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Performance Evaluation Of Image Transmission Over WiMAX With MIMO Antenna Diversity Scheme

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Abstract— The image transmission over wireless communication channel is already explored by many researchers. Due to eye perception for only low frequency component the de-noising system may be add at receiver end of the wireless device. Multiple antenna can be used in order to obtain a multiplexing gain, a diversity gain, or an antenna gain, thus increasing the bit rate, the error performance of wireless systems. With a tremendous yearly publications, in the field of multiple-antenna communication systems, often called multiple-input multiple-output (MIMO) systems, has evolved rapidly. In this paper WiMAX system are used for image transmission and Modulation techniques. PSNR and RMSE are taken as two parameters for comparing the performance. The MIMO system is also used here with the 2x1 and 2x2 antenna system and QAM-16 for BER performance improvement.
Keywords- WiMAX, MIMO, STBC, QAM-16, Communication channel, Denoising technique, etc.

I. INTRODUCTION

In today's technology wireless communication is based on radio signals. Earlier, wireless applications were voice centric and demanded only moderate data rates, while most high rate applications such as file transfer or video streaming were wire line applications. In recent years, there has been a shift to wireless multimedia applications which is reflected in the convergence of digital wireless networks and the internet. In order to guarantee a certain quality of service, not only high bit rates are required, but also a good error performance. Due to the ill effects caused due to multipath signal propagation and fading effects, makes the task impossible at a same time. In particular, given a fixed bandwidth, there is always a fundamental tradeoff between bandwidth efficiency (high bit rates) and power efficiency (small error rates). Single-antenna transmission techniques aiming at an optimal wireless system performance operate in the time domain and/or in the frequency domain. So channel coding is used to mitigate the effects of fading. When utilizing multiple antennas, the previously unused spatial domain can be used. Focus of MIMO systems is to combine the signals at the receiver in such a way that the quality, bit error rate and data rate is improved. To achieve these improvements, both transmitter and receiver must be designed in a special way.

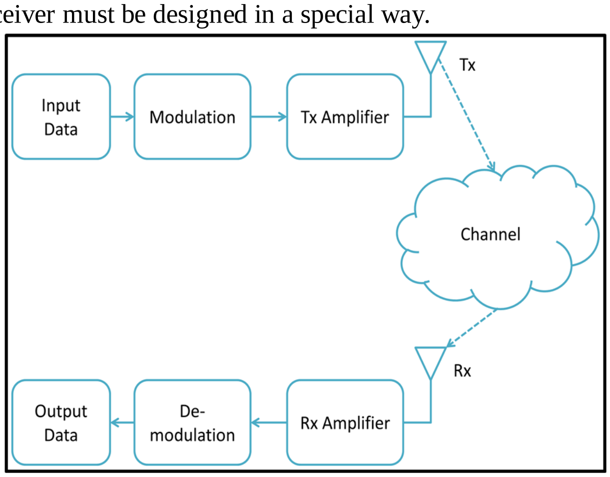

Fig. 1 Wireless communication system [8]

The performance of wireless communication systems is mainly governed by the wireless channel environment system. As opposed to the typical static and predictable characteristics of a wired channel, in the wireless channel is rather dynamic and unpredictable, in making an exact analysis of the wireless communication system often difficult. In optimization of the wireless communication system has become critical to the rapid growth of mobile communication services and broadband mobile Internet access services. In fact, the understanding of wireless communication channels will lay the foundation for the development of high performance and bandwidth-efficient wireless transmission technology.

The image transmission from one place to another place is most common since many decades. As requirement of communication goes up, the problem of channel behavior for data takes a major limiting role during communication. Today many wireless techniques such as WiMAX etc.

II. MULTIPLE-INPUT MULTIPLE-OUTPUT (MIMO) MODULE

MIMO systems are composed of three main elements, namely the transmitter (TX) side, the channel (H), and the receiver (RX) side. In this paper, Number of transmitter (Nt) is denoted as the number of antenna elements at the transmitter, and Number of receiver (Nr) is denoted as the number of elements at the receiver. Figure 1 depicts such MIMO scheme block diagram. It is worth noting that system is described in terms of the channel. The Multiple-Inputs are located at the output of the TX, and similarly, the Multiple-Outputs are located at the input of the RX.

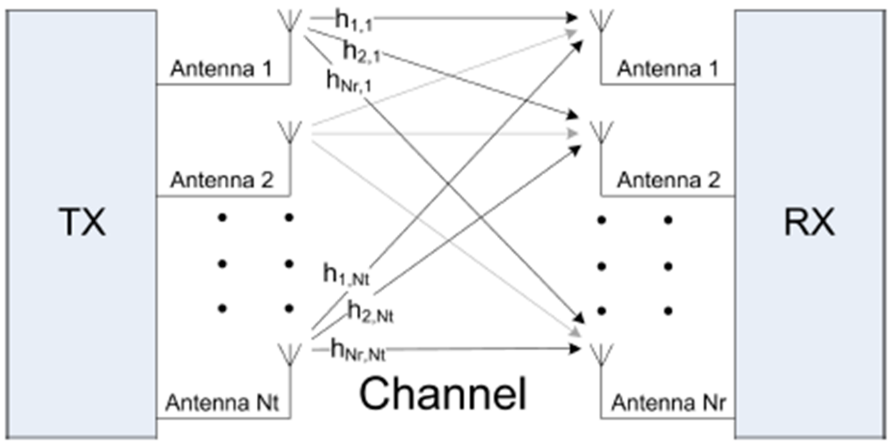

Fig. 2 MIMO system

A. MIMO Alamouti Space Time Block Code

The transmit diversity technique proposed by Alamouti was the first STBC (Space Time Block Code). The encoding and decoding operation is carried out in sets of two modulated symbols rate. Hence, the information data bits are first modulated and mapped into their corresponding constellation points. So, let us denote by x1 and x2 the two modulated symbols rate that enter the space–time encoder.

$$X_1 = \begin{bmatrix} x_1 & -x_2^* \\ x_2 & x_1^* \end{bmatrix} \qquad (1)$$

The coding matrix X1, and the subscript index gives the transmit rate compared to a SISO system. In Alamouti's system, the transmission rate is 1. In the rows of the coding matrix represent the transmit antennas while its columns correspond to different time instances process. It is clear that the encoding is done in both the space and time domains. The transmit sequence from antennas one and two by x^1 and x^2 respectively.

$$x^{t1} = [x_1, -x*_2]$$
$$x^{t2} = [x_2, x*_1]$$

The transmit sequences from the transmit antennas process are orthogonal, and the inner product of the sequences x^1 and x^2 is zero, i.e.

$$x^{t1}.x^{t2} = x_1 x*_2 - x*_2 x_1 \qquad (2)$$

Code matrix has the following as:

$$X.X^H = \begin{bmatrix} |x_1|^2 + |x_2|^2 & 0 \\ 0 & |x_1|^2 + |x_2|^2 \end{bmatrix} = (|x_1|^2 + |x_2|^2)\, I_2 \qquad (3)$$

Where I_2 is a 2×2 identity matrix

At the receive antenna, and the received signals over two consecutive symbol rate periods, denoted by r_1 and r_2 for time t and $t + T$,

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respectively, can be expressed as.

$$r_1 = h_1 x_1 + h_2 x_2 + n_1$$
$$r_2 = -h_1 x*_1 + h_2 x*_2 + n_2 \qquad (4)$$

III.TRANSMITTER AND RECEIVE SYSTEM

The idea of spatial multiplexing was first published in [2]. The basic principle of all spatial multiplexing schemes is taken above. The basic structure of a spatial multiplexing scheme is illustrated in fig.2. At transmitting side there are two scenarios to transmit the data. First one is that the transmitter has partial or full knowledge of the channel and uses it to obtain gain. Second one is that transmitter has no knowledge about the channel and uses coding schemes to obtain gain. In both the scenarios it is assumed that receiver has knowledge about the channel. There are 2 possibilities. (1) Knowledge of channel at the receiver is turned around and used at transmitter. (2) Knowledge of the channel at the receiver is fed back to the transmitter using a handshaking protocol. Now when the transmitter has no knowledge of the channel, then an algorithm should be selected accordingly.

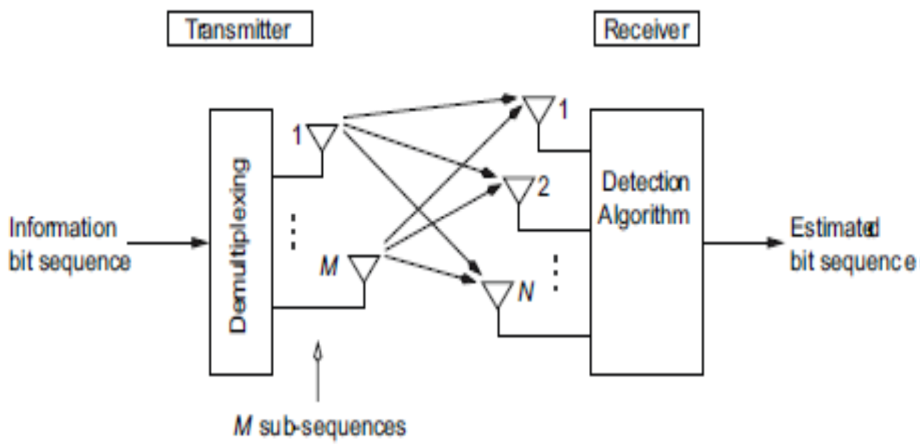

Fig-3 Basic principle of spatial multiplexing [7].

Transmitter encodes the bits over space and frequency and transmits these bits over multiple spatial channels. Interleaving and coding used to reduce the carrier-to-noise ratio for accurate detection. In the case of frequency-flat fading, there are several methods for the detection algorithm at the receiver, which is characterized by different trade-offs between performance and complexity. A low-complexity choice is to use a linear receiver, based on the zero-forcing (ZF) or the minimum mean-squared-error (MMSE) criterion. However, the error performance is typically poor, especially when the ZF approach is used. The optimum receiver in the sense of the maximum likelihood (ML) criterion performs a search over all possible combinations of transmitted bits and selects the most likely one. The ML detector achieves full spatial diversity with respect to the number of receiver antennas, irrespective of the number of transmit antennas used. The major drawback of the ML detector is its complexity of the ML detector is often prohibitive in a practical system.

IV.CHANNEL CODING

In order to guarantee a certain error performance for spatial multiplexing schemes, channel coding techniques are used. Most spatial multiplexing schemes use a channel coding structure that is composed of one-dimension encoders and decoders operating in the time domain. This is in contrast to space-time coding techniques like [3], [4], where two-dimensional coding is performed in time and space, i.e., across the individual transmit antennas. In principle, three different types of channel coding schemes can be used in conjunction with spatial multiplexing: Horizontal coding, vertical coding, or a combination of both.

V. RESULTS AND DISCUSSION

The performance of image transmission over MIMO-2 x 1, 2 x 2, and 2x4 using QAM-16 are implemented using MATLAB and graphical results are found showing the bit error rate probabilities of the systems, the parameters which are used to simulate these both proposed systems are shown in table 1

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Table 1. Parameters of MIMO

S. No.	Parameter	Value
1	IFFT	256
2	Modulation technique	QAM-16
3	No. of Bit	192
3	No. of Symbol	100
4	Carrier Rate	½

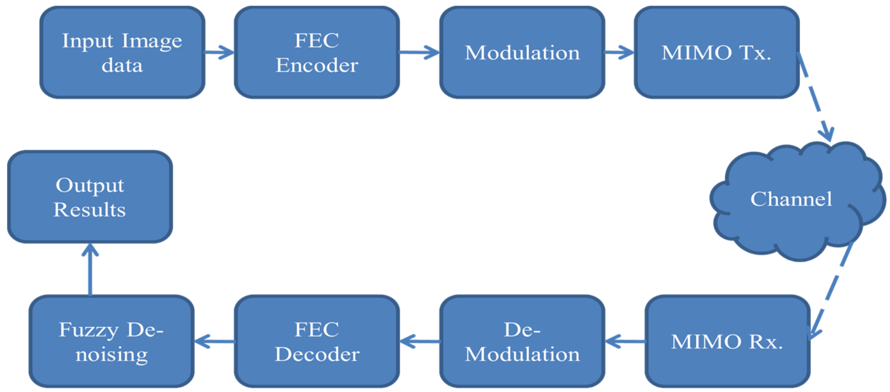

Fig. 4 System block Diagram

Fig. 5 Performance of Imaage transmit for MIMO using QAM-16 with WiMAX

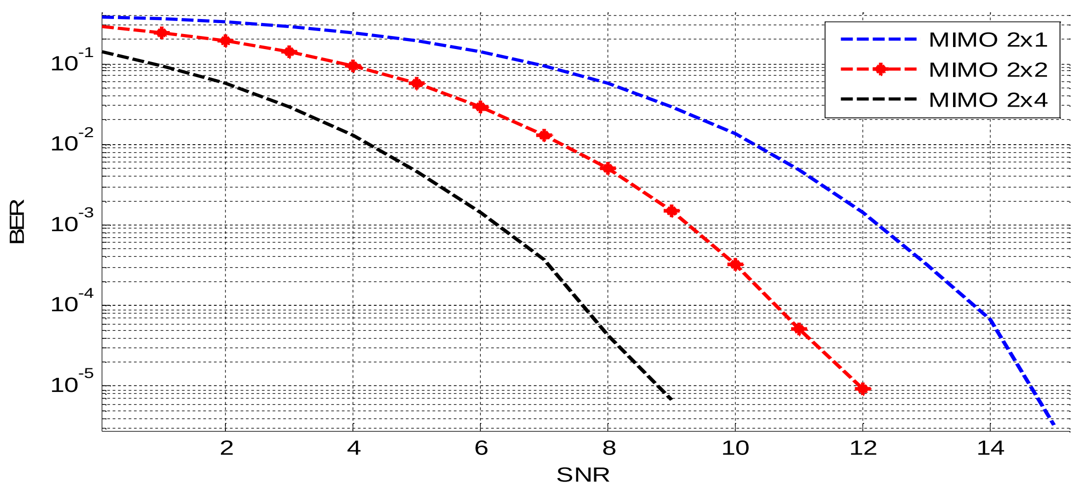

Fig. 6 Performance of BER to SNR

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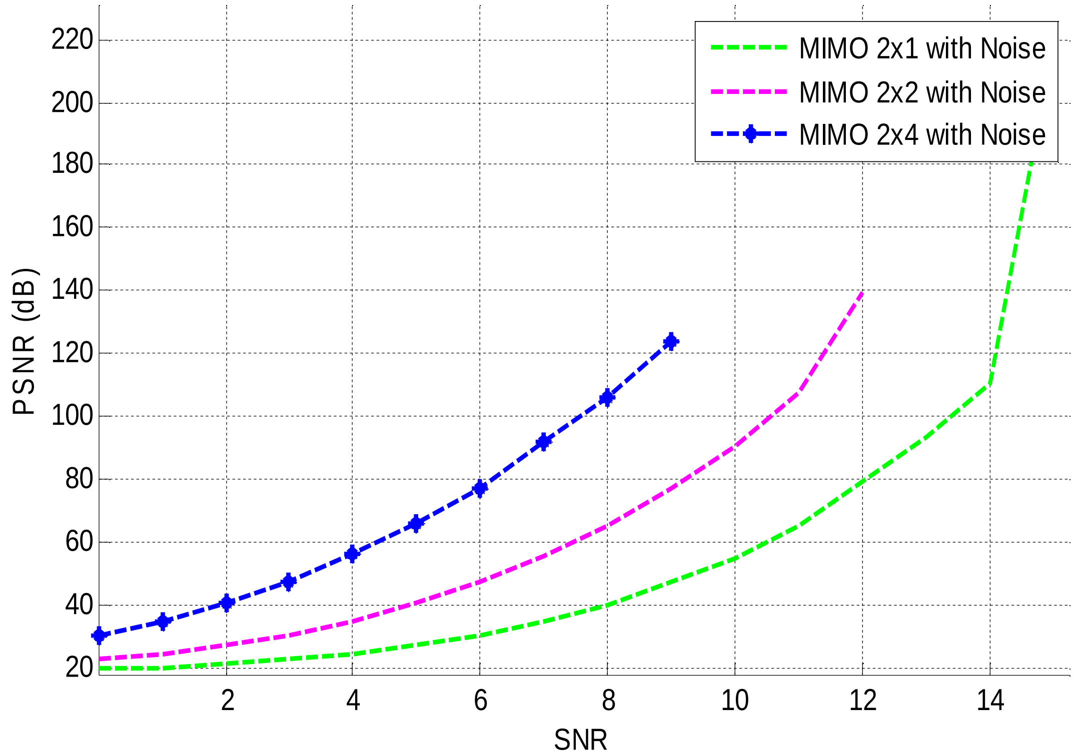

Fig. 7 Performance of PSNR to SNR using MIMO-QAM-16

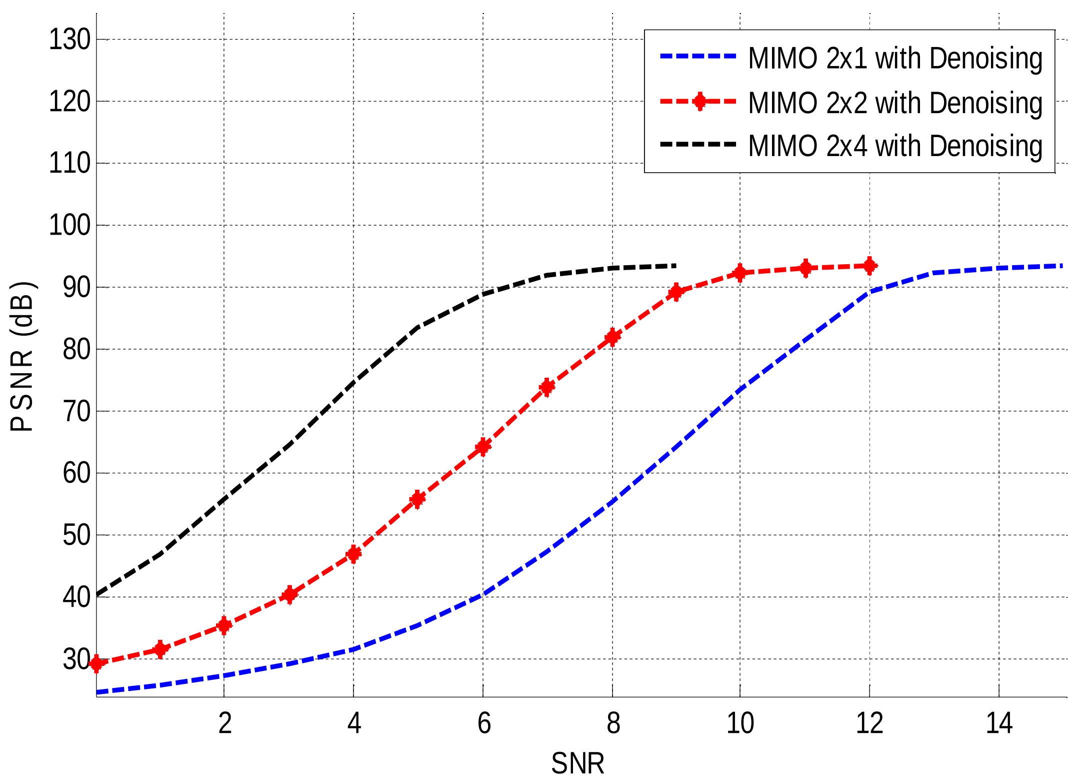

Fig. 8 Performance of PSNR to SNR using MIMO-QAM-16

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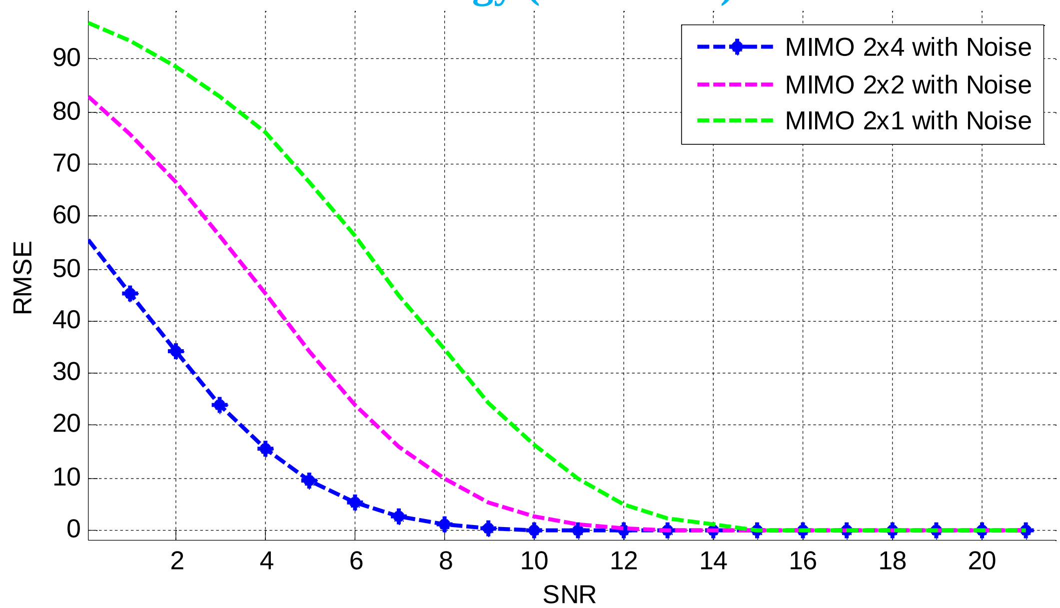

Fig. 8 Performance of RMSE to SNR using MIMO-QAM-16

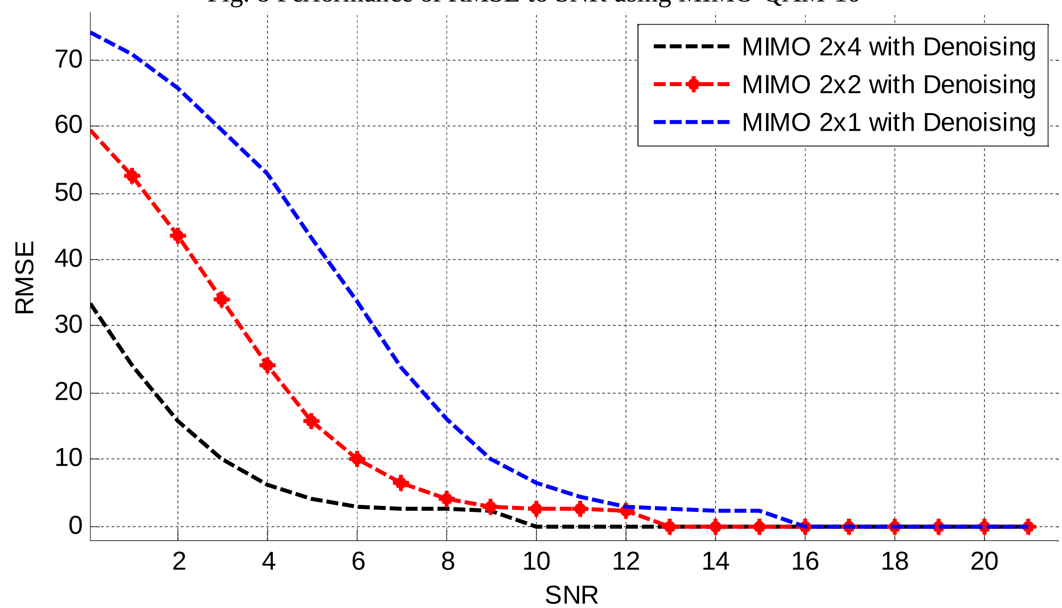

Fig. 9 Performance of RMSE to SNR using MIMO-QAM-16

VI. CONCLUSION

MIMO-WiMAX system gives better performance of image transmission. MIMO technique is also used here with the 2 x 1, 2x2, and 2x4 antenna system with QAM-16 for BER performance improvement. In this paper WiMAX system are used for image transmission and de-noising method is used for improving. In this paper, PSNR and RMSE are taken as two parameters for comparing the performance.

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