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RESEARCH ARTICLE

Optimization Of Capacity Of MIMO Antenna Based Wireless System Using Genetic Algorithm

R.Sharma[1], A.S.Buttar[2]

[1]Student, Dept. of Electronics & Communication Engineering, PITK, Kapurthala

[2]Associate Professor, Dept. of Electronics& Communication Engineering, PITK, Kapurthala

Email rishab626@yahoo.com, danhavtar@rediffmail.com

Abstract— In this work, at the earlier stage, the signal formation and the initial antenna array setup is considered as the input population set to the Genetic process. The genetic process is defined for N number of iterations. With each iteration, the two parent configurations are selected under the fitness rule specification. The fitness rule is defined to analyze the channel capacity under antenna configuration. To perform the selection, Rank selection approach is defined in this work. After the selection of parent configuration, the child configuration is generated by performing the crossover operation. To generate the child one point crossover is defined in this work. At the final stage, the mutation function is implemented over it. The genetic process is defined to identify the identical antenna configuration will be achieved and the effective channel throughput will be drawn. The presented work is implemented in Matlab environment.

Keywords: MIMO, Antenna, Genetic Optimization

I. INTRODUCTION

A communication system is defined affective to the high throughput rate and to attain to attain the quality. The quality parameter considered in such network is the lesser BER ration. Another aspect in this effective communication system is the capacity analysis based communication. Channel capacity is here defined in terms of frequency range defined under the time limits to provide the effective frequency communication so that the reliable communication with gain parameters will be obtained. The common communication system in this real environment includes the MIMO (Multiple Input Multiple Output) system architecture. The communication system is effective in terms of high transmission range, capacity and the error free communication over the system [1][5][7].

MIMO system is defined under the signal quality and communication quality analysis under the antenna. These kinds of systems are having multiple transmitter/receiver antennas as shown in figure 1.

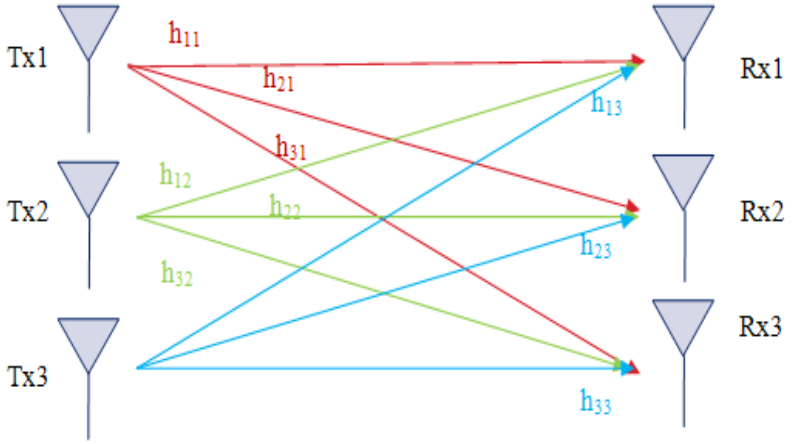

Figure 1 : MIMO Channel Model

Here figure 1 is showing the MIMO system under channel model specification under multiple transmitter and receiver specification. Figure is showing the interconnection between these antennas to perform reliable communication [11][13].

MIMO system is defined to improve the communication throughput and to reduce the BER. This system is defined under the signal processing algorithms to improve the channel capacity, bandwidth improvement, channel equalization and effective communication channel estimation. In this growing communication scenario, MIMO systems are improved under the integrated circuits so that the physical level communication analysis and improved will be attained. MIMO system is defined with multiple antenna system where each antenna is having the specific range capability to control the communication and to provide the effective communication throughput. These kind of communication systems are having the following capabilities

- MIMO system enables the significant communication throughput with effective range enhancement without including additional channel and transmission power over the channel.
- Higher spectral analysis is defined to improve the channel communication.
- The reliability over the system is defined under diversity analysis.

MIMO systems are defined as the effective path communication network with signal specification under various communication parameter analysis. Author defined the MIMO system with multiple parallel signals so that the signal transformation and signal generation will be obtained effectively. The MIMO system includes the distance communication under different fading channels and irregular communication channels. These kind of system requires the effective channel formation, utilization and estimation. One of important aspect of such communication system is the antenna capacity estimation and improvement so that the overall communication over the channel will be improved. These kind of communication systems are defined with signal modeling and channel effective communication so that the system reliability will be improved[6][7][14].

MIMO system is defined as the transmitter and signal generation so that the multi-path communication will be performed. The transmission stream with channel matrix estimation is defined under the transmitter and multiple antenna specification. The signal vector under antenna capacity evolution and decoding is defined under signal vector. The MIMO system model is defined as

$$Y=HX+G \qquad (1)$$

Where **Y** and X are receive and transmit vectors, H and G are the channel matrix and noise vector, respectively.

In this paper, an effective MIMO system model is defined along with antenna system optimization so that the channel capacity will be improved. In this section, the exploration to MIMO system is defined along with feature definition and antenna system specification. In section II, the work defined by the earlier researchers is discussed. In section III, the

effective system model is defined to optimize the MIMO system based antenna system placement. In section IV, the results obtained from the work are discussed. In section V, the conclusion obtained from the work is discussed and presented.

II. Review of Literature

In this section, the work defined by earlier researchers is defined and presented. Some of the work defined by earlier researchers is presented in this section.

Manuel O. Binelo[1] has defined a work on antenna array based capacity optimization using genetic approach. Author defined a MIMO based antenna system under the array antenna specification and capacity optimization under propagation modeling. Author defined the constraint analysis approach using antenna modeling and array optimization over the system. Author defined the work to optimize the channel and to gain the high throughput over the network. U. Olgun [2] has defined a work on antenna array optimization for capacity evaluation and optimization in MIMO system. Author defined the work to analyze the MIMO system capacity estimation so that the multiple component based integration will be obtained. Author defined communication analysis along with system volume analysis. Author defined PSO based approach for optimization of integrated tool as the effective linear and circular array based system. Rui Xu[3] has defined a range based optimization system using channel optimization and LoS parameters for MIMO system. Author defined the communication system for indoor communication. Author presented the study for 2x2 and 3x2 MIMO system to obtain the effective communication over the network. Author defined the measurement analysis over the system to gain the high capacity communication in optimization environment.
M.-H. Ho[4] has defined a channel capacity estimation and optimization approach using PSO. Author defined work for indoor communication under radiation pattern analysis. Author defined the optimized antenna array formation to maximize the channel capacity in indoor communication. Author defined the frequency response analysis under antenna pattern analysis and capacity estimation. Jianxin Dai[5] has defined uplink capacity estimation based approach for MIMO system analysis for SIMO. Author defined the work with smart antenna system and investigate the direction of arrival under transmission analysis. Author defined the antenna array formation under capacity estimation and evaluation for antenna array specification. Rick S. Blum[6] has presented an optimal antenna selection criteria for MIMO system. Author defined the antenna array specification under receiver and transmitter based analysis so that the signal estimation and optimization will be achieved. Author defined the antenna selection analysis under capacity formation and generation. Author presented the signal level estimation over the system so that the system error probability will be reduced. Ralf R. Muller[7] has defined a probabilistic estimation and analysis approach channel capacity evaluation for multiple antenna array. Author defined the detection channel capacity generation so that the signal analysis with dual antenna capacity estimation will be obtained. Author defined the work under fading channel and perform the error probability estimation.
Ben Lu[8] has defined the performance analysis based optimization approach MIMO coded system. Author defined the design system optimization under density parity check so that the MIMO system improvement will be gained. Author performed the frequency level estimation and evolution under optimized irregular codes to compute the signal to noise ratio. Author perform the optimization of various channel model with demodulation scheme to optimize the system performance. Yuuta Nakaya[9] has defined an array antenna analysis for MIMO system under the interference analysis for MIMO system. Author define dthe SINR ratio analysis along with MIMO system formation and capacity analysis to improve the system. Shahab Sanayei [10] has defined the capacity improvement method using transmitter receiver antenna analysis so that the MIMO system improvement will be gained. The system optimization is here done under th antenna receiver specification. Author defined the suboptimal algorithm for the system improvement in such environment and system. Jiansong Chen [11] presented a work antenna selection for MIMO system under complexity and cost estimation.

III. PROPOSED WORK

In this paper, a genetic based model is defined to perform MIMO system optimization by antenna array configuration. In this work channel estimation and frequency analysis is defined to optimize the system configuration. In this work, channel system communication with channel modeling and parametric estimation and modeling is defined. The efficiency of MIMO system depends on the capacity of MIMO system and this capacity depends on the antenna array configuration. A MIMO system with lesser number of antennas can be configured manually performing different check for different configuration. But as the number of antennas in MIMO system increases, it is not possible to check each and every configuration. In such case, some optimum analysis approach is required that can analyze the MIMO system dynamically and find the effective configuration for MIMO system. In this work, a genetic based optimization apporach is suggested to perform MIMO system

configuration so that the optimal antenna configuration obtained. This antenna configuration improved system capacity and reduced the communication error.

A) MIMO Channel Model

In this present work MIMO system channel modeling is defined by N_R x N_T. Here N_R represents the number of receiving antennas and N_T represents the number of transmitter antennas. As the MIMO system is defined, some antennas are set activated and deactivated so that the effective particular antenna position in H matrix will be identified. The presentation of the antennas is done in the form of H-Matrix. It has assumed that receiver is perfectly synchronized with transmitter means one sample per symbol and optimum sampling rate and synchronization is achieved by symbol time estimator. The perfect synchronization ith received block Y_i is given as:

$$Y_i = HC(s) + G_i$$

$$\overline{H} = \begin{bmatrix} \mathrm{Re}(H) & -\mathrm{Im}\,g(H) \\ \mathrm{Im}\,g(H) & \mathrm{Re}(H) \end{bmatrix}$$

Here $\overline{H}$ is the complex version of channel matrix H

B) Antenna Configuration

As the H Matrix of antenna is representation, the matrix formation is done so that the activation and deactivation of antennas will be performed. This configuration is considered as the specific formation values shown with an example for 3*3 MIMO system

- Means we have three transmitter antennas and one receiver antenna
- Example [010010]
- represents tx0=1,tx2=1,tx3=0,rx1=0,rx2=1,rx3=0
- Suppose we have a 00001100 where
- 0-represents antenna is OFF
- 1-represents antenna is ON
- And in a matrix consisting of 3*3
- Means we have three transmitter antennas and three receiver antenna

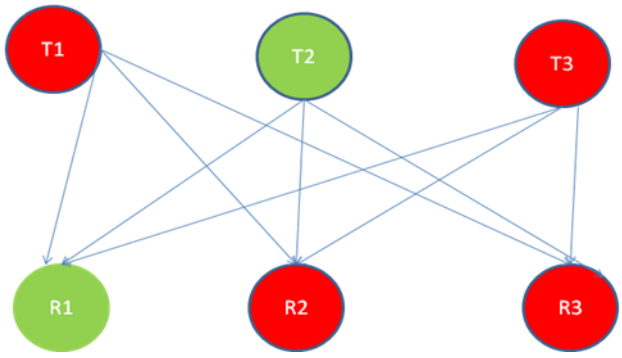

Figure 2 : Antenna Array Configuration

C) Algorithm

In this work an antenna array system is defined using genetic approach. The algorithmic representation is given by

AntennaArrayOptimization(AntennaArray)
/*AntennaArray is the initial specification of antenna configuration*/
{

1 Setup the MIMO system configuration with the specification of channel length and relative parameters.
2 Setup the antenna array configuration with on and off the particular antenna position
3 Generate the signal under the specification of channel parameters and the antenna configuration.
4 Define the setup with the combination of channel specification and the antenna parameters and consider it as initial population for genetic process.
5 For i=1 to MAX_Iteration
[Process the genetic for fixed number of iterations]
{
6 Perform the selection under defined rank based selection approach.
7 Define the fitness rule under the acceptance constraints for antenna and signal specification.
8 Perform cross
9 Perform the image enhancement using preprocessing Tools to Normalize the Image
10 Initialize the population respective to the Genetic algorithm
11 Perform the Selection of Selection on this Training Dataset
12 Perform the Crossover on selected parents and generate the next level child
13 Perform the Mutation to neglect the values that does not support fitness function
14 Recombine the generated child with existing population to Generate new Population Set
15 Obtain the channel capacity estimation for the configuration.
16 }
}

IV. RESULTS

The presented work is implemented in matlab environment. The obtained results from the system are analyzed respective to the BER. In this present work, MIMO system is defined along with antenna system configuration. The MIMO system settings are defined in table 1

Table 1 : Simulation Parameters

Parameters	**Values**
Number of Transmitter	2
Number of Receiver	2
Number of Iterations	10
SNR Values	0,2,4,6,8,10,12,14,16,18,20
Crossover Probability	.9
Mutation Probability	.1

Based on the system, the configuration is defined here under

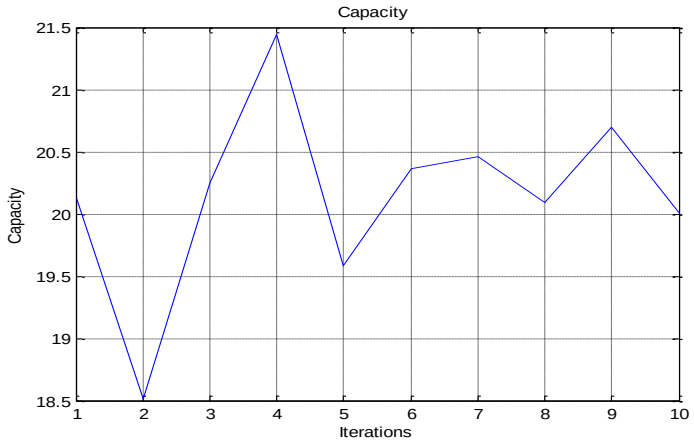

Figure 3 : Channel Capacity Estimation

Figure 3 is showing the optimized identification of channel capacity using genetic approach in case of MIMO 2x2 system. As we can see, here x axis represents the genetic interations and y axis is showing the channel capacity. During the channel capacity identification, each iteration performs the positional changes over the antenna to gain the maximum channel capacity. Here we can see, different capacity degrees respective to different iterations. These results are obtained under the effect of SNR. The results show at iteration 2, the optimized channel capacity is achieved.

The work is testing on different MIMO antenna configuration.

V. CONCLUSION

In this present work an optimization to MIMO channel capacity is defined by MIMO antenna array configuration. The work has defined the effective array configuration so that the channel capacity will be improved. The work is tested on different MIMO system configuration. The work is optimized using genetic approach and effective channel optimization is obtained. The results show the effective estimation of this configuration under different configuration vectors.

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