Analysis of V Blast Technique for MIMO Structure through Image Processing at Various SNR

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***Abstract*— In this paper we provide an efficient scheme for transmission of bit map images over MIMO system by employing spatial multiplexing. The image under test is compressed using *bmp* compression algorithm and all the pixels are transmitted with an optimal unequal power allocation algorithm. V BLAST or ZF receiver is selected for symbol detection and the image is reconstructed by decompression algorithm at the receiver. First of all the image to be transmitted is converted into bits and then headers and markers are added to the obtained bits. These bits are transmitted through the MIMO channel consisting of two transmitting and two receiving antennas. Spatial multiplexing technique is employed. Zero forcing equalization technique is employed at the receiver to get the output bits at the receiver then the reverse process is done to get the output image.**

***Index Terms*— Bit error rate, Image processing, MIMO, Phase shift keying, Interference cancellation**

I. INTRODUCTION

Multiple-Input Multiple-Output (MIMO) can offer high capacity to wireless systems, and the capacity is increased as the number of bits that are transmitted per second are increased and it keeps on increasing till the number of receiving antennas is greater than equal to the number of transmitting antennas. [1] There are many different schemes that can be applied to the MIMO system, the V-BLAST algorithm has become a potential alternative due to its excellent complexity performance tradeoff besides the complexity performance tradeoff, the V-BLAST algorithm is also considered to be a scheme which effectively exploits the MIMO potentials. This paper aims to exploit the V-BLAST algorithm [2] introduce many ideas regarding coding and design principles for the V-BLAST system, for example, Space-Time Coding reference proposed a low-complexity Zero Forcing (ZF) decoding approach for the V-BLAST Space Time Block Codes (STBC) system. Some V-BLAST systems perform detection and decoding layer by layer in a successive way at the receiver, a low-complexity detector with Successive Interference Cancellation (SIC) is used. The interest is on the bit error rate and performance while using different detection methods. Zero Forcing (ZF) is used as detection algorithms [3]. SIC is introduced instead of joint detection in order to reduce the complexity. We also investigated several methods to minimize the influence of the error propagation, which is considered to be the key problem to SIC for a given channel matrix H, zero-forcing enhances the noise. V-BLAST is a practical approach to achieve spatial multiplexing. Its decoder consists of ordering, interference cancelation, and interference nulling. There is a trade-off between the complexity of the decoding and the achieved diversity going from linear decoding methods to V-BLAST and to ML decoding, the diversity gain and the decoding complexity increase simultaneously [4]. Some important parameters during image processing are:

(a) Headers and Markers:

Headers and reset markers are introduced to prevent error propagation between different parts of the bit stream. Bit errors occurring during transmission can affect the headers, the markers, the dc layer and ac layers. If there is an error in the header, the entire image will be damaged and cannot be recovered. In case of error in reset markers, synchronization will be lost. So it is assumed that headers and reset markers are transmitted error free.

(b) Channel (H)

The Rayleigh flat fading channel (H) is commonly used to describe multipath fading channels when there is no Line-Of-Sight (LOS) component, the number of independent copies (multipath) of the signal arriving at the receiver is large, and the coherence bandwidth of the channel is greater than the bandwidth of the signal itself.

(c) Image Reconstruction

The received image data will be noisy. Mostly in all transmission schemes error detection algorithms will be used to obtain the actual transmitted values by eliminating the errors. In this project it is assumed that the headers and markers are received without any errors. So error detection algorithms are not used. In image transmission, with the less corrupted image data actual image can be reconstructed easily. The errors in the image are discernable to human eyes

II. OBSERVATIONS

Fig. 1: Original image

- Input Parameters

i) Number of frames: 200
ii) Modulation: BPSK
iii) Amplitude clipping introduced by communication channel (in dB):0

- Received image at different signal to noise ratios:

SNR= 0 dB

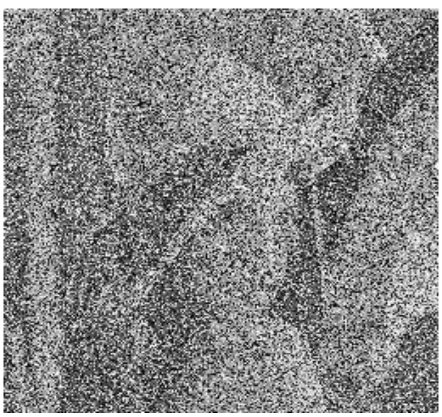
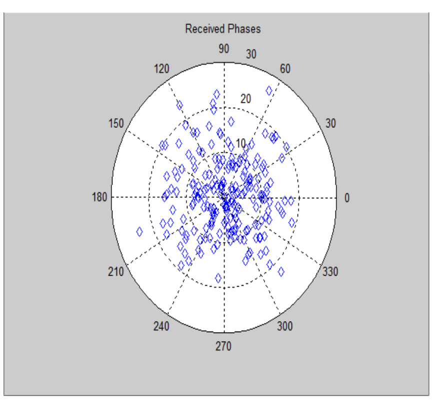


Image 1: 0dB SNR



Constellation 1: 0dB SNR

Fig. 2: 0 dB SNR

Total number of errors = 154898 (out of 524288)
Bit Error Rate (BER) = 29.544449%
Average Phase Error = 65.579490 (degree)
Percent error of pixels of the received image = 93.780518%

SNR= 5dB

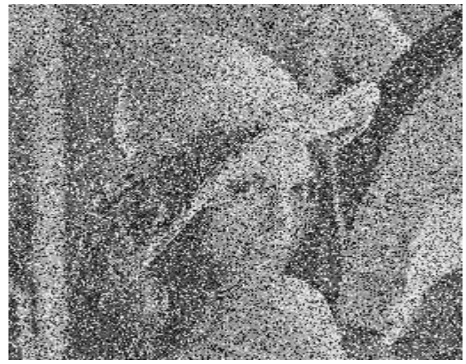
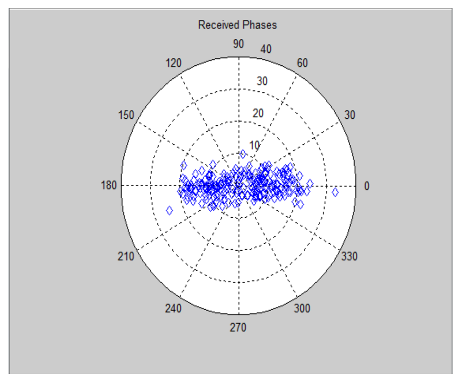


Image 2: 5 dB SNR



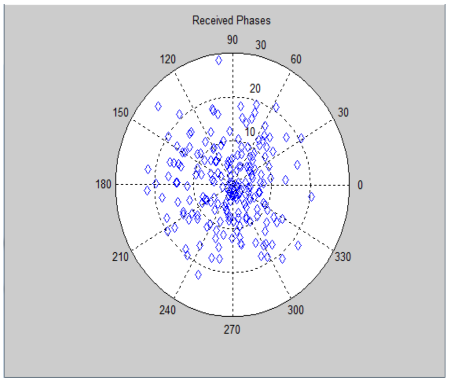
Constellation 2: 5dB SNR

Fig. 3: 5 dB SNR

Total number of errors = 103525 (out of 524288)
Bit Error Rate (BER) = 19.745827%
Average Phase Error = 50.686078 (degree)
Percent error of pixels of the received image = 82.884216%

SNR=10dB

Image 3: 10 dB SNR



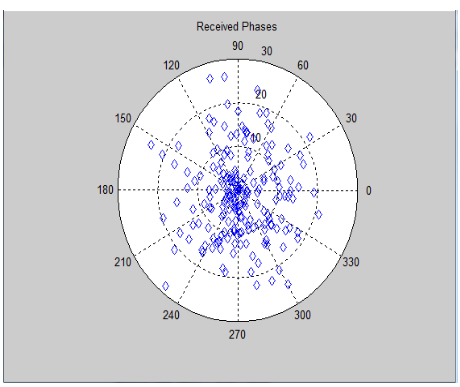
Constellation 3: 10 dB SNR

Fig. 4: 10 dB SNR

Total number of errors = 78048 (out of 524288)
Bit Error Rate (BER) = 14.886475%
Average Phase Error = 39.208707 (degree)
Percent error of pixels of the received image = 72.506714%

SNR= 20dB

Image 4: 20 dB SNR



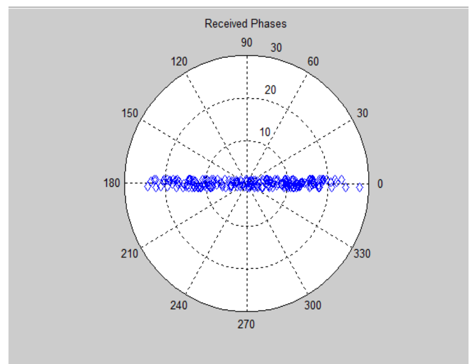
Constellation 4: 20dB SNR

Fig. 5: 20 dB SNR

Total number of errors = 66465 (out of 524288)
Bit Error Rate (BER) = 12.677193%
Average Phase Error = 27.491739 (degree)
Percent error of pixels of the received image = 66.415405%

SNR= 25dB

Image5: 25 dB SNR



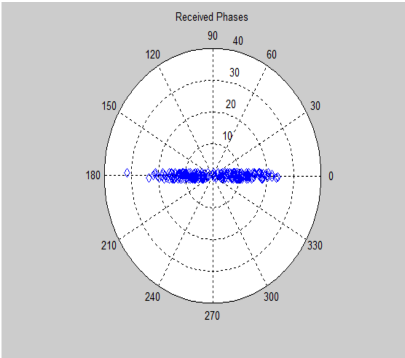
Constellation 5: 25dB SNR

Fig. 6: 25 dB SNR

Total number of errors = 65663 (out of 524288)
Bit Error Rate (BER) = 12.524223%
Average Phase Error = 24.738900 (degree)
Percent error of pixels of the received image = 66.036987%

SNR=30dB

Image 6: 30 dB SNR



Constellation 6: 30 dB SNR

Fig. 7: 30 dB SNR

Total number of errors = 65580 (out of 524288)
Bit Error Rate (BER) = 12.508392%
Average Phase Error = 23.494912 (degree)
Percent error of pixels of the received image = 66.061401%

III. Results and Discussion

We observe that the image quality increases as the signal to noise ratio increases. The image that is given as input should be a 256-grayscale bitmap file (*.bmp image file) as data source and the output image is also a bmp image whose quality depends on the signal to noise ratio.

The digital transmission of image over a noisy channel can be improved by selecting the best antenna. The transmit antenna corresponding to the highest SINR path is selected. The performance of this scheme is validated by computing its symbol error rate (SER) and bit error rate (BER). Original image and reconstructed images from image 1 to 6 are given. The above results prove that transmission of important feature of the image through the best antenna with unequal power outperforms the known scheme.

IV. Conclusion

The key advantages of MIMO are exploited to obtain a reliable distortion less image transmission. Instead of transmitting all pixels in an image with equal power through the transmit antennas; the path with highest SINR is selected to transmit the most important feature of the image and the next best antenna to transmit the other important feature with a Simple power allocation schemes. Results show that the proposed scheme provides significant image quality improvement and less distortion compared with equal power allocation with no antenna selection.

References

[1]. G.J.Foschini, “Layered space-time architecture for wireless communication in a fading environment when using multielement antennas," BLTJ, Autumn, 1996
[2]. David Tse and Pramod Viswanath”Fundamentals of Wireless Commu-nication”, Cambridge Universtiy Press, 2005
[3]. X.Li, H.Huang, G.J.Foschini, and R.A.Valenzu,”Effects of Iterative Detection and Decoding on the Performance of BLAST", IEEE Global Telecommunications Conference, vol.2, pp.1061-10066, Nov 2000.
[4]. W.Yan and S.Sun,”Iterative Interference Cancellation and Decoding for Convolutional Coded VBLAST Systems", Information, Communications and Signal Processing 2003, vol.3, pp.1511-1515, Dec 2003.
[5]. S. Loyka and F. Gagnon. “Performance Analysis of the V-BLASTAlgorithm: An Analytical Approach”. 2002 International Zurich Seminar on Wireless Broadband.
[6]. Nirmalend. B and Rabindranath B. “Capacity and V-BLAST Techniques for MIMO Wireless Channel”. Journal of Theoretical and Applied Information Technology, 2005- 2010.
[7]. P. W. Wolniansky. G. J. Foschini. G. D. Golden and R. A. Valenzuela “V-BLAST: An Architecture for Realizing Very High Data Rates Over the Rich-Scattering Wireless Channel”. Bell Laboratories.
[8]. S. Loyka and F. Gagnon. “Performance Analysis of the V-BLASTAlgorithm: An Analytical Approach”. 2002 International Zurich Seminar on Wireless Broadband.
[9]. Taekyu Kim and Sin-Chong Park. “Reduced Complexity Detection for V-BLAST D Systems from Iteration Canceling”. 2008.