Volume 5, Issue 6, June 2015 ISSN: 2277 128X
International Journal of Advanced Research in Computer Science and Software Engineering
Research Paper
Available online at: www.ijarcsse.com

Comparison of Beamforming Techniques of MISO over Rayleigh Fading Channel

Asst. Prof. Deepak Bicholia, Mohd. Abuzer Khan
Dept. of E&TC Engineering, IES, IPS Academy
Indore [M.P] India

Abstract— ***Over the last decade, there has been a tremendous growth in the wireless communication industry. In this new information age, high data rate and strong reliability features are becoming the dominant factor for a successful deployment of business-related networks. Multiple Input Multiple Output - Orthogonal Frequency Division Multiplexing , a new wireless broadband technology gain great popularity for its capability of high rate transmission and its robustness against multi-path fading and other channel impairments. The focus of this paper is to simulate a Time Variant Frequency Selective, MISO model for low velocity in the mobile environment. Space time modulation technique have been employed in single receiver and multiple transmitters i.e., Multiple Input Single Output (MISO) system which provide transmit diversity. Multiple receiver antenna bring in the concept of antenna combining where the data can be combined at each antenna by various methods. In this paper, we are going to analysis three methods of transmission diversity namely, EGT, SDT & MRC. The simulation carried in two channel namely, AWGN and Rayleigh Fading channel. We analysed various case for BER (Bit Error Rate) v/s SNR (Signal to Noise Ratio). After comparison of transmitter diversity beam forming techniques, we found, the MRT is the best diversity technique over Rayleigh fading channel as compare to EGT & SDT.***

Keywords— MISO, BER, SNR, EGT, SDT, MRT & BPSK.

I. INTRODUCTION

MIMO systems are with Multiple Element Antennas (MEAs) at both link ends. Originally suggested in Winters [1987], they fascinated great consideration during theoretical investigations in the 1990s ([Foschini and Gans 1998] and [Telatar 1999]). Since that time, research in these systems has exploded and practical systems based on MIMO have been developed.

The MEAs of a MIMO system can be used four different purposes: (i) diversity, (ii), interference suppression (iii) beam forming and (iv) spatial multiplexing. The first 3 concepts are the equal as for (smart antennas) SA. Having assorted antennas at both connect ends leads to some fascinating new technological potential, but doesn't modify the elementary effects of this approach.

Spatial multiplexing (SP), on the other hand, is a innovative idea, and has thus haggard the most awareness. It allows unswerving enhancement of capability by concurrent spread of various information stream.

In the early years of MIMO research, the main emphasis was on information- theoretic limits, and this section will also mostly concentrate on these aspects. After 2000, emphasis shifted more to the question of how the theoretical gains of MIMO can be realized in practice. Advance in practical implementation of MIMO systems have also greatly helped in their adoption by international standard organization. MIMO and MISO was included in 4thG cellular systems as well as high - throughput wireless LANs.

The main objective to write this paper is, to compare the beam forming techniques of MISO system.

A. Comparison of channel capacities of SISO,SIMO and MISO systems

According to Shannon, the limit on the channel capacity:-

$$C = B\ \log_2(1 + SNR) \tag{1.1}$$

This is the SISO system. For the SIMO system, we have M antennas at the receiver end. Suppose the signals received on these antennas have the same amplitude on average. Then they can be added coherently to produce M^2 times increase in the signal power. Hence, the increase in SNR is equivalent to:-

$$SNR \approx \frac{M^2 .\ (signal\ power)}{M\ .\ Noise} = M\ .SNR \tag{1.2}$$

So, the channel capacity becomes:-

$$C = B\ \log_2(1 + M\ .\ SNR) \tag{1.3}$$

For the MISO system, we have N transmitting antennas. The total transmitted power is divided into N branches. There is only one receiving antenna and the noise level is the same as in the SISO case.

Thus, the overall increase in SNR is approximately:-

$$SNR \approx \frac{N^2 .\ (signal\ power/N)}{Noise} = N\ .SNR \tag{1.4}$$

Thus, the channel capacity for this case is:-

$$C = B\ \log_2(1 + N\ .\ SNR) \quad (1.5)$$

By analyzing the given equations above, it can be accomplished (conclude) that the channel capacity for the MISO system is higher.

B. Purpose of using smart antenna

Smart antennas can be used for various purpose:-

- Increase of coverage.
- Increase of capacity.
- Improvement of link quality.
- Decrease of delay dispersion.
- Improvement of user position estimation.

C. Types of System

Presently, four different types of systems can be categorized as far as diversity is concerned.

- Single input-single output (SISO): No diversity.
- Single input-multiple outputs (SIMO): Receiver diversity.
- Multiple inputs-single output (MISO): Transmit diversity.
- Multiple inputs-multiple outputs (MIMO): Transmit receive diversity.

The SISO system is very simple and deals with communication between transmitter and a receiver. In SISO, error probability is critically damaged by fading. Other diversity techniques, such as SIMO and MISO systems, are also represented conceptually in Fig. 1 and Fig. 2 which is given below.

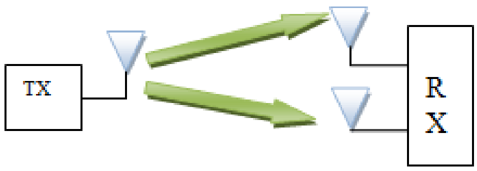

Fig. 1 SIMO

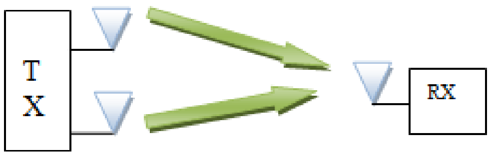

Fig. 2 MISO

In SIMO channel, the concept of MRC, as a way to exploit the receiver diversity is offered. The error probability achieved by the MRC is to be much smaller than the one corresponding to the SISO channel. To perform MRC, the receiver has to know the fading or, in other words, the receiver has to have access to the channel state information (CSI). Full CSI means the knowledge of the complete channel transfer function. Partial CSI provides limited channel information. This is usually done by sending some known signal through the channel.

The multipath environment is such that up to L signals arrive at each base station antenna from different mobile terminal (l) from different amplitudes (α_l) and phase $(\emptyset_l)$ at different delays (τ_l) from different direction (θ_l). These are in general time invariant and, as a result, the channel impulse response (CIR) for each antenna is usually represented by:-

$$h(t) = \sum_{l=1}^{L}[\,\alpha_l(t)e^{j\emptyset(t)}]\delta[(t - \tau_l(t)]a[\theta_l(t)] \quad (1.6)$$

Here it should be noted that the channel impulse response is now a vector rather a scalar function of time. Further, $a[\theta_l(t)]$ is nothing but an array response vector and will have K different components if there are K antenna elements of the receiving antennas array. Thus, there K channel impulse response each with L multipath components. The amplitude are usually assumed to be Rayleigh distributed although they are now dependent on the array response vector $a[\theta_l(t)]$ as well.

When there are l antenna element in a mobile terminal and one base station antenna element, it makes an MISO channel. In this case, the channel impulse response is an $l \times 1$ matrix. When there are l mobile terminals, transmitting at a time and K base station antenna elements to receive them all, it makes an MIMO channel. In this case, the channel impulse response is an $l \times K$ matrix that associates a transmission coefficient between each pair of antennas for each multipath component.

In MISO specifically, the beam-forming technique is analysed. The beam forming is nothing but directional reception of waves. By beam forming, one can increase the average SNR through focusing the energy into desired directions.

II. A BRIEF LITERATURE SURVEY

Guglielmo Marconi demonstrated the first NLOS wireless communication system in 1896 by communicating over a hill. From that day onwards, engineers viewed multipath signals as a serious problem. The first paper describing wireless MIMO's capacity was published 100 years later in 1996 in Global Communication Conferences Proceedings.

In wireless mobile radio communication, there is an never-ending pursue for improved capacity and improved quality. Hence, MIMO is of greatest importance today's scenario, especially for 4G. Multiple antenna systems became popular roughly a decade ago. There are two researchers Thomas Kailath and Arogyaswami Paulraj were first who propose the use of SM (spatial multiplexing) using MISO in 1993 and US patent was granted.

III. PROPOSED SYSTEM MODEL

Multiple input-single output (MISO) is also known by transmit diversity. In the case of MISO system the replicas of the information is transmitted via multiple antennas or two transmitter antennas redundantly. Then receiver receive the information via single antenna and extract the required data.

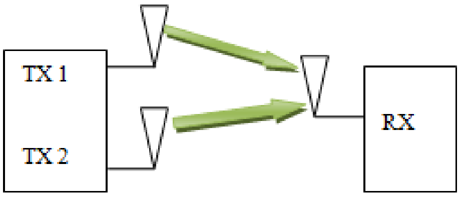

Fig. 3 Block diagram of MISO system

The conceptual block diagram of MISO system is shown in the Fig. 4 which is given below.

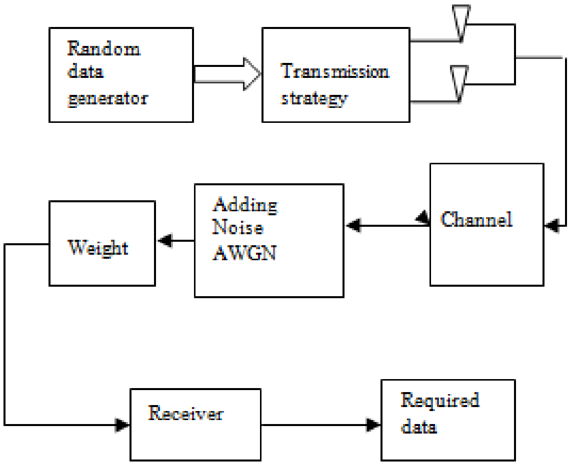

Fig. 4 Conceptual block diagram of MISO system

From the conceptual block diagram it is clear that we need to deal with the three transmission strategy or three transmission techniques of MISO beam forming they are EGT (Equal Gain Transmission), SDT (Selection Diversity Transmission) and MRT (Maximum Ratio Transmission).

At the transmitter side when multiple antennas are available, the techniques that is called beam forming techniques are used such as equal gain transmission (EGT), selection diversity transmission (SDT) and maximum ratio transmission (MRT) to utilize the available diversity from the MISO wireless channels.

IV. SIMULATION PARAMETERS & RESULTS

A. Simulation Parameters

TABLE I SIMULATION PARAMETERS

No. of bits	1000
Fading Channels	Rayleigh & AWGN channel
Signal constellation	BPSK
No. of transmitter	2
No. of receiver	1
SNR	0:1:12
Transmission techniques	EGT, SDT and MRT

B. Results

As we already know that if BER decreases than BER performance will be increases or we can say that BER performance increases than SNR also increases or vice versa.

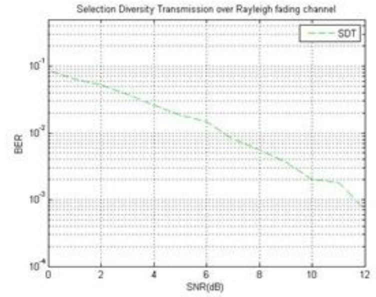

Fig. 5. BER performance of SDT over Rayleigh fading channel

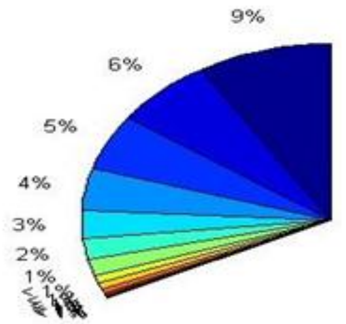

Fig. 6. Pie chart of SDT MISO technique

The EGT BER and pie chart graph are given below, which shows that EGT technique is better than SDT beam forming technique.

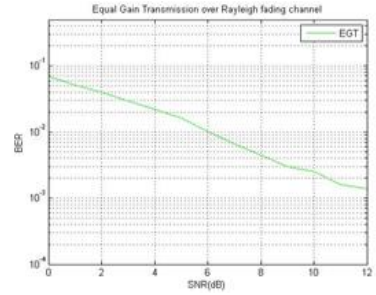

Fig. 7. BER performance of EGT over Rayleigh channel

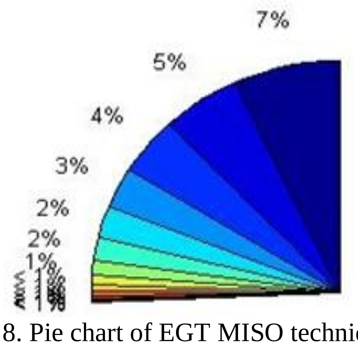

Fig. 8. Pie chart of EGT MISO technique

BER Vs. SNR analysis of MRT beam-forming technique curves are given in the figure 9 which is given below.

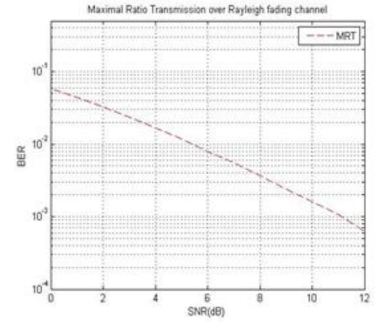

Fig. 9. BER performance of MRT over Rayleigh channel

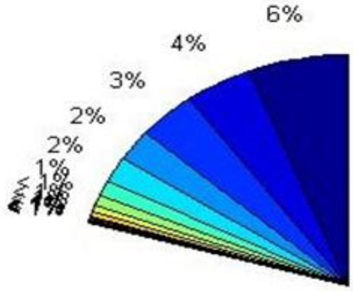

Fig. 8. Pie chart of EGT MISO technique

From the given graph above, it is clear that MRT is better as compare to SDT and EGT MISO beam-forming techniques.

TABLE III COMPARISON BETWEEN EGT, MRT AND SDT TECHNIQUES

SNR	***SDT (BER)***	***EGT (BER)***	***MRT (BER)***
0	9 %	7 %	6 %
2	6 %	5 %	4 %
4	5 %	4 %	3 %
6	4 %	3 %	2 %
8	3 %	2 %	1 %

From the above table we notice that in comparison of SDT, EGT and MRT beam-forming techniques of MISO smart antenna system, MRT is better as come to SDT and EGT techniques.

V. CONCLUSIONS

In this paper, the study of BER/SNR have been analysed using SDT, EGT and MRT beam-forming MISO transmission techniques. After analysing we conclude that MRT is better transmission technique in MISO system as compare to EGT and SDT where as EGT is better as compare to SDT transmission beam-forming technique.

REFERENCES

[1] Upena Dalal, *Wireless Communications*, Oxford Higher Education, 2009.
[2] David Smith, *Enginnering Computation with MATLAB*, International 3 Edition, 2012.
[3] Ben Lu, "*Performance Analysis & design optimization LDPC-coded MIMO OFDM systems*", IEEE Trans. on signal processing vol. 52, No. 2, pp. 348-361, feb. 2004.
[4] Yahong Rosazheng and chengshanxiao, "*Simulation model with correct statistical properties for Rayleigh fading channel*", IEEE Trans. on Communications vol. 51, pp. 920-928, June 2003.
[5] Ming xian chang, "*Performance Analysis of Equalized OFDM system in Rayleigh fading channel*", IEEE Trans. On Wireless Comm. Vol. 1 no. 4, pp 721-32 oct.-2002.
[6] Xiaoyi tang, "*Effect of channel estimation error on QAM, BER performance in Rayleigh fading*", IEEE Trans. on Communications, vol. 47, pp. 1856-64, Dec 1999.
[7] L. J. Cimini, Jr., "*Analysis and simulation of a digital mobile channel using orthogonal frequency division multiplexing*", IEEE Trans. on Communications., vol. 33, pp. 665-675, July 1985.
[8] Q. T. Zhang, Senior Member, IEEE, and S. H. Song, Member, IEEE, "*Exact Expression for the Coherence Bandwidth of Rayleigh Fading Channels*", IEEE Transactions on Communications, Vol. 55, No. 7, July 2007.
[9] A. Omri and R. Bouallegue, "*New Transmission Scheme for MIMO- OFDM System*", International Journal of Next-Generation Networks (IJNGN) Vol.3, No.1, March 2011.
[10] M. Ergen, *Introduction to Mobile Broadband. Individual Book Chapter*. Springer, New York, USA, 2009.
[11] S. Yi, Y. Li, T. Liangrui and W. Wenjin, "*Adaptive resource allocation algorithm based on IEEE 802.16 OFDM*", Seventh IEEE International Conference on Natural Computation, 2011.
[12] Mohamed A. Mohamed, Mohamed S. Abo-El-Seoud and Heba M. Abd-El-Atty, "*Performance Simulation of IEEE 802.16e WiMAX Physical Layer*" Seventh IEEE International Conference on Natural Computation, 2010 .