve high performance.

d^nu,p = Q (znu,p) ………………………(23)

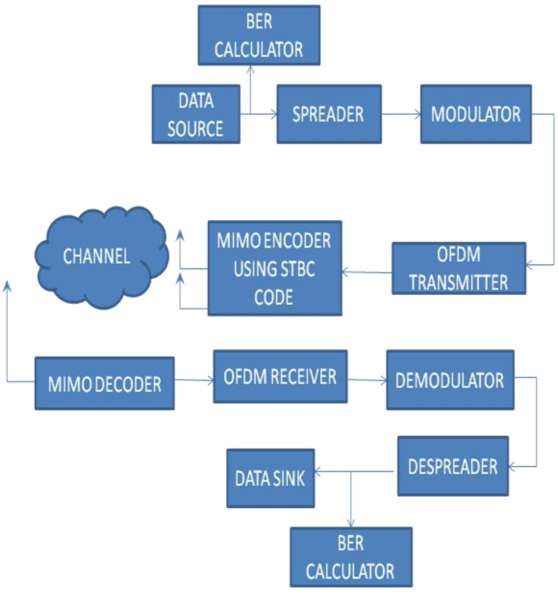


Fig.4. Communication System Model OF 2*1 MISO-MC-CDMA

Table:1. Summary of simulated model parameters.

No. of transmitting and receiving antennas	2*1
Channel Encoder	½ rate convolution encoder
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 analysis of MISO-MC-CDMA in different modulation technique in terms of gain w.r.t 64-QAM with reference to fig.5 in 3dB SNR:

Modulation	BER	Gain w.r.t 64-QAM
QPSK	**0.004808**	**17.25dB**
8-QAM	**0.05269**	**6.8549dB**
8-PSK	**0.08526**	**4.764dB**
16-QAM	**0.1291**	**2.963dB**
32-QAM	**0.2097**	**0.8562dB**
64-QAM	**0.2554**	**0dB**

5. DESCRIPTION

Figure 5 compares the performance of MISO-MC-CDMA with various modulation strategies, and Table 2 compares the BER and gain of various modulation techniques relative to 64-QAM with a 3dB SNR. Based on Table 2 and Figure 5, we can conclude that the performance of MISO-MC-CDMA utilising the QPSK modulation approach is superior to other modulation techniques in terms of error probability and gain. For 3G and 4G communications, we can therefore prefer the QPSK modulation method.

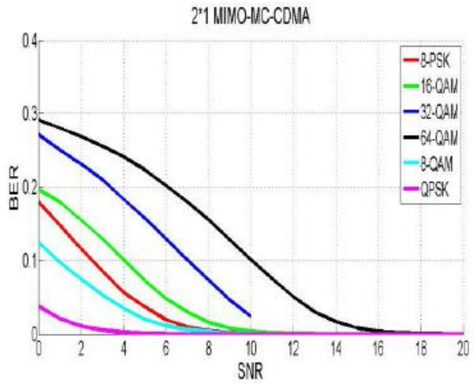


Fig.5. Performance investigation of 2*1 MISO-MC-CDMA in *different modulation schemes*

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