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BER reduction using beam forming technique for Rayleigh fading channel

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Abstract— ***Wireless network become a part of everyday of life. Wireless LAN, cell phone network, and personal area network are just a example of widely used wireless networks. Wireless devices are range and data rate limited. The ever increasing demand for very high rate wireless data transmission calls for technologies. Space time block coding this is a new evolution for communication and finding the channels and use the multiple transmit antennas. Encoded data using by the space time block code. It is simultaneously transmitted by uses number of transmit antennas. It is uses the orthogonal structure of the space time block code. In this paper, the BER is analyzed for BPSK in Rayleigh channel with two transmit and one receive antenna for Alamouti STBC and with or without BER reduction technique (beamforming) case shown performance.***

Index Terms— ***MIMO, OFDM, STBC, Multipath, fading, beam forming .***

I. Introduction

The space time block coded orthogonal frequency division multiplexing (STBC-OFDM) system is a scheme for communications). The OFDM is becoming the chosen modulation technique for wireless communication. The orthogonal frequency division multiplexing (OFDM) can provided the large data rate with more robust. In an orthogonal frequency division multiplexing OFDM scheme, a large number of orthogonal, overlapping, narrowband sub-carriers all these are the transmitted in parallel. These are the divide the available transmission band-width. It is possible with orthogonal frequency division multiplexing (OFDM) to have the overlapping sub channel in frequency domain, thus increasing transmission rate. The main advantage of OFDM is its ability to convert a frequency selective finding channel into several nearly flat fading channel and high spectral efficiency. The Rayleigh distribution is a good model for channel propagation, where there is no strong line-of-sight path from the transmitter to the receiver. This can be used to represent the channel conditions seen on a busy street in a city, where the base station is hidden behind a building several blocks away and the arriving signal is bouncing off many scattering objects in the local area. Technically speaking, beam forming technology is based on digital signal processing (DSP) logic and MIMO technology. Beam forming can determine the right direction of the given device. To do this, a transmitter changes the phase and relative amplitude of the signal. I use the beam forming technique to reduce this problem in my paper work.

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II. SYSTEM MODEL

We consider a multiple antenna wireless communication system, in this model there is a two transmit antenna and one receive antenna, we send the signal from two transmit antenna and receive the signal from one antenna. h_1 and h_2 is the channel impulse response and R_x is the receiving antenna. When we apply the beam forming we multiply the symbol from each transmit antenna with a complex number corresponding to the inverse of the phase of the channel to ensure that the signals add constructively at the receiver. The received signal is as follows,

On the receive antenna, the received signal is,

$$y = [h_1 \;\; h_2] \begin{bmatrix} x \\ x \end{bmatrix} + n,$$

$$y = \underbrace{(h_1 + h_2)}\, x + n$$

Where,

y Is the received symbol,
h_i Is the channel on the i^{th} transmit antenna,
x Is the transmitted symbol and
n Is the noise on the receive antenna.

When transmit beam forming is applied, we multiply the symbol from each transmit antenna with a complex number corresponding to the inverse of the phase of the channel so as to ensure that the signals add constructively at the receiver. In this scenario, the received signal is,

$$y = [h_1 + h_2] \begin{bmatrix} e^{-j\theta_1} \\ e^{-j\theta_2} \end{bmatrix} x + n$$

Where,

$$h_1 = |h_1| e^{j\theta_1}$$

$$h_2 = |h_2| e^{j\theta_1}$$

In this case, the signal at the receiver is,

$$y = \underbrace{(|h_1| + |h_2|)}\; x + n \;\; .$$

For equalization, we need to divide the received symbol y with the new effective channel, i.e.

$$\hat{y} = \frac{y}{(|h_1| + |h_2|)} = x + \frac{n}{(|h_1| + |h_2|)}.$$

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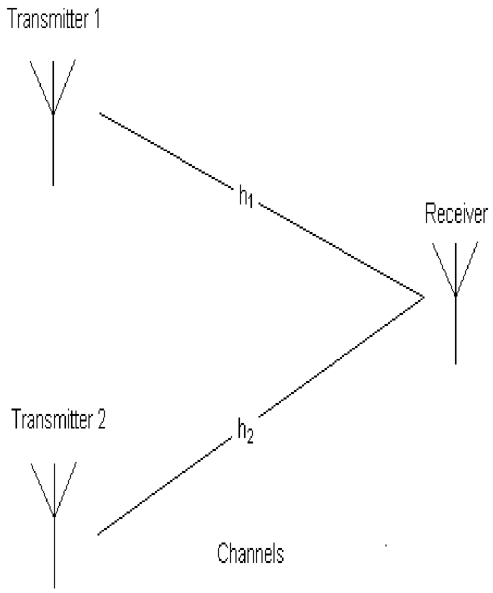


Fig 1: 2transmit & 1 receive antenna $(2T_x - 1R_x)$

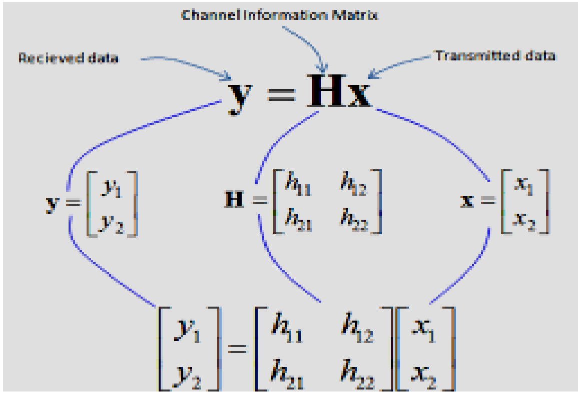


Fig 2-received data & transmit data

III. MIMO STBC OFDM SYSTEM WITH BEAAMFORMING

In this MIMO STBC OFDM SYSTEM WITH BEAAMFORMING TECHNIQUE the ofdm symbol on Kth carrier and lth antenna is as follows,

Where $a_k^l = \sum_{i=0}^{N-1} x_i e^{j2\pi \frac{i}{N}k}$

Where x_i is data symbol for ith subcarrier ,each a_k^l make block of ofdm symbol of lth antenna where k = 0 to N-1 and we use N carrier so length of OFDM symbol N times the period of single data symbol , after this beam forming technique process is as follow,

a_k^l (Beam)=$avg\ value,\ if\ a_k^l > avgvalue$ a_k^l (Beam)=$-avg\ value, if\ a_k^l < -avg\ value$

The effect on OFDM (orthogonal frequency division multiplexing) symbol in with-out beamforming technique

$if\ a_k^l > avg\ value$

$a_k^l = a_k^l + noise$

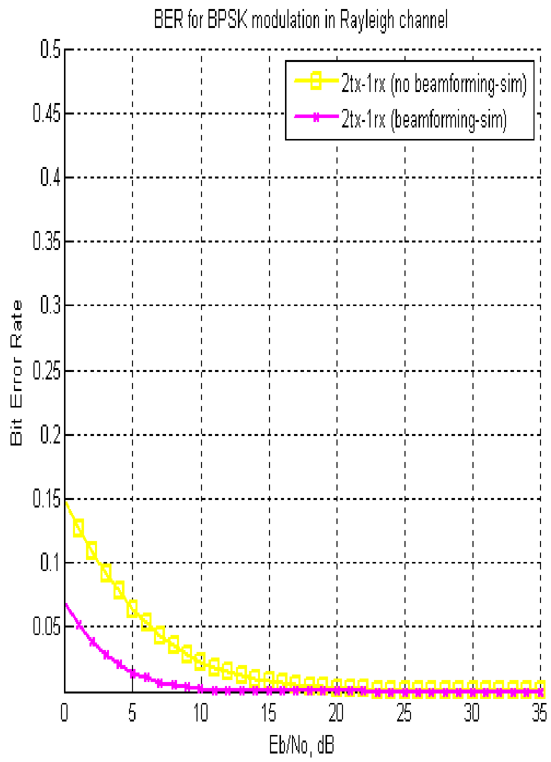
$if\ a_k^l < -avg\ value\ a_k^l = a_k^l + noise.$

IV PERFORMANCE ANALISES AND DISCUSSION

We present beam forming designs for multiuser MIMO-OFDM where the transmit and receive beam former is obtained iteratively with closed-form steps. In the first case, the transmit (Tx) beamformer is set and then they receive (Rx) beam former is calculated. The result shows that MIMO-STBC-OFDM system in with beam forming produce a better result than MIMO-STBC-OFDM system in without beam forming. Result shows that at the zero SNR value BER for MIMO-STBC-OFDM (2Tx-1Rx) system with beam forming, in with beam forming is 0.0671 and for without beam forming is 0.1464.This shows the system in with beam forming produce better result than without beam forming.

Table1:- MIMO-STBC-OFDM system comparison in with beam forming or without beam forming

SNR (db)	**Result with beam forming $(2T_x - 1R_x)$**	**Result without beam forming $(2T_x - 1R_x)$**
0	0.067167	0.1464
1	0.051803	0.1264
2	0.0387	0.1088
3	0.0287	0.0923
4	0.0209	0.0767
5	0.0148	0.0640
6	0.0102	0.0528



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