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Joint Beam Forming Power and Channel Allocation in Multi User and Multi Channel using Multiple Relay MIMO Cognitive Radio Networks

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Abstract: ***In this paper, the joint beam forming, power, and channel allocation in a very multi-user and multi-channel underlay a couple of input single outputs (MISO) cognitive radio network (CRN) machine, primary users' (PUs') spectrum can be reused via the secondary consumer transmitters (SUTXs) to maximize the spectrum utilization even as the intra-consumer interference is minimized through implementing beam forming at each SU-TX. Formulate procedure on CR community and put in force beam forming shape on unique user based totally precise distance analysis on Singular Valued Decomposition (SVD) using receiver part of analysis. Without beam forming the use of channel allocation on a couple of customers, the performance of cooperative communication is degraded. So on this project imposing multi channel on multiple user analysis of relay direction primarily based throughput charge evaluation on CR network on SVD with comparison of semi definite relaxation approach analysis. Expecting proposed allocation scheme has substantial development on throughput rate more on CR network secondary customers.***

Keyword*:* Cognitive radio network, Singular Valued Decomposition

1. Introduction

The relaying is a spectrally efficient technique to enable information exchange between two users. Two-way relaying protocols, such as those based on decode-and-forward, amplify-and-forward, and estimate-and-forward relaying which are able to fulfill two-way data exchange in precisely two phases. Specifically, each users at the same time transmit within the same channel throughput the primary section, whereas the relay broadcasts the processed mixture to each users within the second section. Every user utilizes the knowledge of the previously transmitted message, known as self-interference, to decode the received mixture. Attracted by the benefits of multi antenna in enhancing system capacity and reliability, subsequent works on non regenerative two-way relaying extend to a multi antenna scenario. References and considered sum-rate optimizing AF-based beam forming and power allocation at the relay, for the case where only the relay is equipped with multiple antennas.

Meanwhile, and looked into the case with a single pair of multi antenna users and a non regenerative multi antenna relay. Reference proposed a sum-rate maximizing beam forming design at the relay subject to a hard and fast power constraint. However, the quantity of antennas needed at the relay is doubly the quantity of antennas required at every user because of zero-forcing criterion. Reference studied the joint design of the beam former at the relay and the decoder at the users to minimize the sum of the mean-square error (MSE) subject to an individual power constraint at each node. The possibility of beam forming at the users was not explored in the joint design of the transmit and receive beam formers in the multiple-input–multiple-output (MIMO) two-way relaying channels was studied.

2. System Model and Assumptions

Reference proposed an iterative looking algorithm primarily based on the gradient-descent technique to find the locally formost answer for the beam formers on the users and the relay satisfying individual power constraints with equality. The algorithm has to be considerably repeated with extraordinary starting points to boon the chance of finding the best locally most suitable solution that corresponds to the globally best answer.

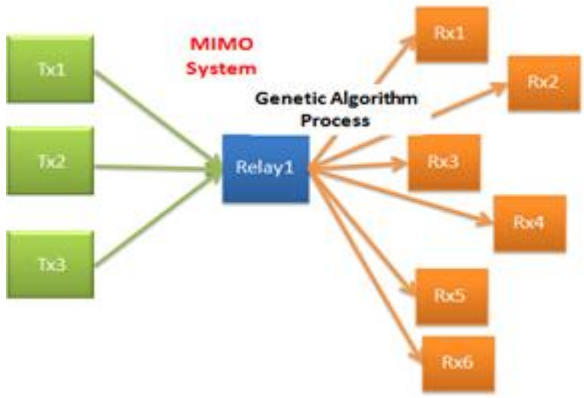

Figure 1: A Simple Block Diagram of MISO System Using Single Relay

Without beam forming using channel allocation on more than one users the use of co-operative system on orthogonality under practical situations. From the above Fig 1 illustrate that a single relay is used in MISO system by considering the three transmitters to six receivers. Cooperative diversity systems relay on using relay nodes of transmitted information to the destination such that it experiences different channel fading. but, without proper processing of the message at the relays, the performance of cooperative device might not perform better than direct transmission systems. On this device i.e, without beamforming they do not attain enough throughput rate to the secondary users. The drawbacks of this existing system are Secondary User (Out of Coverage Area) they're not getting enough result. Orthogonality between Primary User's to Secondary User's is lost in practical communication systems. And performance of Cooperative Communication is degraded.

The proposed system usage of a couple of relay path analysis on Multiple Input Multiple Output (MIMO) system, the use of Beamforming on Power and Channel Allocation in Cognitive Radio Networks. With the capability of beamforming at each secondary user transmitter to mitigate interference, permit greater transmission possibilities and take the benefits of spatial diversity or beamforming. The major benefits of proposed system of this paper is: Signal Coverage Area Improvement, Time Duration is much less and Throughput rate greater on CR network secondary users.

3. Beamforming

Beamforming is a widespread signal processing approach used to control the directionality of the reception or transmission of a symbol on a electrical device array. Using beam forming you can direct most of the signal energy you transmit from a collection of transducers (like audio speakers or radio antennae) in a chosen angular path.

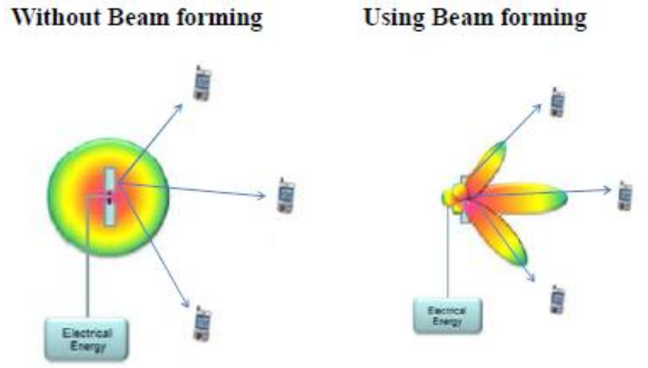

Figure 2: Comparison Between Beam forming and Without Beam forming

From the above Fig 2 shows that using of beamforming can transmit the accurate information from transmitter to the receiver than using without beamforming method. Not only reducing the interference but also improving the quality of signal, while using beamforming methods.

A. MIMO Beamforming

More than one antennas may be used to perform clever antenna features such as spreading the overall transmit power over the antennas to achieve an array advantage that incrementally improves the spectral performance (more bits per second per hertz of bandwidth,) or achieving a diversity benefit that improves the link reliability (reduces fading,) or both. In (single-stream) beam forming, the identical signal is emitted from every of the transmit antennas with suitable phase and advantage weighting such that the signal strength is maximized at the receiver input.

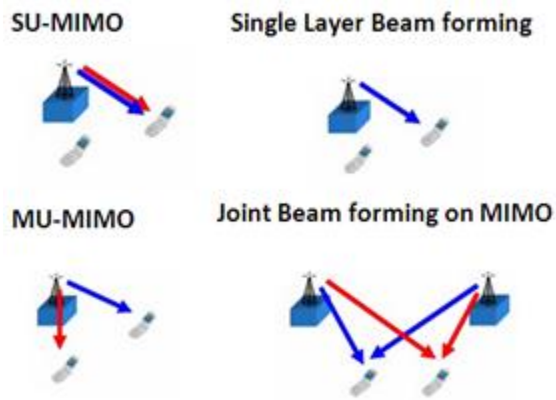

Figure 3: Comparison between MIMO on Beam forming Usage

3.1 Joint Beamforming Using Genetic Algorithm Process

GA is a searching algorithm, which might be applied to search out close to best value to an optimization problem without the knowledge of the objective function's derivatives or any gradient related information. The key plan of GA is to first select a set of feasible values for the decision variables and then design new solutions based on the previous set to improve the objective function.

Step: 1
- Set that parameter based more than one base station (three Base stations) 1 relay direction and 6 destinations.

Step: 2
- Each channel path we want to process on random variable of signals (channels)

Step: 3
- Every channel path need to analysis on one by one loop on chromosome set 3 base station to 1 relay

Step: 4
- Depend upon corresponding rate we need to choose best path; worst path using descending order condition

Step: 5
- Discovered that direction then we need to transmit maximum through put rate Crossover condition.

Step:6
- Most suitable channel allocation evaluation on relay path to destination we need to implement on decode forward relay path process.

3.2 Joint Beamforming Using Simulated Annealing Algorithm

This SA algorithm is used to generate new neighbour channel allocation that is honestly decided on to improve the performance. The cooling time table manages the control parameter at some stage in the optimization problem.

Step: 1
- Initially set the new iteration index L=0 and randomly pick the channel allocation.

Step: 2
- Generate the new channel allocation and calculate the sum-rate ΔR.

Step: 3

- If $\Delta R \geq 0$ then accept the high performance of new channel allocations. else if $\exp(\Delta R/T) >$ random [0,1]

Step: 4

- Update the cooling rate i.e T_{L+1}=cooling-rate$*T_L$

L=L+1

Step: 5

- Repeat 1- 4 steps until the stopping criteria is met.

Step:6

- Optimal channel allocation analysis on relay path to destination we need to implement on decode forward relay path process.

4. Multiple Input Multiple Output

MIMO is a method of transmitting multiple data streams on the transmitter side and also receiving multiple knowledge streams at the receiver side. MIMO antenna configuration describes that use of multiple transmit and multiple receive antennas for a one user produces higher Capability, spectral efficiency and additional knowledge rates for wireless communication. Once the information rate is to be enhanced for a one user, this is often known as single user-MIMO (SU-MIMO) and when the individual streams are assigned to various users; this is called multiuser MIMO (MU-MIMO).

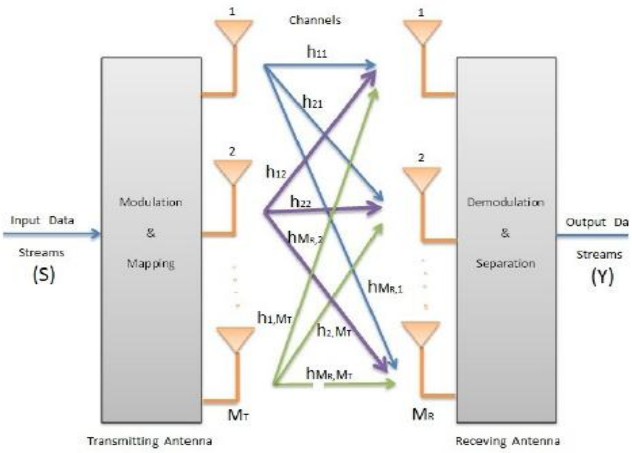

Figure 4: Multi Input and Multi Output Configuration

From the above Figure 4 Output user data stream $y=Hs+\eta$ (input output relation of MIMO channel), where as $s=[s1\ s2\ldots sM]t$ is that the transmitted knowledge vector, $y=[y1\ y2\ldots yM]$r is that the received knowledge vector, and $\eta=[\eta1\ \eta2\ldots\eta M]t$ is that the Additive White Gaussian noise (AWGN). MIMO has higher capability as compare to different system..The MIMO capability is given by,

$$C=MtMrBlog_2(1+S/N) \quad (1)$$

Where C is understood as capacity, B is known as bandwidth, S/N is known as signal to noise ratio. Mt is that range of antennas used at the transmitter aspect. And Mr is the quantity of antennas used at receiver aspect.

5. Simulation Results

5.1 MIMO System Without Relay

SNR Vs Achievable rate in MIMO system without relay gives throughput rate upto 4.6bits/sec.

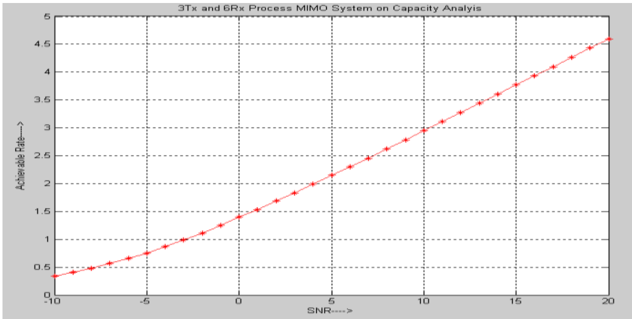

Figure 5: Without relay

5.2 MIMO System With Relay Process

When the relays are increased the achievable rate increases and the performance of the system also improved. which is upto 5.5 bits/sec. As shown in Figure 6.

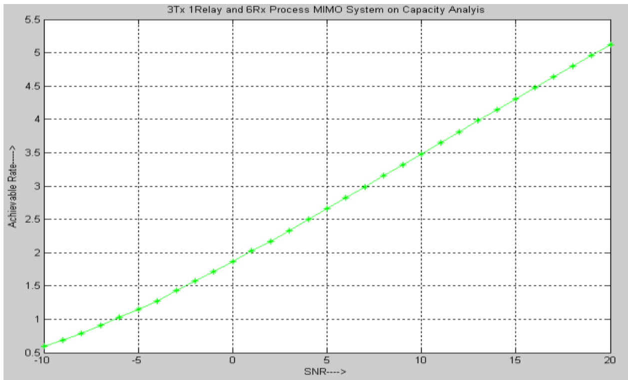

Figure 6: With relay process

5.3 Joint Beamforming with Genetic Algorithm

The main purpose of genetic algorithm is used to determine the sub optimal channel allocation. In this graph, the channel is allotted in random manner. Based on the channel allocation, we select the channel with highest achievable rate (best case). The following graph is plotted between the transmit SNR and achievable rate.

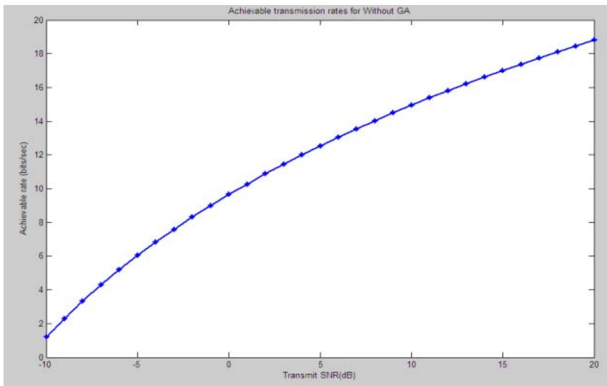

Figure 7: Achievable Transmission Rate Using Joint Beamforming in MISO

5.4 Joint Beamforming with Genetic Algorithm in MIMO System

When MIMO system is used the achievable transmission rate is further increased which is upto 38bits/sec.

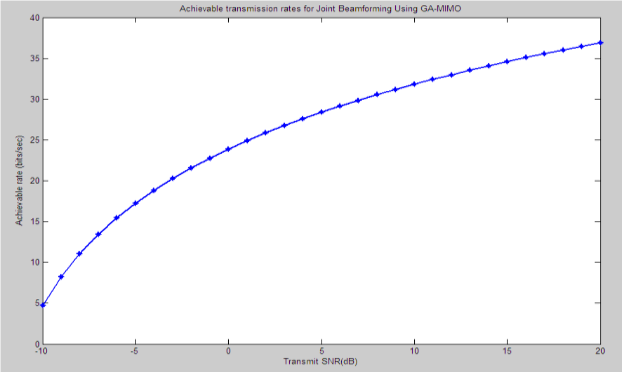

Figure 8: Achievable Transmission Rate Using Joint Beamforming in MIMO

When compared with above to Figure 7,8 the achievable transmission rate is further increased by using of MIMO system than MISO.

5.5 Joint Beamforming with Simulated Annealing (SA) Algorithm in MIMO System

By using SA Algorithm, the maximum achievable transmission rate attained are upto 40 (bits/sec). Among all those, the joint beamforming using Simulated Annealing Algorithm has the highest achievable rate.

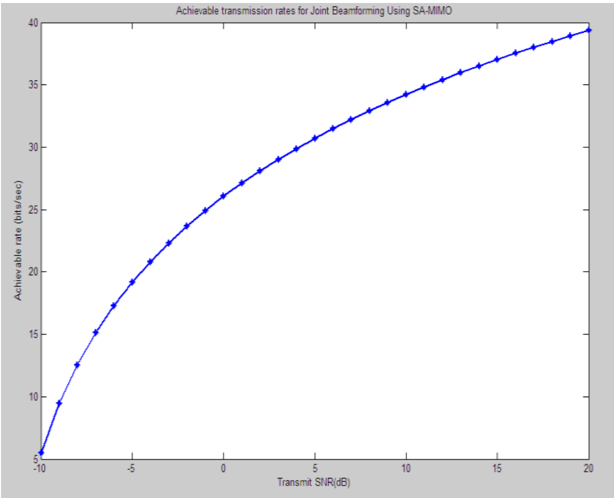

Figure 9: Achievable Transmission Rate Using Joint Beamforming in MIMO

5.5 Comparison of Simulation Results with MISO and MIMO System

Comparing the results with, transmission without relay, with relay and GA, SA Algorithms with MISO and MIMO System.

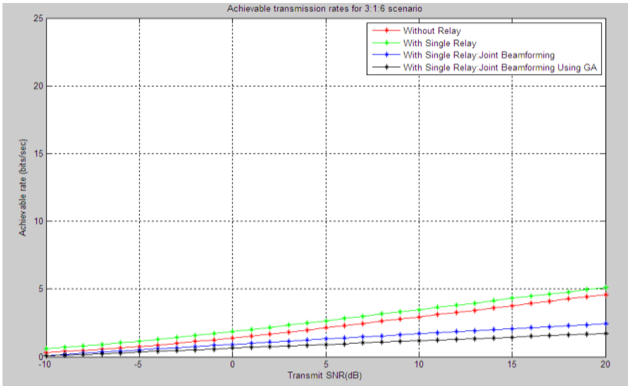

Figure 10: Performance Analysis on the parameter using MISO System

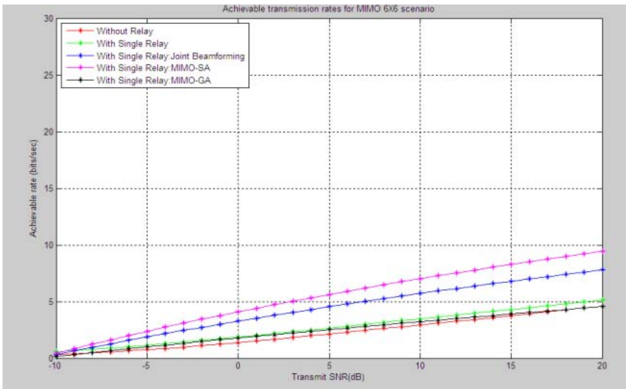

Figure 11: Performance Analysis on the parameter using MIMO System

Simulation results indicate that achievable transmission rate is more in MIMO System when compared with MISO System.

5.6 Comparing the results with 3 Transmitters (TX) and 6 Receiver (RX) using MIMO joint beamforming

a) SNR Vs Achievable rate in MIMO system with 3TX to 1Rx

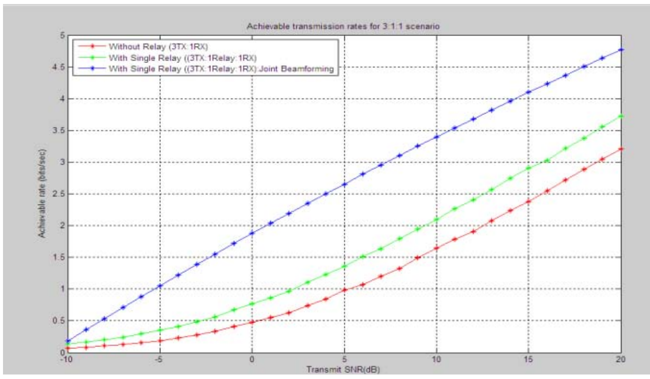

Figure 12: MIMO joint beam forming (3TX 1RX)

From the above Figure 12, we can see that achievable transmission rate attained are 3.2(bits/sec) for without relay, 3.8(bits/sec) for with relay,4.8(bits/sec) using GA in MIMO system.

b) SNR Vs Achievable rate in MIMO system with 3TX to 2Rx

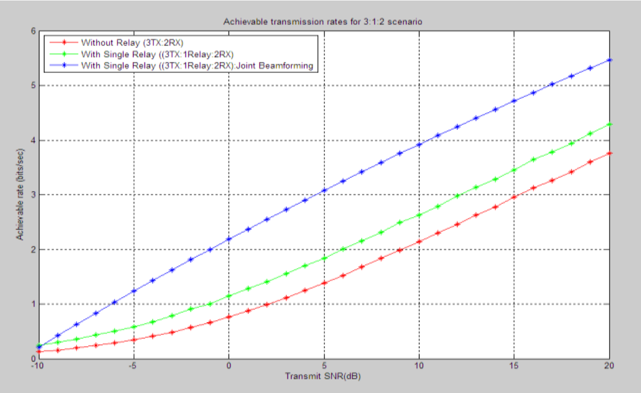

Figure 13: MIMO joint beam forming (3TUX 2RX)

From the above Figure 13, we can see that achievable transmission rate attained are 3.8(bits/sec) for without relay, 4.2(bits/sec) for with relay,5.5(bits/sec) using GA in MIMO system.

c) SNR Vs Achievable rate in MIMO system with 3TX to 3Rx

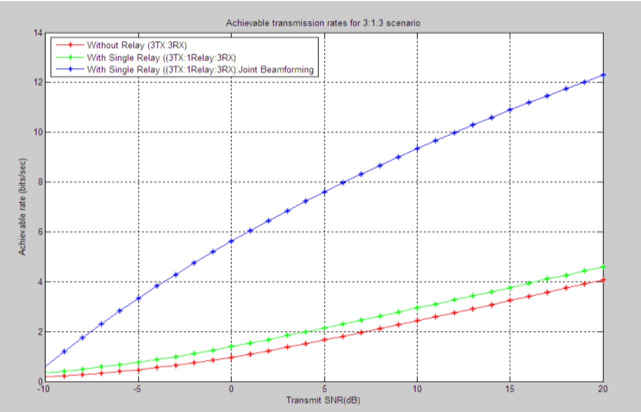

Figure 14: MIMO joint beam forming (3TUX 3RX)

From the above Figure 14, we can see that achievable transmission rate attained are 4(bits/sec) for without relay, 4.2(bits/sec) for with relay,12(bits/sec) using GA in MIMO system.

d) SNR Vs Achievable rate in MIMO system with 3TX to 4Rx

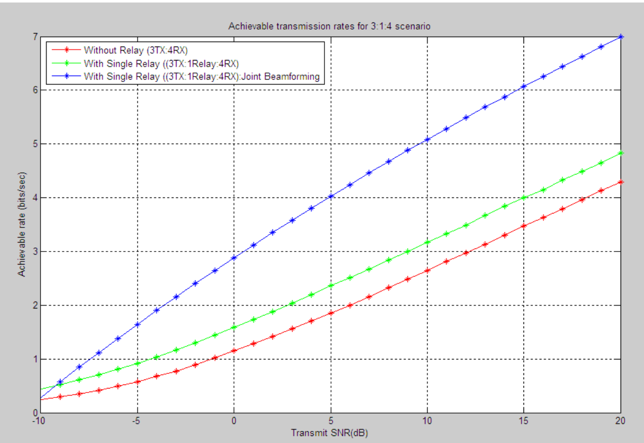

Figure 15: MIMO joint beam forming (3TUX 4RX)

From the above Figure 15, we can see that achievable transmission rate attained are 4.2(bits/sec) for without relay, 4.8(bits/sec) for with relay,7(bits/sec) using GA in MIMO system.

e) SNR Vs Achievable rate in MIMO system with 3TX to 5Rx

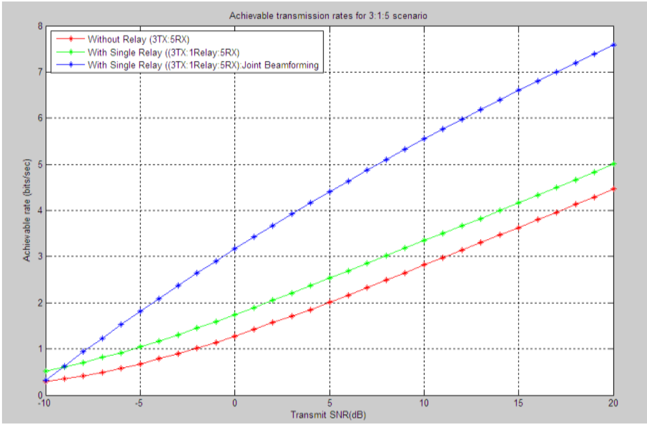

Figure 16: MIMO joint beam forming (3TUX 5RX)

From the above Figure 16, we can see that achievable transmission rate attained are 4.4(bits/sec) for without relay, 5(bits/sec) for with relay,7.6(bits/sec) using GA in MIMO system.

f) SNR Vs Achievable rate in MIMO system with 3TX to 6Rx

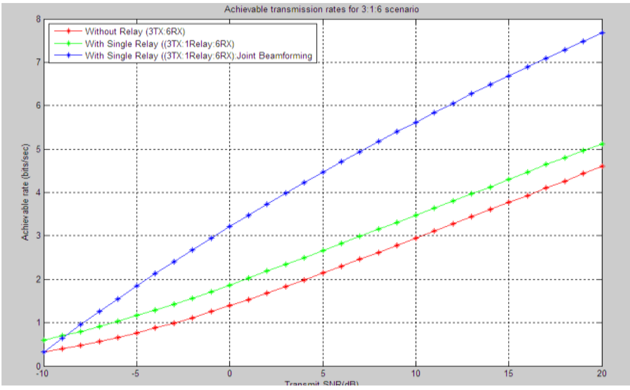

Figure 17: MIMO joint beam forming (3TUX 6RX)

From the above Figure 17, we can see that achievable transmission rate attained are 4.6(bits/sec) for without relay, 5.1(bits/sec) for with relay,7.8(bits/sec) using GA in MIMO system. From the above Fig. 12-17, we can see that maximum achievable transmission rate is improving at each Receiver (RX) in MIMO system.

6. Conclusion

In this paper, the problem of joint beamforming, power and channel allocation in MIMO (Multiple-Input Multiple-Output) based Cognitive Radio Network (CRN) is taken into account for the usage of efficient signal among the multiple users at a time. We looking out an algorithm that is Genetic Algorithm (GA) and Simulated Annealing Algorithm (SAA) were introduced, that is to extend the signal strength and also the maximum achievable rate. Once multiple relay stations are increased, the system performance will increases hence signal strength also increases and also the signal coverage area increases. Moreover, beamforming with interference tolerance capability introduced by our system model are able to do higher performance, when compared with Multiple Input Single Output (MISO) and Multiple Input Multiple Output (MIMO) System.

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