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Cell Co-ordination Using Beam forming and Parameters of MIMO

Miss Madhavi Vilas More[1], Mr. V.D.Shinde[2]

P.G. Student, ElectronicsDepartment S.S.V.P.S.B.S. Deore College of Engineering, Deopur, Dhule, India[1]

Assistant Professor, ElectronicsDepartment S.S.V.P.S.B.S. Deore College of Engineering, Deopur, Dhule, India[2]

Abstract: Wireless communication has grown staggeringly over the last decade, wireless systems and mobile telephones have been the most reason for the expansion. There is a requirement for ever faster wireless communications as this can allow new applications like widespread wireless broadband web access. Multi-Antenna transmission schemes, using multiple antennas at the transmitter and/or receiver have been projected as some way to satisfy the demand for exaggerated capacity. Main aim of this project is to enhance the capacity of MIMO system. Capacity is increased by variable parameters like SNR and BER using channel coding such as alamouti coding, feedback systemopen-loop and close-loop comparison, channel correlation, antenna selection techniques as optimum and sub-optimum antenna selection techniques. In the LTE mobile system, all cells use the same set of frequencies. This means that a user may expertise interference from different cells. A method that has been studied so as to cut back this interference and thereby increase rate or system outturn is to coordinate programming between cells. Good results of this have been found in numerous studies. However, the interference is generally assumed to be well-known. Studies using calculable interference and simulating more than one cluster of cells have found virtually no gain. This paper focused on how to use information from coordinated scheduling and other traffic estimates to do better interference estimation and link adaption.

Keywords: MIMO, Channel Correlation, Open Loop-Close Loop, Alamouti Coding, Antenna Selection Techniques, Optimum And Sub-Optimum Selection Technique, CSI Feedback, Cell Co-Ordination, Beam forming.

I. INTRODUCTION

MIMO is effectively a radio antenna technology because it uses multiple antennas at the transmitter and receiver to enable a range of signal methods to hold the information, choosing separate methods for every antenna to change multiple signal methods to be used. One of the core ideas behind MIMO wireless systems reference system signal process during which time (the natural dimension of electronic communication data) is complemented with the spatial dimension inherent within the use of multiple spatially distributed antennas, i.e. the use of multiple antennas located at completely different points. Accordingly, MIMO wireless systems can be viewed as a logical extension to the sensible antennas that are used for several years to boost wireless. It is found between a transmitter and a receiver; the signal can take several methods. Additionally, by moving the antennas even a small distance the methods used can modification. The variety of methods out there happens as results of the quantity of objects that seem to the facet or maybe within the direct path between the transmitter and receiver. Previously these multiple methods solely served to introduce interference. By using MIMO, these additional methods will be accustomed advantage. They can be accustomed give extra lustiness to the link by up the signal to noise magnitude relation, or by increasing the link data capacity. As a result of the employment multiple antennas, MIMO wireless technology is able to significantly increase the capacity of a given channel whereas still obeying Shannon's law. By increasing the number of receive and transmit antennas it's attainable to linearly increase the outturn of the channel with each combine of antennas additional to the system. This makes MIMO wireless technology one of the foremost important wireless techniques to use in recent years. As spectral bandwidth is turning into associate degree ever a lot of valuable trade goods for radio communications systems, techniques are required to use the out of these information measure a lot of effectively. MIMO wireless technology is one of these techniques.

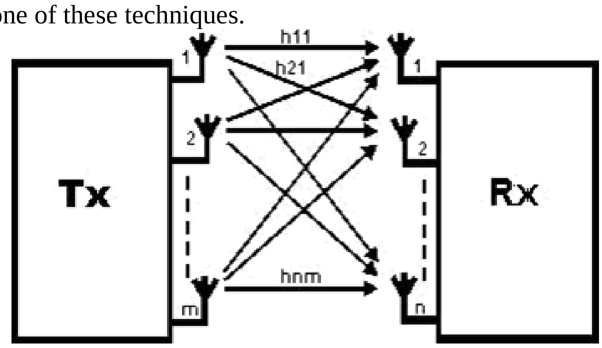

Figure: Multiple Transmitter and receiver antenna

II. LITERATURE REVIEW

Capacity Analysis of Correlated MIMO Channels:
This paper gives expressions for the capacity of ergodic multiple-input multiple-output channels with finite dimensions, in which the channel gains have a correlated complex normal distribution and receivers experience

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independent Gaussian noise. The particular correlated normal distribution considered corresponds to flat Rayleigh fading with arbitrary transmit and receive correlation. Knowledge of the correlation matrices is assumed at both the transmitter and receiver, while the receiver, but not the transmitter, has complete knowledge of the channel realization. The optimal input density is characterized via a necessary and sufficient condition for optimality, along with an iterative algorithm for its numerical computation. The resulting capacity is expressed in terms of hypergeometric functions of matrix argument, which depend on the channel correlation matrices only through their eigenvalues. Some closed-form expressions are also given in the case of single-sided correlation. Some consideration is given to high- and low-power asymptotics. Easily computable asymptotic expressions are also given for receive-side only correlation in the case that the number of transmitters is large. In that case, the capacity can be divided into two components: one arising from the dominant eigenvalues of the receiver-end correlation matrix, and the other from the remaining spherically distributed eigenvalues. Some numerical results are also presented.

Performance Analysis of adaptive low rate differential CSI feedback for MIMO-OFDM techniques:
In situations where the channels are fast changing, systems that require channel state information at the transmitter would need frequent feedback from the receiver. Low rate feedback will be required in these cases, and there have been many proposals on how to compress channel state information to enable a fast feedback to the transmitter. Of these proposed methods, a simple but yet promising way to achieve low rate feedback would be via the use of differential quantization techniques. In this paper, we investigate the use of adaptive delta modulation with givens rotation to encode the CSI in MIMO-OFDM systems. We look at the design of the feedback system, and investigate methods of improving the performance of such systems.

BER Analysis of Precoded-Alamouti and Precoded OSTBC:
The proposed work in this paper involves a transmitted signal consists of a precode followed by Alamouti code. A new design criterion and a corresponding design method of precoders are proposed which shows comparison of Bit Error Rate (BER) performance of Alamouti OSTBC and Precoded Alamouti in Zero Forcing and MMSE equalization techniques. The Rayleigh fading channel is used as modulation channel.

Design and implementation of alamouti encoder for 4g wireless system: Multiple-input multiple-output (MIMO) systems are called to play a crucial role in fourth Generation (4G) wireless systems to provide advanced data services. This paper addresses the design and implementation of a MIMO encoder that is based on Alamouti scheme on a Xilinxreg Virtextrade-4 XC4VLX60 Field Programmable Gate Arrays (FPGA) device. This encoder is a part of MIMO testbed, equipped with multiple antennas at both ends of the link which appropriately encodes the modulated symbols to achieve both time and spatial diversity. In this paper, a comprehensive explanation of the complete design process is provided, including an illustration of the tools used in its development. The encoder for the MIMO testbed is developed based on modular design which simplifies system design, eases hardware update and facilitates testing the various modules in an independent manner.

Design of adaptive modulation using imperfect CSI in MIMO system:
A design of variable-power variable-rate adaptive modulation using imperfect channel state information (CSI) in multiple-input-multiple-output (MIMO) systems is proposed. Analysis and simulation results show that this design provides a good trade-off between the spectral efficiency and bit error rate performance in an adaptive way. Hence, it makes the adaptive modulation MIMO system much more robust to CSI imperfections than a system designed under a perfect CSI assumption.

III. SURVEY OF PROPOSED SYSTEM

In this project MIMO systems are accustomed increase the capacity of the system and to realize higher Bit Error Rate victimisation water gushing algorithmic rule, open-loop and close-loop comparison, channel correlation, alamouti coding, antenna choice techniques as optimum and sub-optimum antenna selection techniques.

To achieve these following strategies were used
- Feedback such as closed-loop system were used
- Precoding techniques and antenna selection were used

All these simulations were wiped out Matlab.
After all these simulations the best coding technique and algorithm were sorted out of all and implementation of these techniques with beam-forming algorithms to form a practical situation of increasing the capacity in an ad-hoc environment to utilize the resources in a better way.

IV. DESCRIPTION

A. Channel Capacity:
At the input of a communication system, discrete supply symbols are mapped into a sequence of channel symbols. The channel symbols are then transmitted/conveyed through a wireless channel that by nature is random. In addition, random noise is added to the channel symbols. In general, it is possible that 2 totally different input sequences could bring about to constant output sequence, causing totally different input sequences to be similar at the output. To avoid this situation, a non-confusable subset of input sequences should be chosen therefore that with a high likelihood, there is just one input sequence causing a specific output. It is then possible to reconstruct all the input sequences at the output with negligible likelihood of error. A measure of however abundant information that

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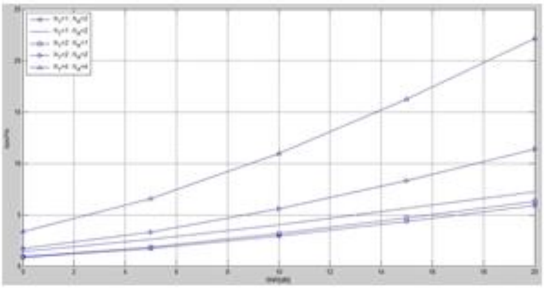
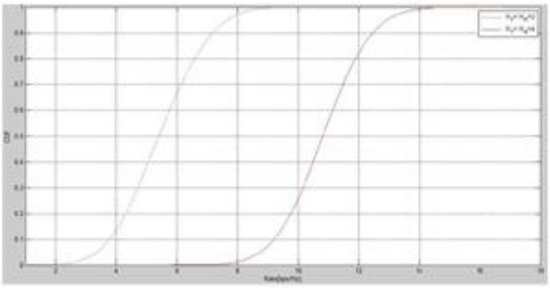
may be transmitted and received with a negligible likelihood of error is termed the data rate.

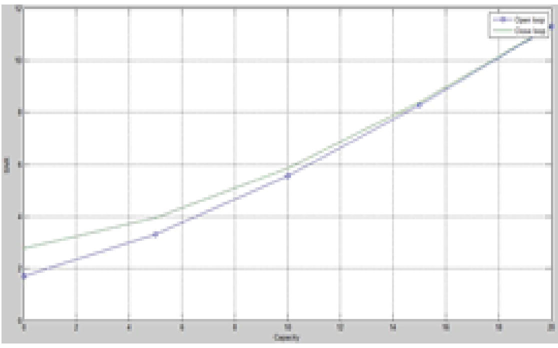
$$\overline{C} = E\{C(\mathbf{H})\} = E\left\{\max_{\mathrm{Tr}(\mathbf{R}_{xx})=N_T} \log_2 \det\left(\mathbf{I}_{N_R} + \frac{E_x}{N_T N_0}\mathbf{H}\mathbf{R}_{xx}\mathbf{H}^H\right)\right\}$$



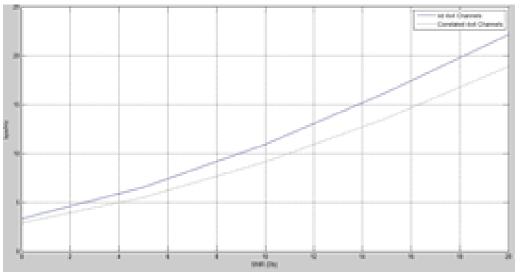
B. Channel Capacity of Increase in Antenna:
The CDFs of the random 2x2 and 4x4 MIMO channel capacities when SNR is 10dB. It is clear from Figure that the MIMO channel capacity improves with increasing the number of transmit and receive antennas [1]



C. Open loop-close loop Comparison:
It compares the ergodic capacities for 4x4 MIMO channels with and without using CSI at the transmitter side. It shows that the closed-loop system provides more capacity than the open-loop system. However, we can see that the CSI availability does not help to improve the channel capacity when the average SNR is extremely high [2][3][6].



D. Channel Correlation:
The performance of a multiple-input multiple-output (MIMO) is critically dependent on the provision of independent multiple channels. It is documented that channel correlation will downgrade the performance of a MIMO system, especially its capacity. Channel correlation is a measure of similarity or probability between the channels. The channel correlation is closely related to the capacity of the MIMO channel. The channel capacity reduces once there exists a correlation between the transmit and receive antennas[1].



E. Space time block codes (STBC) and Alamouti Coding:
Space-time block codes are used for MIMO systems to alter the transmission of multiple copies of an information stream across variety of antennas and to take advantage of the varied received versions of the information to boost the dependability of data-transfer. Space-time writing involves the transmission of multiple copies of the information. This helps to compensate for the channel problems like attenuation and thermal noise. Although there is redundancy within the information some copies might arrive less corrupted at the receiver.

When victimization coordinate system block writing, the data stream is encoded in blocks before transmission. These information blocks are then distributed among the multiple antennas (which are spaced apart to de-correlate the transmission paths) and the data is additionally spaced across time.

Alamouti Coding: It was designed for a two-transmit antenna system and has the coding matrix:

$$C_2 = \begin{bmatrix} c_1 & c_2 \\ -c_2^* & c_1^* \end{bmatrix},$$

Where C* denotes complicated conjugate.

It is readily apparent that this is often a rate-1 code. It takes 2 time-slots to transmit two symbols. Using the optimum decipherment theme mentioned below, the bit-error rate (BER) of this STBC is equivalent to $2n_R$-branch maximal quantitative relation combining (MRC). This is a results of the right orthogonally between the symbols after receive process, there are 2 copies of every image transmitted and copies received. n_R [5].

Precoded OSTBC Consider the MISO system with National Trust antennas. Let C denote a space time code word with a length of M, which is described as

$$\mathbf{C} = [\mathbf{c}_1\, \mathbf{c}_2 \cdots \mathbf{c}_T]$$

In the precoded OSTBC systems, the space-time code word C is increased by a precoding matrix W two CNT_M, which is chosen from the codebook F ={W1,W2,W3,…..WL}.

The objective is to settle on an acceptable code word that improves the system performance like data rate or error performance [4].

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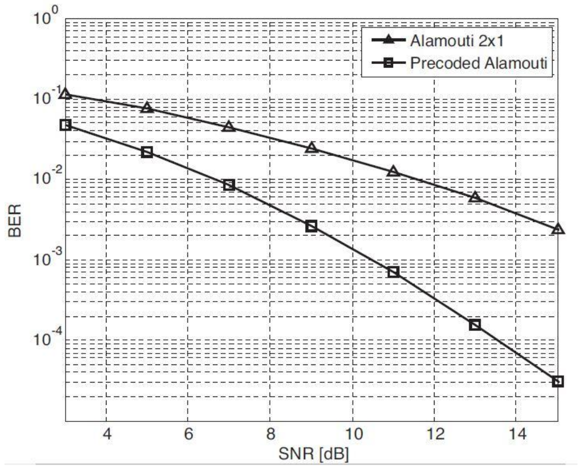


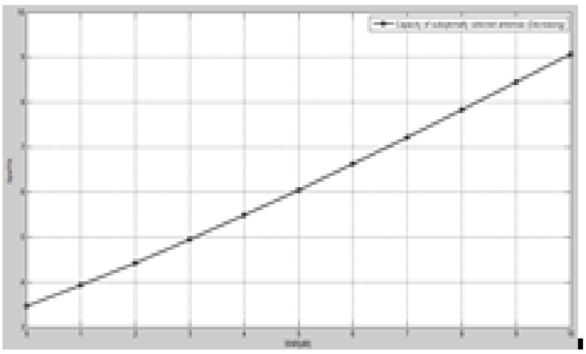
It demonstrates that the Precoded Alamouti scheme performs better than the traditional alamouti 2x1 STBC scheme without increasing transmit power or increasing spectral bandwidth.

F. Antenna Selection Technique:

The advantage of MIMO systems is that better performance can be achieved without using additional transmits power or bandwidth extension. However, its main drawback is that additional high-cost RF modules are required as multiple antennas are employed. Antenna selection techniques can be used to employ a smaller number of RF modules the number of transmit antennas. [10].

G. Optimum and Sub-OptimumAntenna Selection Technique:

A set of Q transmit antennas must be selected out of NT transmit antennas so as to maximize the channel capacity. As mentioned in the previous subsection, optimal antenna selection may involve too much complexity depending on the total number of available transmit antennas. In order to reduce its complexity, we may need to resort to the sub-optimal method. The channel capacities with two suboptimal selection methods can be computed. [10]



Above figure shows the channel capacity with the selection method in descending order for various numbers of selected antennas with NT=4 and NR=4. We can see that the suboptimal antenna selection method in achieves almost the same channel capacity as the optimal antenna selection method.

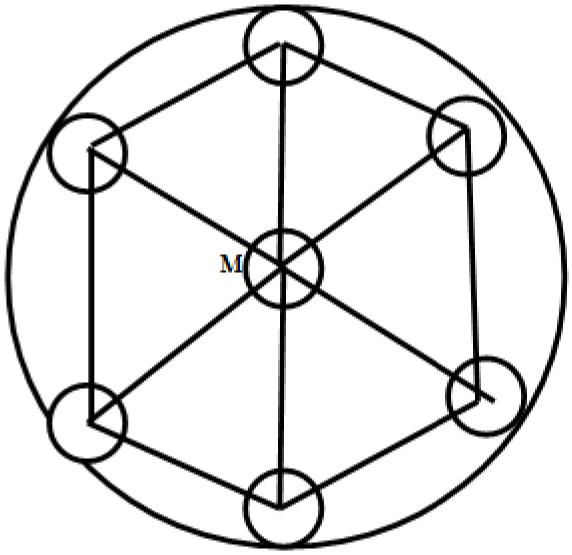
H. MU-MIMO:

Multi-user MIMO or MU-MIMO is an increased kind of MIMO technology that's gaining acceptance. MU-MIMO, Multi-user MIMO enables multiple freelance radio terminals to access a system enhancing the communication capacity of every individual terminal. MU-MIMO exploits the maximum system capacity by planning multiple users to be ready to at the same time access an equivalent channel victimization the abstraction degrees of freedom offered by MIMO. To enable MU-MIMO to be used there are many approaches that will be adopted, and a number of applications / versions that are obtainable. In MU-MIMO, regularized channel inversion and DPC performs equally well for low SNR however at higher SNR, Dirty Paper Coding (DPC) performs higher than regularised channel inversion. [7]

I. Capacity Enhancement using cell Co-ordination:

The cell in clusters in coordinated scheduling and to share channel state and precoding information in order to create an ad-hoc clusters which can use beam shifting to utilize the resources in a better way. [9]

J. Cell Co-ordination:



This is a cluster connected to its main computer through star and every one others area unit connected in ring topology.

The problem is, in power limited system say 3G WCDMA for 4G LTE as the range of subscribers will increase cell respiration takes place i.e. cell size reduces and less number of subscribers get served.

The problem is solved as, in this cells are organized in a very cluster during this one cell is appointed as main cell, if load on a particular node b will increase then it'll send data to main server, if its neighbouring node b area unit free they, then node b will transfer its channel data and precoding details to alternative node through cell coordination and exploitation a code book approach with high rate. And accordingly the serving node can shift its spectrum to serve alternative node and its existing subscribers. Based on the windowing algorithms, I selected Blackman formula and primarily based on the DOA (Direction of Arrival), selected Capon formula.

V. CONCLUSION

I have exploited the capacity parameter of MIMO systems by showing varied configurations that have well-tried that MIMO antennas give higher capacity and shown improvement in capacity by varied parameters like SNR open loop, closed loop, correlation and including alamouti committal to writing for capacity improvement. In this project, all methods of capacity improvement and results are valid victimisation Matlab (Matlab Codes). These several varied parameters are

1) Number of antenna: Varying the number of transmitting and receiving antennas, it is found that throughput of more number of antennas is more than less number of antennas. It means MIMO performs higher than alternative kind of antennas.
2) Closed loop and open loop system: during this, the closed-loop system provides more capacity than the open-loop system. However, CSI availability does not help to improve the channel capacity when the average SNR is extremely high.
3) Consideration of correlation between antennas: capacity reduction due to the channel correlation which implies channels while not channel correlation provides higher capacity than correlated channels.
4) Together with OSTBC (Alamouti) in MIMO: Including OSTBC in MIMO shows that the Precoded Alamouti theme performs betterwithout increasing transmit power or increasing spectral information measure.
5) Number of antennas improvement technique: It shows that the suboptimal antenna selection method achieves almost the same channel capacity as the optimal antenna selection method, but Optimal antenna selection in Equation may involve too much complexity depending on the total number of available transmit antennas. In order to reduce its complexity, we can use the suboptimal antenna selection method in which the selection method in descending order for various numbers of selected antennas shows the channel capacity more than antenna selection in ascending order of increasing the channel capacity.

All the above results are used to integrate the cell in clusters in coordinated scheduling and to share channel state and precoding information in order to create an ad-hoc clusters which can use beam shifting to utilize the resources in a better way.

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