Space Time Block Coding With Monte Carlo for Performance Enhancement on MIMO-OFDM System

[1]Himanshu Khare, [2]Prof. Anshuj Jain
[1]M.Tech Scholar, Department of Electronics and Communication, Scope College of Engineering, Bhopal, India
[2]Associate Professor, Department of Electronics and Communication, Scope College of Engineering, Bhopal, India.

Abstract : Analysis on numerous researches on MIMO-OFDM system so as to achieve the higher system performance is standard that the performance of the wireless communication systems can be enhanced by utilization multiple transmit and receive antennas (MIMO), that is typically supposed because the MIMO-OFDM has been included. The Alamouti STBC may be a promising approach to achieve higher SNR within the wireless communications system exploitation MIMO. To extend the code rate and also the output of the orthogonal space time block code for over 4 transmit antennas is analyzed. The designed system is outperformed once imposed with M-PSK (i.e upto 128-PSK) modulation. The system organized and tested for 4xN, wherever N is variety of receiver antennas. This paper proposed STBC method with monte carlo function for channel estimation calculations for LTE Downlink frameworks. This incorporates channel estimation utilizing pilot symbols and able to give lower bit error ratio.

IndexTerms – STBC, Channel, SNR, BER, OFDM, MIMO.

I. Introduction

In present day use, the expression "MIMO" demonstrates something beyond the nearness of multiple transmit antennas (multiple input) and multiple receive antennas (multiple output). While multiple transmit antennas can be utilized for beamforming, and multiple receive antennas can be utilized for assorted variety, "MIMO" alludes to the synchronous transmission of multiple signals (spatial multiplexing) to duplicate phantom proficiency.

Generally, radio specialists treated characteristic multipath spread as a weakness to be relieved. MIMO is the main radio innovation that treats multipath proliferation as a wonder to be abused. MIMO increases the limit of a radio connection by transmitting multiple signals over multiple, co-found antennas. This is practiced without the requirement for extra power or bandwidth. Space–time codes are utilized to guarantee that the signals transmitted over the various antennas are orthogonal to one another, making it simpler for the receiver to recognize one from another. In any event, when there is observable pathway access between two stations, double radio wire polarization might be utilized to guarantee that there is more than one vigorous way.

OFDM empowers dependable broadband correspondences by conveying client information over various firmly divided, narrowband subchannels.[1] This course of action makes it conceivable to dispose of the greatest impediment to solid broadband interchanges, intersymbol obstruction (ISI). ISI happens when the cover between back to back images is enormous contrasted with the images' span. Typically, high information rates require shorter term images, expanding the danger of ISI. By separating a high-rate information stream into various low-rate information streams, OFDM empowers longer span images. A cyclic prefix (CP) might be embedded to make a (period) watch interim that anticipates ISI altogether. In the event that the gatekeeper interim is longer than the defer spread—the distinction in postpones experienced by images transmitted over the channel—at that point there will be no cover between contiguous images and thus no intersymbol obstruction. In spite of the fact that the CP somewhat decreases ghostly limit by expending a little level of the accessible bandwidth, the end of ISI makes it an exceedingly advantageous tradeoff.

A key preferred position of OFDM is that fast Fourier transforms (FFTs) might be utilized to rearrange usage. Fourier transforms convert signals to and fro between the time area and frequency space. Subsequently, Fourier transforms can misuse the way that any mind boggling waveform might be deteriorated into a progression of basic sinusoids. In signal handling applications, discrete Fourier transforms (DFTs) are utilized to work on ongoing signal examples. DFTs might be applied to composite OFDM signals, maintaining a strategic distance from the requirement for the banks of oscillators and demodulators related with singular subcarriers. Fast Fourier transforms are numerical calculations utilized by PCs to perform DFT calculations.[2]

FFTs additionally empower OFDM to utilize bandwidth. The subchannels must be divided separated in frequency sufficiently only to guarantee that their time-space waveforms are orthogonal to one another. Practically speaking, this implies the subchannels are permitted to in part cover in frequency.

MIMO-OFDM is an especially ground-breaking mix in light of the fact that MIMO doesn't endeavor to alleviate multipath spread and OFDM stays away from the requirement for signal adjustment. MIMO-OFDM can accomplish high phantom productivity in any event, when the transmitter doesn't have channel state data (CSI). At the point when the transmitter possesses CSI (which can be gotten using preparing arrangements), it is conceivable to move toward the hypothetical channel limit. CSI might be utilized, for instance, to apportion diverse size signal groups of stars to the individual subcarriers, utilizing the correspondences channel at some random snapshot of time.

II. Description of STBC schemes

In a given Alamouti code block, two symbols of s1 and s2 are encoded using the following orthogonal matrix

$$\mathbf{A} = \begin{bmatrix} s_1 & s_2 \\ -s_2^* & s_1^* \end{bmatrix} \qquad \text{(Equation 1)}$$

The encoding matrix defines the transmission format with the row index indicating the antenna number and the column index indicating the OFDM symbol index (sub-carrier index) for STBC (for SFBC).

A) *Subcarrier mapping for STBC*

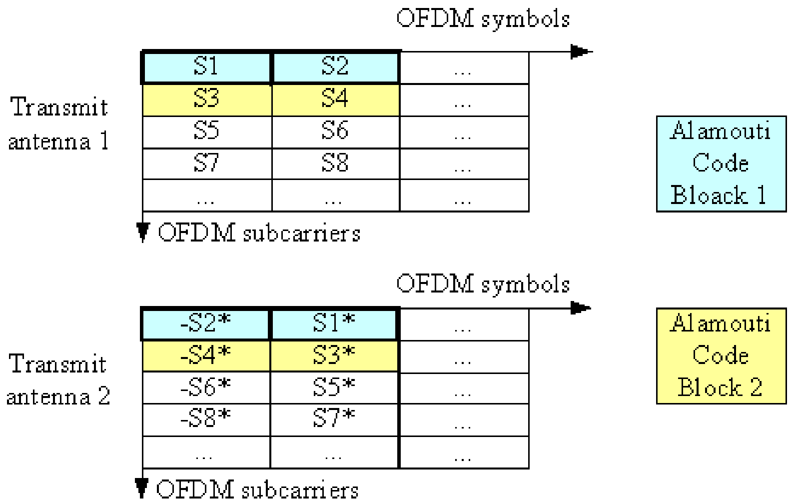

Figure 1: STBC encoding

For STBC, a pair of symbols, $s1$ and $s2$, are encoded into four variants, $s1$, $s2$, $-s2^*$, and $s1^*$. As illustrated in Figure 1, $s1$ is transmitted over a certain sub-carrier from antenna one, and $-s2^*$ is over the same subcarrier from antenna two. During the next OFDM symbol, $s2$ and $s1^*$ are mapped onto the same sub-carrier from the two antennas. That is, each symbol (or its positive/negative conjugate) is transmitted from two antennas and over two OFDM symbols.

III. SYSTEM TRANSMISSION MODEL

We take here a baseline configuration of MIMO with two transmit antennas and two receive antennas as an example to show the transmission model. The same principle is feasible for other MIMO configurations with two transmit antennas and multiple receive antennas. Assuming $\mathbf{H}^1 = \begin{pmatrix} h_{11}^1 & h_{12}^1 \\ h_{21}^1 & h_{22}^1 \end{pmatrix}$ and $\mathbf{H}^2 = \begin{pmatrix} h_{11}^2 & h_{12}^2 \\ h_{21}^2 & h_{22}^2 \end{pmatrix}$ be channel matrix of receive/transmit antenna pairs during the 1st and 2nd symbol/subcarrier intervals of Alamouti code, respectively. In the equations, h_{mn}^k denotes the channel fading coefficient between the m th receive antenna to the n th transmit one during the k th symbol/subcarrier intervals. Then, the MIMO channel is quasi-static if $\mathbf{H}^1 \approx \mathbf{H}^2$, otherwise the MIMO channel is selective.

A) *Quasi-static flat fading channel*

In the design of Alamouti code, quasi-static flat fading channels are assumed, which makes it possible to use simple decoder to achieve full spatial diversity. In this case, the received signals can be expressed as

$$Y^1 = \begin{bmatrix} y_1^1 \\ y_2^1 \end{bmatrix} = \mathbf{H}^1 \begin{bmatrix} s_1 \\ -s_2^* \end{bmatrix} + \begin{bmatrix} n_1^1 \\ n_2^1 \end{bmatrix} \quad \text{(Equation 2)}$$

and

$$Y^2 = \begin{bmatrix} y_1^2 \\ y_2^2 \end{bmatrix} \approx \mathbf{H}^1 \begin{bmatrix} s_2 \\ s_1^* \end{bmatrix} + \begin{bmatrix} n_1^2 \\ n_2^2 \end{bmatrix} \quad \text{(Equation 3)}$$

where $s_i\left(i=1,2\right)$ is the transmitted symbols, y_i^j $(i, j=1,2$) is the received signal during the j th symbol/subcarrier interval over i th antenna; h_{ij}^1 $(\text{i}=1,2$ and $j=1,\ldots,m)$ is the fading coefficient during the 1st symbol/subcarrier interval; and n_i^j is the additive Gaussian noise with zero mean - and variance - N_0 during the j th symbol interval over the i th antenna.

B) *Selective fading channel*

In a selective fading channel where the quasi-static assumption doesn't hold, the receive signals will be expressed as

$$Y^1 = \begin{bmatrix} y_1^1 \\ y_2^1 \end{bmatrix} = \mathbf{H}^1 \begin{bmatrix} s_1 \\ -s_2^* \end{bmatrix} + \begin{bmatrix} n_1^1 \\ n_2^1 \end{bmatrix} \quad \text{(Equation 4)}$$

and

$$Y^2 = \begin{bmatrix} y_1^2 \\ y_2^2 \end{bmatrix} = \mathbf{H}^2 \begin{bmatrix} s_2 \\ s_1^* \end{bmatrix} + \begin{bmatrix} n_1^2 \\ n_2^2 \end{bmatrix} \quad \text{(Equation 5)}$$

IV. SIMULATION AND RESULT

Table 1 represents all simulation parameters, which is used during simulation. Now simulate program with different M-PSK order. Result graph is showing considerable improvement in bit error rate and signal to noise ratio.

Table 1: Simulation Parameters

Parameter	Value
Number of transmit antennas	4
Number of receive antennas	8
Number of subcarriers	64
Guard interval percentage	1/4
M-PSK Modulation	8-128
Subcarrier space between two pilots	1
Signal to noise ratio	25 dB
Symbols	1000-2000
Number of transmit antennas	4

TX=4 AND RX=8 WITH 128-PSK AND ALAMOUTI STBC

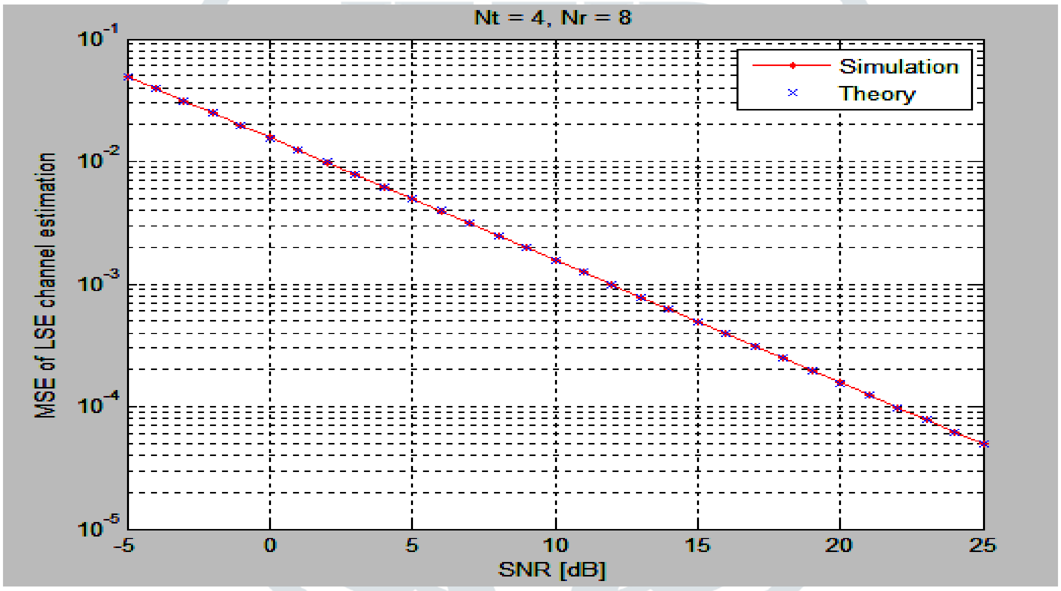

Figure 2: MSE vs SNR graph for Tx=4 and Rx=8 to

Figure 2 is showing output graph between mean square error and signal to noise ratio. To increasing SNR performance, MSE is decreasing, which is significant.

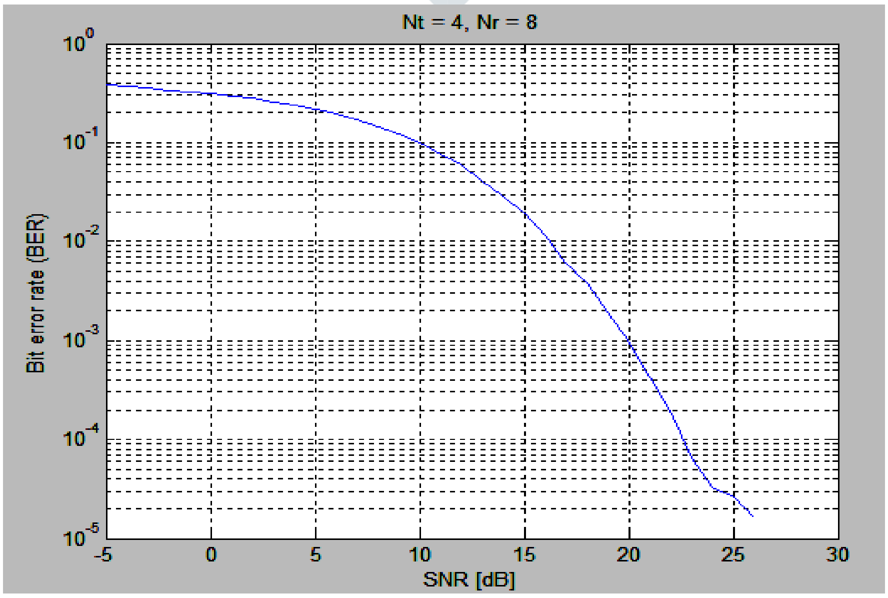

Figure 3: BER vs SNR Curve for Tx=4 and Rx=8 with 128-PSK with improved SNR

Figure 3 is showing output graph between bit error ratio and signal to noise ratio. Here modulation scheme is 128-PSK, after analyzing both graphs, it is clear that antenna combination of 4Tx8Rx gives better SNR (27dB) than previous approach. BER achieved $10^{-4.8}$, which is also improved.

Table 2: Simulation Result for 128 PSK with improvement

Tx-Rx Antenna	BER	MSE	Max .SNR
4Tx-8Rx	$10^{-4.8}$	$10^{-2.0}$	27

From table 2, it is can say that for significant performance of SNR as well as BER MIMO dimension 4Tx-8Rx is considerable and BER value is less than previous.

After simulation of 4Tx and M-Rx antenna configuration (where M=4,8,16,32,64,128). Table 3 shows that simulation result of proposed work and previous work and proposed work is better than previous work in terms of number of transmitter number of receiver antenna and BER, MSE and SNR.

Table 3: Comparison chart of proposed work with Base Work

Parameters	**Previous Work**	**Proposed Work**
Method	Spatial Phase Coding With CoMP	Alamouti-STBC
Modulation	Q-PSK	M-PSK (M=8 To 128)
BER	$10^{-4.5}$	$10^{-5.5}$
MSE	-	$10^{-2.0}$
SNR	-5 to 25 dB	-5 to 27 dB
Number of subcarriers	256	64
Throughput	1 bps	1.6 kbps
Tx Antenna	2	4
Rx Antenna	2	8

Therefore proposed work result is better than previous work so STBC-OFDM approach is considerable and significant result is achieved.

V. CONCLUSION

MIMO-OFDM is very promising technique to improve communication services. In this paper STBC approach is proposed to improve performance over MIMO-OFDM system. The evaluation of Alamouti code in MIMO-OFDM simulation with various TX and RX antenna is presented. Simulated results shows that proposed scheme better than Spatial Phase Coding with coordinated multi point transmission scheme. Result is calculated in terms of bit error rate and signal to noise ratio. Therefore antenna combination of 4T X 8Rx gives better SNR i.e 27dB and BER obtain $10^{-4.8}$.

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