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POWER OPTIMIZATION OF LINK PROTOCOL IN MIMO BASED ON COGNITIVE RADIO

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Abstract: The achievable rate of MIMO cognitive radio network when one primary user (PU) and multiple secondary users (SU) are present, where the latter adopt dirty paper coding (DPC) to cancel the interference of PU's transmission at their receivers. We formulate an optimization problem to maximize the achievable rate of the system under the constraints of power limits of each transmitter, where the requirement of not affecting PU's transmission rate is also incorporated. An algorithm is proposed to jointly determine the inflation factors in DPC method and the input covariance matrix of each SU. Simulations show that the proposed problem achieves better achievable rate when compared with the existing results without compromising PU's transmission rate. Using location base protocols try to improve avaibility rate of SU (secondary user).and use threshold approach to allow certain node which take a part in CR.

Keywords: Cognitive radio, MIMO, Achievable Rate, Dirty Paper Coding.

I. INTRODUCTION

There are of great interest on cognitive radio network (CRN) because of the high spectral efficiency it can achieve. The CRN should design CR techniques to accommodate cognitive devices without disrupting the communications of the primary users (PU). Generally, CR techniques falls into three types, i.e., underlay, overlay and interweave. Among these techniques, the secondary user (SU) in the overlay approach uses part of its power to relay primary transmissions in order to compensate its interference to PU. In addition, to remove the interference of the PU's data at its receiver, it employs dirty paper coding (DPC) method at the transmitter.

Multiple-input multiple-output (MIMO) has been well-known for its multiplexing and diversity gain, and many papers have investigated MIMO CRN to exploit the benefits of MIMO. When perfect transmitter-channel-knowledge (CSIT) is available derives the optimal beamforming and power allocation to maximize the secondary rate while satisfying the primary rate requirement. A practical MIMO-DPC scheme is proposed in, and the optimal inflation factor is derived. On the other hand, focus on the design of various schemes under imperfect CSIT. Studies the impact of imperfect channel state information (CSI) on a MIMO system with interference and compares the performance of DPC with that of a scheme where interference is decoded at the receiver, referred to as beamforming with joint decoding. Deals with the fading dirty paper channel (FDPC) with positive semi-definite input covariance matrix and develops an iterative algorithm to jointly optimize the input covariance matrix and the inflation factor. Considers FDPC under imperfect CSIT and develops two iterative algorithms to determine the inflation factor used in DPC. In contrast to the channel model in and that the signal X and interference S experience the same fading channel, generalizes this model to the one that X and S experience different fading channels. There have been recently some researches on MIMO CRN with multiple SUs. Considers multiuser MIMO CRN with limited feedback, where zero-forcing beamforming is performed under imperfect CSI at each SU, and an adaptive resource allocation is designed to provide a feedback-efficient and delay-guaranteed service. studies the sum rate maximization problem for spectrum sharing MIMO broadcast channels under Rayleigh fading with partial CSI, which maximizes the sum capacity under the power limits. considers a spectrum sharing scenario in a MIMO CRN where the overall objective is to maximize the total throughput of SU by jointly optimizing the detection operation and the power allocation, under a interference constraint bound to PUs.

1.1 What is MIMO?

MIMO (Multiple Input, Multiple Output) is an antenna technology for wireless communications in which multiple antennas are used at both the source (transmitter) and the destination (receiver). The antennas at each end of the communications circuit are combined to minimize errors and optimize data speed. MIMO is one of several forms of smart antenna technology, the others being MISO (Multiple Input, Single Output) and SIMO (Single Input, Multiple Output).

In conventional wireless communications, a single antenna is used at the source, and another single antenna is used at the destination. In some cases, this gives rise to problems with multipath effects. When an electromagnetic field (EM field) is met with obstructions such as hills, canyons, buildings, and utility wires, the wave fronts are scattered, and thus they take many paths to reach the destination. The late arrival of scattered portions of the signal causes problems such as fading, cut-out (cliff effect), and intermittent reception (picket fencing). In digital communications systems such as wireless Internet, it can cause a reduction in data speed and an increase in the number of errors. The use of two or more antennas, along with the transmission of multiple signals (one for each antenna) at the source and the destination, eliminates the trouble caused by multipath wave propagation, and can even take advantage of this effect.

MIMO technology has aroused interest because of its possible applications in digital television (DTV), wireless local area networks (WLANs), metropolitan area networks

(MANs), and mobile communications.

Fig1: MIMO exploits multipath propagation to multiply link capacity[9]

1.2 COGNITIVE RADIO NETWORK

The term Cognitive Radio was proposed by Joseph Mitola in 1999 and is defined by Simon Haykin as an intelligent wireless communication system that is aware of ambient radio environment and is able to adapt to the varying environment by adjusting its transmission parameters. Cognitive radio has two main characteristics: Cognitive Capability: It refers to the ability of capturing (sensing) information from the radio environment, thus provides spectrum awareness. Reconfigurability: It enables the CR to be dynamically programmed according to the radio environment. Cognitive radios are derivative of SDRs where digital processing operations are implemented in software.

[A] COGNITIVE RADIO ARCHITECTURE:

The typical cognitive radio architecture consists of three sub-systems : Digital transceiver , Channel monitoring and spectrum sensing module and Communication management and control unit The digital transceiver further consists of RF front end and baseband processing unit as shown below

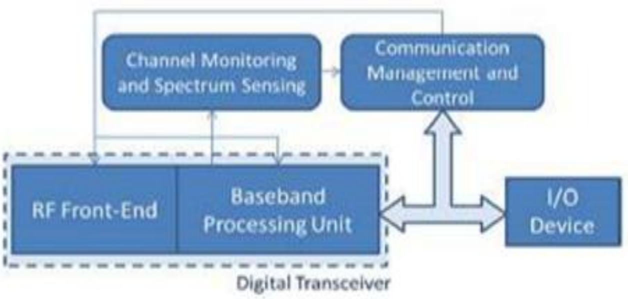

Fig 2: cognitive radio physical architecture.[8]

The RF front-end module corresponds to the hardware part of CR whose function is the reception, down conversion, amplification, mixing , filtering etc. The baseband processing unit is implemented in software and is responsible for all the necessary digital processing of the signal like modulation and coding. The channel monitoring and spectrum sensing module is capable of spectrum sensing and sending information to communication management sub-system so that the CR can adjust its operation parameters. The communication management and control subsystem manages all CR operations namely switching mode decisions.

[B] COGNITIVE CYCLE:

A Cognitive Radio system performs four cognitive tasks:

Spectrum Sensing
Spectrum Management
Spectrum Mobility
Spectrum Sharing

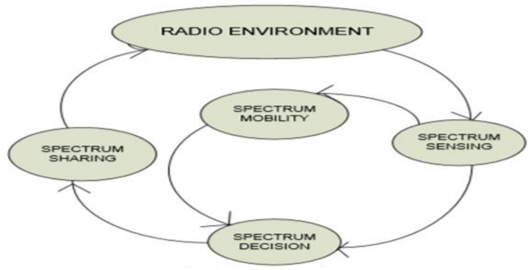

Fig 3: cognitive cycle[8]

Spectrum sensing aims to determine spectrum availability and the presence of the licensed users. Spectrum management is to predict how long the spectrum holes are likely to remain available for use to the unlicensed users. Spectrum sharing is to distribute the spectrum fairly among the secondary users. Spectrum mobility is to maintain seamless communication during transition to better spectrum.

II. RELATED WORK

Flow chart of the proposed algorithm

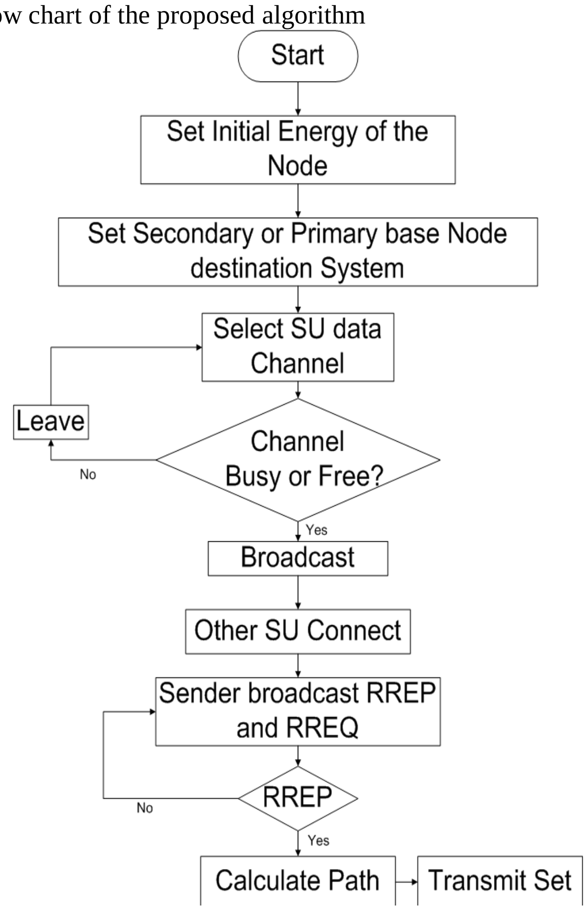

Fig 4: Flow chart of the proposed method

Flow chart presented above shows the process of the suggested algorithm. This proposed algorithm will be implemented in the next phase. To find efficient pattern is main idea of this algorithm

Proposed Algorithm
Begin

1. Set initial data packet node, energy,
2. Set primary and secondary user,
3. Secondary user update channel,
4. Identify Busy/Update channel,
5. Use mobility model with amodv routing protocol using leatch protocol,
6. Accept and provide optimum spectrum in CR,
7. Calculate shortest path for packet transrecevier,
8. Final o/p

End

Proposed Algorithm sudo code:

```
smv2: summary messages vector of node j
boolean different = exchange(smv,smv2)
if Not (different) then
   continue
else
   for each NonCommonMessage-m in smv do
      node-k: destination of m
      if isSignal(m) then
         removeRedundantMessage (m)
         removeMessage.add (m)
      else if (U_{i,k} < U_{j,k} and SS_i ≥ SS_i) or
            (U_{i,k} < U_{j,k} and SS_j - SS_i ≤ SS_jB_j) or
            (L_m ≤ θ) then
            requestMessage.add (m)
      end if
for each NonCommonMessage-m in smv2 do
      node-k: destination of m
      if isSignal(m) then
         removeRedundantMessage (m)
         removeMessage.add (m)
      else if (U_{j,k} < U_{i,k} and SS_j ≥ SS_i) or
            (U_{j,k} < U_{i,k} and SS_i - SS_i ≤ SS_iB_i) or
            (L_m ≤ θ) then
            requestMessage.add (m)
end if
```

IMPLEMENTATION STRATEGIES:
The proposed approach work on design cognitive radio using matlab and also design scenario base on aomdv protocol.
MATLAB:
MATLAB (matrix laboratory)provides numerical environment and fourth generation programming language which is developed by Math Works.
It allows matrix manipulations, plotting of functions and data, implementation of algorithm, provide GUI, and interfacing with programs written in other languages, including C, C++, Java.

Input:

No of Nodes	10,20,100
Dimension	100×100 meter
Time	100 sec
Initial Energy	0 to 1 joule
Threshold	0.5 joule
Random Waypoint Model	

OUTPUTS:

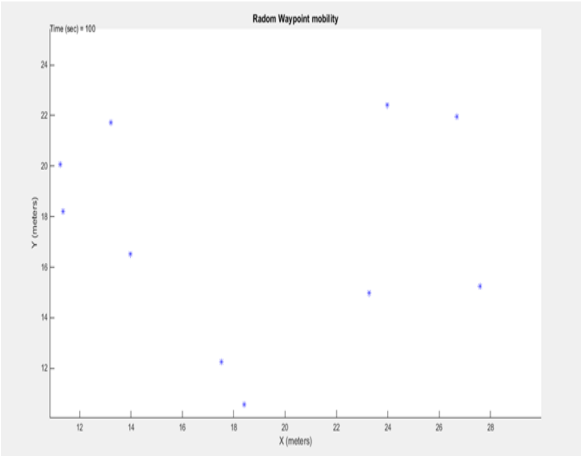

Fig 5: Random Waypoint mobility model node 10

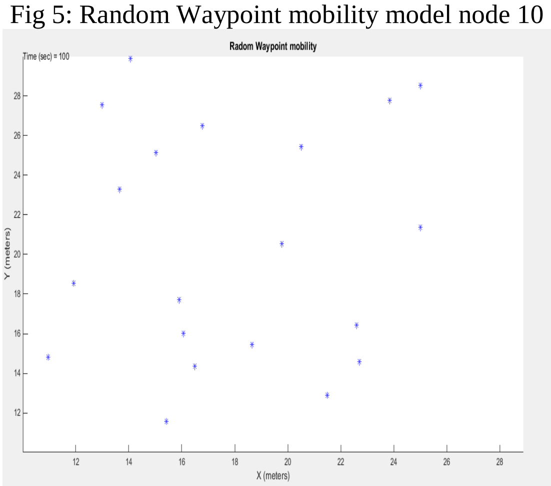

Fig 6: Random Waypoint mobility model node 20

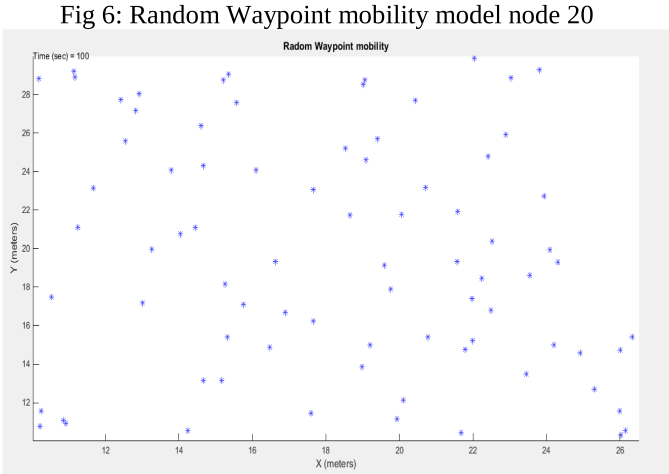

Fig 7: Random Waypoint mobility model node 100

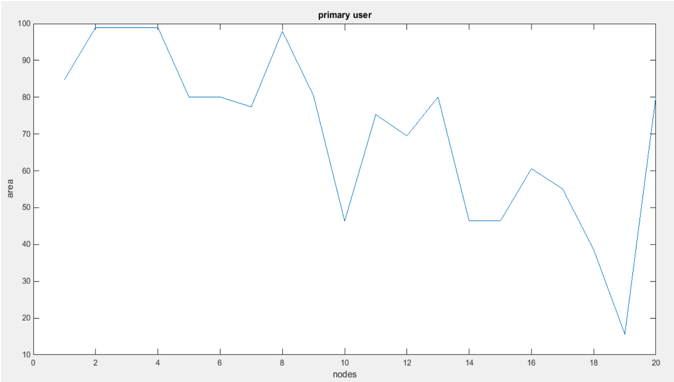

Fig 8: Energy based Primary user Selection

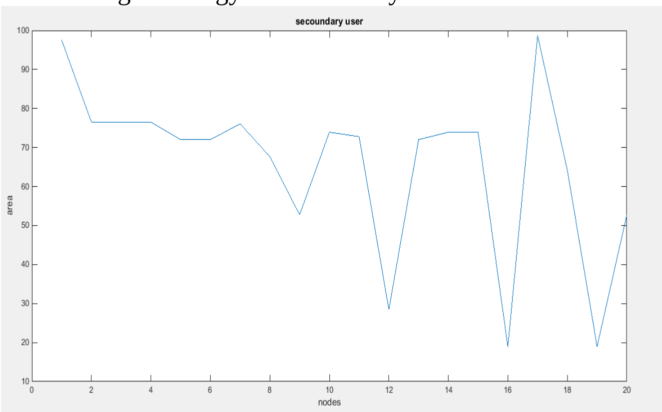

Fig 9: Energy based Secondary user Selection

III. CONCLUSION

Multiple secondary users are present in the MIMO cognitive radio network, the joint optimization of inflator factor and input covariance matrix of each SU is studied.

This problem is formulated as the maximization of the system achievable rate with the guarantee of not affecting PU's transmission. We propose one algorithm to solve the problem iteratively and it is shown to work well by simulations. In this paper, we give simulations when the transmitters only have channel distribution information.

However, once there exists the feedbacks of CSI from the receivers, they can be easily utilized during the optimization as the same way in. That is, the results in this paper also apply for the network with imperfect CSIT.

Future Work
Work of different routing protocol like MAODV, SAODV and DSR.

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