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PERFORMANCE ANALYSIS OF ZF AND MMSE DECODERS AND ANALYSING THE BER FOR MIMO SYSTEMS

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ABSTRACT

A leading breakthrough in wireless communications has come into existence with the help of Multiple Inputs Multiple Output (MIMO) Systems. It is aimed to achieve a high data rate with a high spectral efficiency without altering the channel statistics. A high throughput can be obtained especially when MIMO is used in a scattering rich environment. Here the system has been analyzed at a high signal to noise ratio (SNR) using Binary Phase Shift Keying (BPSK) modulation technique and by using various linear detectors. Several techniques can be applied to this system. Some of them are Space time trellis codes, Space time block codes, D- BLAST and V-BLAST. The implementation complexity of diagonal approach is considerably high hence it is generally avoided. The V-BLAST is easy to implement and considered as an appropriate technique. Here, a MIMO system with Zero Forcing (ZF) Minimum Mean Square Error (MMSE) detector and Maximal Ratio Combining (MRC) is presented in this letter. Both the techniques have been analyzed with respect to their general characteristics and bit error rate performance. Finally the performance and the simulation results are also shown.

KEYWORDS: MIMO, SIC, ZF, MMSE.

INTRODUCTION

In wireless communication reducing and cancelling interference through multiple antenna arrays is one of the intensive research field. The concept of MIMO was first introduced in the year 1987 for both wired and wireless communication systems [1]. It is considered to be the best cost effective approach. Also, in order to increase the bit error rate or to achieve extraordinary data rate in space and time domain separately an improved reliable link with spatial diversity in space- time coding system and in spatial multiplexing system, the data streams are transmitted independently over different antennas, hence the system capacity can be increased [5]. It may seem the detection process is tedious because of multiple antennas but it is made simpler with iterative decoding cancelling process [7]. The symbols are detected in the order of highest SNR. The SIC detector along with ZF and MMSE equalizer balances the detection process most effectively.

EXISTING SYSTEM

There are several techniques to realize MIMO system. Ali Abdullah Ai-Saihati [2] analyzed the Performance using Zero forcing Detector. It is used multiple spatial ports is developed with adequate signal processing techniques [2]. These sort of systems can achieve 90% of Shannon capacity with linearly growing number of transmit antennas. The MIMO technique uses smart antennas at transmitter and receiver to enhance the capacity of the system without extra bandwidth [4]. Generally MIMO technique can be applied to two situations. They are: space-time coding systems and spatial multiple access systems. The bit error rate is improved due to to detect the symbols in the highest order of SNR. But it worked well with a noise free environment. The desired Performance was not achieved in a noisy case. This was considered as a drawback of the ZF detectors.

Taekyu Kim and Sin-Chong park [3] Proposed an iterative interference cancelling mechanism for V-BLAST. In order to combat the frequency selective fading he proposed Turbo equalization approach. But, it increased the computational complexity of the system. Hence this equalization technique was not widely accepted.

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The diagonally layered space time architecture known as D-BLAST was proposed by G.J.Foschini [5] it also employs multiple antenna arrays and decodes the symbols in an elegant diagonal way. Here the symbols are dispersed across the diagonal. It was considered as an inappropriate selection for antenna configuration since it suffers from many implementation complexities.

R.Xu and FCM Lau [6] analyzed the Bit Error rate using single carrier frequency equalization technique. For a MIMO system with large number of subcarriers increases the complexity of the system.

Also, it was considered as a complete error free approach. He observed for both Rayleigh and Rice fading channels [7].

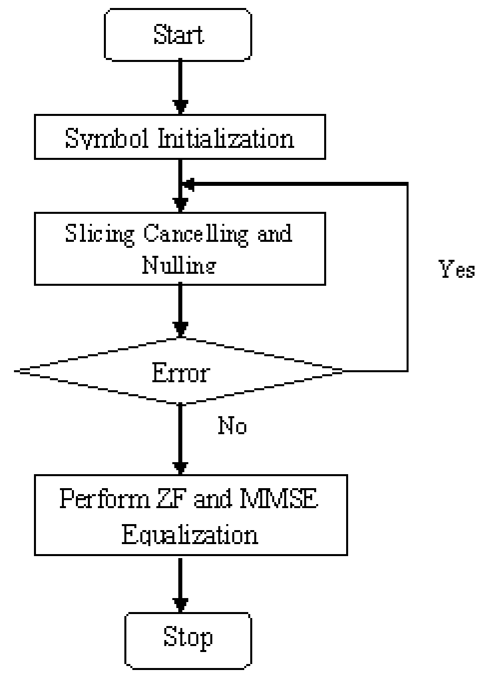
PROPOSED SYSTEM MODEL

The general MIMO system can provide a promising capacity gain in V-BLAST structure. The spectral efficiency can be enhanced by spatial multiplexing of coded or uncoded symbols over the channel. The proposed system model is explained by the flow chart. The signal arrives at the receiver end as y = Hx + v ----(1)

Where x is the transmitted symbol, y is the symbol received, H represents the channel matrix, and V represents the antenna white Gaussian noise.

Since it follows a linear detection procedure, the symbols are detected one by one and decoded iteratively. At each step the amount of interference cancelled becomes smaller and to avoid this modified V-BLAST was proposed but that too stops the iteration when the value becomes one. It indicates the system is not completely error free, and still contains certain amount of interference. In order to remove the interference pattern completely the ZF and MMSE equalizers are used. The Proposed model will work as follows:

The operation asserts with symbol initialization from the transmitter. Then slicing cancelling and nulling of symbols takes place. If the symbol is received without any error then zero forcing or minimum mean square equalization takes place. If any error persists then the loop passes to the step next to symbol initialization.



ZERO FORCING EQUALIZER

The incoming signal is detected in a linear way since it is a linear detector. This equalizer has the ability to produce a noise free outcome. The name indicates Zero Forcing that is it brings down the interference pattern to zero efficiently. The ZF equalizer employs pseudo inverse of the channel frequency to the received signal, to restore the signal at the receiver. Their general characteristics also have shown better results.

MINIMUM MEAN SQUARE ERROR EQUALIZER

MMSE is also a linear detector and follows a linear detection procedure. It has the ability to work in a noisy environment and its implementation is also quite simpler. As a substitute of inversing the frequency it attenuates the signal to a particular level to minimize the error between the transmitter and receiver. It can be shown with its attenuation rate and noise rate.

MAXIMAL RATIO COMBINING

In order to obtain the original signal back at the receiver the MRC is used. It works with a complex factor obtained from each branch and then it adds the signal to noise ratio form each branch.

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SIMULATION RESULTS

The general performance analysis and the Bit Error rate analysis are done using Binary Phase Shift Keying approach. The ZF equalizer output is compared with MMSE output and the results are presented. The SNR is achieved up to 30db in the proposed method.

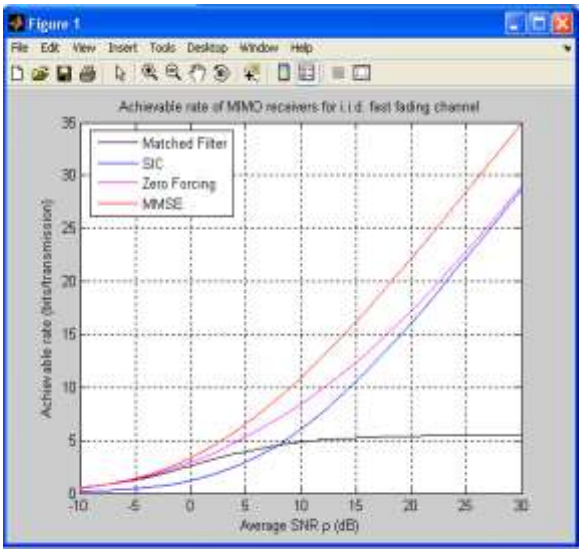

Figure 1: General Performance Analysis

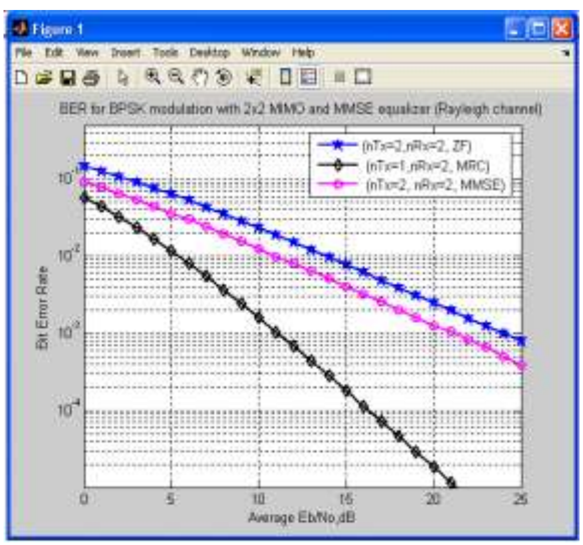

Figure 2: ZF and MMSE Performance

CONCLUSION

From the above result MMSE has a better performance in terms of bit error rate when compared with ZF detection and MRC in turn has a better performance when compared with MMSE detection by 5db. The complexity along with error rate has been considerably decreased when compared with other techniques.

REFERENCES

1. Nirmalendu Bikas Sinha, R. Bera, M. Mitra "Capacity and V-BLAST Techniques for MIMO Wireless Channel" Assistant professor Department of Electronics and Communication Engineering and Electronics and Instrumentation Engineering, C.E.M.K, K.T.T.P Township, WB India.
2. Ali Abdullah Ai-Saihati "BER Performance of V-BLAST Detection Schemes Over MIMO Channels" King Fadh University of Petroleum and Minerals, Electrical Engineering Department.
3. Taekyu Kim and Sin-Chong park "Reduced Complexity Detection for V-BLAST Systems From Iteration cancelling", School of Engineering, Informations and Communications University, korea.
4. Professor Shridhar A. Joshi, Ms Anusha, Ms. Bhagyalaxmi, Ms, Seema Bhat " Performance Analysis of MIMO Technology for V-BLAST detection" Department of Electronics S.M.D college of Engineering and Technology, Dharwad, India.
5. P.W.Wolniansky, G.J.Foschini, G.D.Golden.R.A.Valenzuela " V-BLAST an Architecture for Realizing Very High Data Rates Over Rich Scattering Wireless Channel", Bell Laboratories, Lucent Technologies, Holmdel.
6. R.Xu and FCM Lau "Performance analysis for MIMO systems using Zero Forcing Detectors Over Fading Channels", IEEE Proc. Communication volume 153, No.1 February 2006.
7. Wei Mo Zhengdao Wang "Loe Complexity Nulling Cancelling detection Algorithm foe coded MIMO systems with near optimal performance ", Department of Electrical and Computer Engineering, lowa state university. Ames IA 50011.