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DOABLE RATE OF SPECTRUM SHARING COGNITIVE RADIO MULTIPLE-ANTENNA CHANNELS USING WATER FILLING POWER ALLOCATION ALGORITHM

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ABSTRACT

We analyzed and dissected the spectral efficiency gain of an uplink Cognitive Radio (CR) Multi-Input-Multi-Output system in which the Primary User (PU) shares the spectrum with the Secondary User (SU), using a specific pre coding scheme to communicate with a common receiver. The main contemplation of our proposal is the selection of relay and to analyze spectrum sharing in cognitive radio networks and to perform the selection of relays models to reduce the interference of primary region and achieve the maximize rate in secondary region. We are implementing Multiple Relays to carry out the communication even more effectively, we are also using ARP(Alternating Relay Protocol) to increase the data rate in the primary side and to reduce the interference in the secondary side, appending to this we are using Monte Carlo Algorithm for continuous iteration of communication because communication always should be in a continuous form to increase its efficiency, so for this reason we use this algorithm because it not only allows the iteration of communication in a continuous form but also it reduces the power consumption which also make economically feasible and finally we are using Frequency Selective Fading to select the frequency range according to our rationale and we are not using TDMA and CDMA which basically involves lot of disadvantages like the selection of the desired time slot and apposite users which will suit for only certain type of communication as it will be found to have many disadvantages, so in our paper the implementations which we made is found to stand as a strong refuge in meeting the customer satisfaction and also it is found to be economically feasible. At the common receiver, we also adopt a Successive Interference Cancellation (SIC) technique to eliminate the effect of the detected continuous interference in the primary signal. We exemplify that a water-filling power allocation algorithm at the Primary User which can increase the secondary rate with a complete elimination of interference in the primary side and also the power consumption is found to be low as we are amending this water filling algorithm with the multiple relays and also it initiates the increase in the data rate to ensure the more effective communication.

INTRODUCTION

The Federal Communication Commission has stated the fact that due to the increase in the spread of the current wireless services and wireless communication evolution more bandwidth is required to offer more high data rate services and also the traditional used accessible radio networks is found to be critically scarce so to overcome all these disadvantages we go in for cognitive radio network approach. In general the Cognitive radio is a transceiver and it is found to support multiple users, this Cognitive Radio network is an approach which helps to reduce the interference in the primary region and to increase the data rate in the secondary region Spectrum sharing is the most suitable technique to enhance the communication rate more smoothly and efficiently, so this Spectrum sharing is nothing but which helps the secondary user who is considered to be the unlicensed users to share the network with the primary user who is considered to be the licensed user and this approach continues until the interference in the primary region is endurable. This quandary is frequently formulated as increasing the secondary rate by reducing the interference constraints in the primary region and it is also found to be handled as a dual role as both minimizing the interference rate in the primary and maximizing the data rate in the secondary regions. At present there are number of spectrum sharing techniques available at present in the souk which can work under delineated circumstances. But these spectrum sharing approaches varies drastically from very simple to extremely complex situations and it is notified to achieve even with extremely difficult technologies which in future is found

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to be even more advancement to come into existence. This spectrum sharing technique generally varies from simple problems like geographic sharing between two types of fixed systems and extremely complex problems like mobile technology to share with multiple government systems which might take several years to develop, test and implement in an economically rational manner. Bringing this spectrum sharing approach into reality will surely leads to the looming of what types of systems can be shared, negotiating and stipulating access rights.Adapting the existing networks to assimilate with the new sharing and developing infrastructures and devices to implement the sharing, endorsing equipment using new test procedures and equipment for observance, and finally enforcing this acquiescence.

In general there are three main CR techniques available and they are underlay, overlay, and interweave. Many studies were focusing on determining the performances of the SU when such techniques are adopted. To this end, one has to distinguish two CR strategies: Orthogonal transmission: in which the PU does not feel the SU communication at all. The SU spots spectrum holes in (space, time and frequency) then opportunistically performs communication. This strategy is called: interweave CR mode .Non-orthogonal transmission: in which the SU is allowed to communicate concurrently with the PU. However, the secondary communication is limited to a certain interference-temperature tolerated by the primary user. This strategy is called underlay CR mode. The interweave mode is based on the strategy of communicating in the non-used primary resources.

Thus, there is no direct effect on the primary communication performances. Meanwhile, this requires a continuous channel sensing from the SU in order to detect the activity/inactivity of the PU. However, the resulting SU rate is limited and can be zero in the case of excessive or full PU activity. On the other hand, in the underlay mode, the PU is willing to tolerate some interference caused by the SU by defining a certain predefined threshold to be respected. This mode allows the SU to transmit even if the PU is at full activity. Furthermore, the adoption of the Multiple-Input and Multiple-Output (MIMO) antenna in CR is seeming to be beneficial to the SU as well as the PU .In previous works, the authors adopted a specific precoding/decoding technique to avoid interference between the PU and the SU. In particular, a space alignment technique was adopted in MIMO CR scenarios and also only limited amount of relays are used which ultimately brings interference and also consumes more power. However, in this paper we can overcome this problem as we are using multiple relay networks and also we are using a combination of water-filling power allocation and Monte Carlo protocol to increase the data rate and also to reduce the interference rate thus enhancing the effectiveness of communication.

Our contribution in this paper is described as follows

1. We are using multiple number of relays, this enhances the rate of communication and also it reduces interferences, it also avoid traffic in the process of communication.
2. We are using the ARP (Alternating Relay Protocol) in order to reduce the interference in the primary region and to increase the data rate in the secondary region.
3. We are using Monte Carlo Algorithm, as communication is a continuous process and to avoid any interference we go in for this algorithm as it provides a continuous iteration of flow of signal in an efficient manner and also the water filling power allocation algorithm helps to reduce power to a certain extreme limit.
4. In this paper we use Frequency Selective Fading to select the desired range of frequencies which we need for the communication purpose accordingly and we are not going in for the Rayleigh fading as it involves Line Of Sight (LOS).

The rest of the paper is organized as follows. In Section II the system model is represented, Section III describes the Successive Interference Cancellation (SIC) concept, Section IV. Represents the numerical results and Section V.provides the conclusion of this paper.

System Model

The system model generally consists of a communication link which consists of a Primary User(PU) and a Secondary User(SU) . The PU, as a licensed user, exploits the channel while the SU, as an unlicensed node, is allowed to share opportunistically the spectrum and to access the channel under some constraints to maintain a certain amount of effective primary communication.

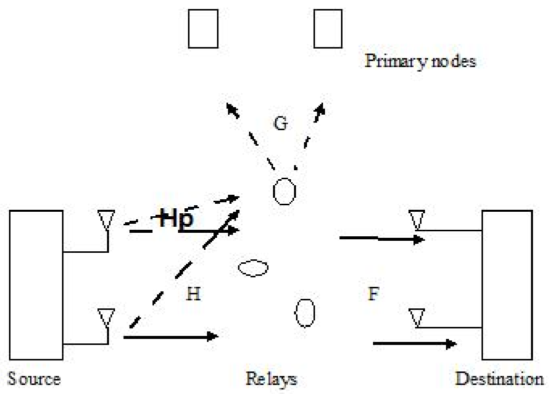

fig.1 Representation of system model

From the system model, the representations are made for Source, Relay and Destination as source (S), relay (i) and destination (D). This is the general outline of our system; here one more nodes called primary users are taking as a part. As we know the licensed user called primary and unlicensed users called secondary. The spectrum sharing network includes multiple primary nodes (Np) and secondary system with M antenna source and destination, and n single antenna half duplex relays. So the communication happens between source and destination via two hops. One is source to primary it is done via relays and second hop is between relay to destination. Multi hop relaying and cooperative communication is known to significantly mitigate interference and increase the throughput in many multiuser scenarios. Each nodes are assumed to be equipped with N antennas, and the channel gain matrices representing the links between the PU and and between SU are denoted by Hpp and Hsp, respectively. In the framework of an uplink scenario where the receiver is common to both transmitters, the interference may cause a significant deterioration to both primary and secondary performances. However, by adopting an interference temperature protection and however the PU tolerates the interference level per receiver antenna denoted as Ipeak. This shows the fact that if the Secondary User is found to have any interference then the whole communication process will blight up, hence to overcome this we in this paper has proposed some of the ways such that to reduce the interference in the primary and allow or permit the increase in the data rate in the secondary to enhance the efficiency of communication. In general a communication system is found to have a transmitter and a receiver ,so here the Receiver is represented as R,and the received signal is represented as y;

Y = $H_{pp}\varphi_p s_p + H_{sp}\varphi_s s_s$**+w**

Where Hpp and Hsp are assumed to be independent, φ_p and φ_s are the linear pre coding matrices and s_p and s_s is denoted as the signal transmitted through the primary user and the secondary user and w is the noise component which is found to be added.

Successive Interference Cancellation (SIC)

Successive interference cancellation (SIC) is a promising technique for increasing the capacity of uplink CDMA systems due to its low complexity, allowance of strong error-correcting codes, and robustness in an asynchronous environment. First channel error can easily cause catastrophic error propagation in a normal SIC system. An optimum power control mechanism is derived that is specially designed for feasible amount of power distribution that is feasible to mitigate error correction. In general the CDMA is found to reduce power but its efficiency is found to be only 50%, so in our project we make us of Frequency Selective Fading which overcomes these types of discrepancies. Secondly non-uniform received power level is kept at the receiver, now this is found to have complexity in the power control performance as all users must be kept near the power consumption level which differ basically of the decoding order.

Finally a multipath channel seriously hinders previous SIC systems, suggesting for a need for an integrated OFDM front end. Analytical BER expressions for a normal Multi-Carrier SIC (MC-SIC) are derived using frequency selective fading channel, simulation results also confirms the fact of using the narrowband carriers to combat multipath. There is only a small degradation related to a AWGN channel and it is shown that the proposed MC-SIC system design with optimal power control increases capacity by up to an order of magnitude over current industry systems.

NUMERICAL RESULTS

Our approach stands simple when compared with the other papers and also it proves to provide effective communication, here in our paper we are not using Rayleigh Fading as it involves Line of Sight(LOS) which stands as an obstacle for not allowing the proper communication process to happen as if any hindrance comes in contact during the transmission or reception of signals the process is found to be stopped, so we go in for Frequency Selective Fading channel ,now this approach allows us to select the desired frequency range according to our convenience which fosters the way for more effective and economically feasible communication. We are also using Eigen modes notion to analyze the channel capacity this is done because in a communication system noise is founded to be added with the communication process and this noise is found to be in the form of both real and complex values and to evaluate these values we go in for Eigen modes perception. In general the antenna radio frequency range is from 30Hz to 300GHz.

The Bit error rate is considered to be small then only the Signal to Noise ratio can be high so that this factor contributes to the reduction of interference and also it leads to an effective communication, the graphical representation between SNR and BER is represented in the fig.2 and its theoretical representation in equation format is also mentioned below.

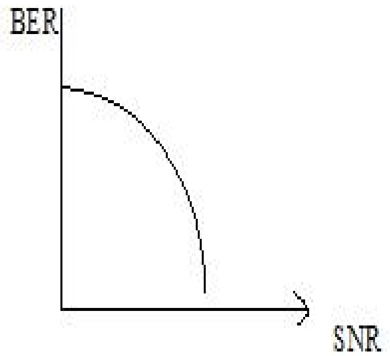

Fig2 Performance of SNR Vs.BER

Mathematically it is expressed as,

H=(randn(Nr, Nt)+sqrt(-1)*randn(Nr,Nt)) /sqrt(2);

Cn(nSNR,n Sample)=log2(real(det(eye(Nt)+ rho/Nt*H'*H)));

So here H is the representation of a reception functioning and Nt aare considered to be the number of receiver and number of transmitter, so this equation also resembles the fact of obtaining the sample values also. The graphical outcomes which are shown below are the outcomes which we obtained from our project and there are three different outcomes which represents the Relay performance, SNR rate performance and finally Power distribution performance.

In general the relay load decreases then it is found that the data rate will increase and this is the right contemplation for an effective communication system, when this relay load increases then the data rate will decrease, so in our paper we have overcome all of these disadvantages by reducing the interference and increase the data rate. Here switch over process is found to be fast when the load increases and this is an essential phenomenon for the communication process. The information which is received in the receiver is passed to the relay and the relay promotes the communication rate and it also reduces the delay rate and interference and the desired output is received at the receiver with the desirable data rate which is found to be achieved.

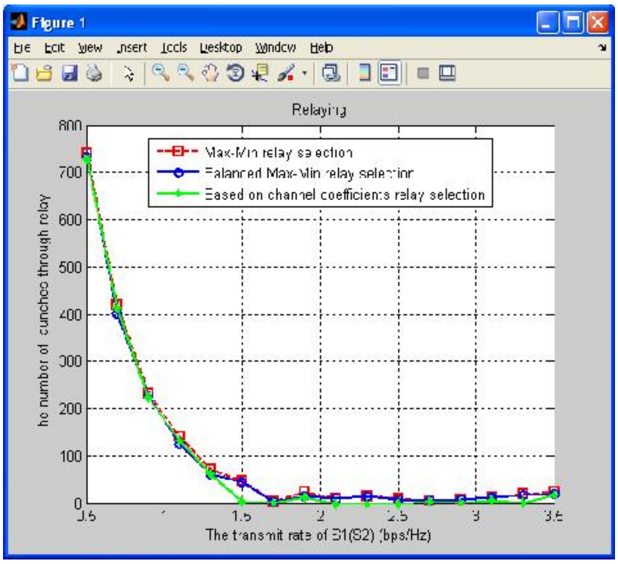

Fig.3 Representation of Relay performance

This graphical representation represents the outcome of the relay performance and it has three main considerations which are, Maximum-Minimum relay selection, Balanced Maximum-Minimum relay selection and Based on channel coefficients relay selection. This graph is plotted between the number of launches through relay and the transmit rate which is given in bps/Hz. Generally there are a number of primary and secondary users present in a communication system and the number of counts is always found to be in an increased manner, the Maximum-Minimum relay selection represents the concept of when the number of count is low the data rate will eventually increase and when this count decreases the data rate is also found to be decreased. The Balanced Maximum-Minimum relay selection shows the balanced form of the count rate and the data rate and so it helps in a provident relay selection method. Finally the Relay selection based on channel co-efficient are found to have three characteristics with it and they are, Source to Source; Source to Destination and Source to Relay all these three considerations are mainly focused on the concept of reducing the interference and increase the data rate accordingly.

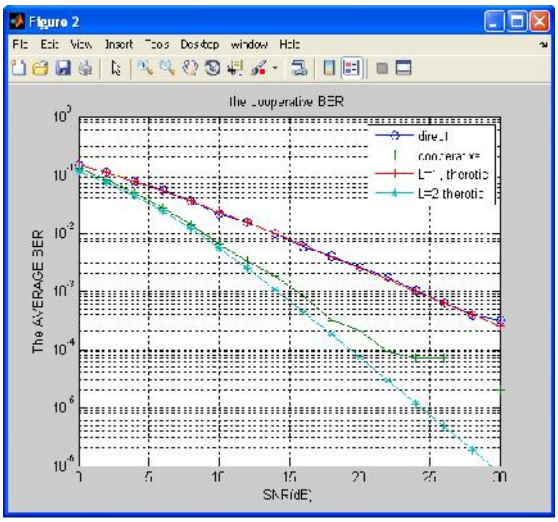

Fig 4 Representation of SNR Vs.BER

The above figure shows the representation of the SNR and the BER graphically, it is generally found that the BER rate must be reduced in order to increase the SNR rate so that the communication will be erroneous and also the interference rate will be vanished which eventually leads to the increase in the data rate with a drastic performance in communication rate.

The Signal to Noise Ratio (SNR) is considered to be a more crucial factor in reducing the interference rate and to increase the signal performance in the communication system.

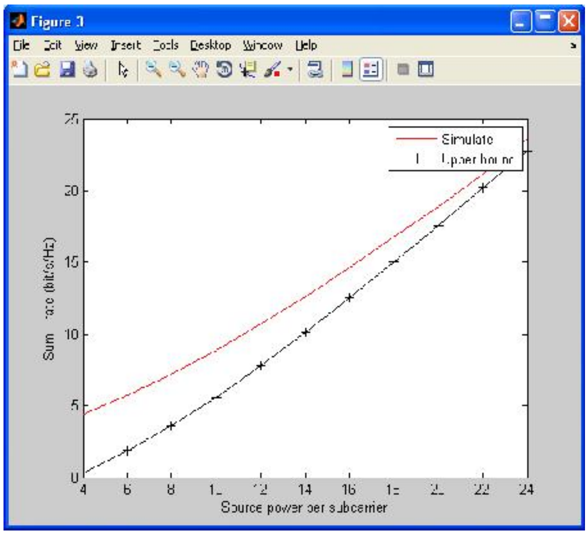

Fig.5 Representation of the power distribution

The above fig.5 shows the representation of the power distribution level and in our paper we are using Water filling Algorithm and which shows the power performance, the purpose of using this algorithm is that the power is utilized economically in a feasible rate, generally the initial amount of power we are giving in the source terminal is about 1000mw and this power is found to be utilized for the entire process in a feasible rate if this power is found to be scarce then this algorithm automatically regenerates power in a continuous successive manner and the Monte Carlo Algorithm also helps in the continuous iteration of the signals to enhance the communication rate. The graph is plotted between the sum rate and the source power carrier and is found to have a good performance rate due to the use of water filling algorithm.

CONCLUSION

In this paper, we have studied that the data rate can be achieved significantly increased amount in the secondary cognitive user in a spectrum sharing MIMO communication by reducing the interference in the primary user .The power is also found to be distributed in an economically feasible manner. We showed that the secondary. We showed that the secondary user and the primary user be haves in the same way as a licensed users with durably achieving the data rate. The purpose of using Successive Interference Cancellation is to reduce the interference significantly which when occurs during a communication process. So finally the outcomes of the relay performance, SNR performance and the power rate performance are all shown and represented and their performance level is found to be increasing and found to achieve the economical feasible rate. The cognitive radio approach is generally found to have many applications especially in the field of medicine and networks and it is found to have a increased performance rate in the communication network system. So therefore we have achieved increased data rate with power reduction and interference cancellation and it is also found that the relay communication and channel modulation can be also achieved with high data rate communication.

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