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A New Approach To Analyse Qosparameters In Cognitive Radio

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Abstract- Cognitive radio is a technology for wireless communication in which either a network or a wireless node changes its transmission or reception parameters to communicate efficiently avoiding interference with licensed or unlicensed users. The spectrum sharing network consists of a pair of primary users (PUs) and a pair of cognitive users (CRs).The pair of PUs establishes a wireless link as the PU link. The PU link and CR link utilize spectrum simultaneously with different priorities. The PU link has a higher priority to utilize spectrum with respect to the CR link. The proposed work focusses on different spectrum allocation techniques for the secondary users, based on Genetic Algorithms and an analysis of the performance of these techniques with an assumption that the radio environment has already been sensed and the QoS requirements for the application have been specified either by the sensed radio environment or by the secondary user itself. The proposed work focusses towards the technique that not only work on the QoS of cognitive radio but also covers all the parameters for efficient communication like power and bandwidth. When the PU link utilizes spectrum, a desired quality of service (QoS) is to be assured and the CR utilizes spectrum with an opportunistic power scale under this constraint, assuring the desired QoS on the PU link. To compute an optimal opportunistic power scale for the CR link, a fuzzy-based opportunistic power control strategy is proposed based on the Mamdani fuzzy control model using four input variables: QoS,RSSI, bandwidth as well as noise delay with the opportunistic power management along with bandwidth allocation.

Keywords- Cognitive radio networks, Fuzzy control, Power control, Bandwidth allocation

I. INTRODUCTION

The idea of cognitive radio was first presented officially in an article by Joseph Mitola III and Gerald Q. Maguire, Jr in 1999 [8]. It was thought of as an ideal goal towards which a software-defined radio platform should evolve: a fully reconfigurable wireless black-box that automatically changes its communication variables in response to network and user demands. The main functions of Cognitive Radios are:

i)Spectrum Sensing: It refers to detect the unused spectrum and sharing it without harmful interference with other users. It is an important requirement of the Cognitive Radio network to sense spectrum holes, detecting primary users is the most efficient way to detect spectrum holes. ii)Spectrum Management: It is the task of capturing the best available spectrum to meet user communication requirements.

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Cognitive radios should decide on the best spectrum band to meet the Quality of Service requirements over all available spectrum bands, therefore spectrum management functions are required for Cognitive radios, these management functions can be classified as:

- spectrum analysis
- spectrum decision

iii)Spectrum Mobility: It is defined as the process when a cognitive radio user exchanges its frequency of operation. Cognitive radio networks target to use the spectrum in a dynamic manner by allowing the radio terminals to operate in the best available frequency band, maintaining seamless communication requirements during the transition to better spectrum.

iv)Spectrum Sharing: It refers to providing the fair spectrum scheduling method, one of the major challenges in open spectrum usage is the spectrum sharing.A fully cognitive radio should have the ability to do the following:

a)Tune to any available channel in the target band

b)Establish network communication and operate in all or part of the channel.

c)Implement channel sharing and power control

d)Implement adaptive transmission bandwidth, data rate and error correction schemes to obtain best throughput.

e)Implement adaptive antenna steering to focus transmitter power in the direction required to optimize received signal strength.

Regulatory bodies in various countries (including the Federal Communications Commission in the United States, and Ofcom in the United Kingdom) found that most of the radio frequency spectrum was inefficiently utilized [9]. For example, cellular network bands are Over loaded in most parts of the world, but amateur radio and paging frequencies are not. Independent studies performed in some countries confirmed and concluded that spectrum utilization depends strongly on time and place. Moreover, fixed spectrum allocation prevents rarely used frequencies (those assigned to specific services) from being used by unlicensed users, even when their transmissions would not interfere at all with the assigned service. This was the reason for allowing unlicensed users to utilize licensed bands whenever it would not cause any interference. This paradigm for wireless communication is known as opportunistic spectrum access and is a feature of Cognitive Radio.Spectrum sharing is an important task of cognitive radio systems.The optimal power control is an important research topic in spectrum sharing. The cognitive radio network is studied and classified into two types of mechanisms: the opportunistic spectrum access and the spectrum sharing. In opportunistic spectrum access, the primary user (PU) link and cognitive user (CR) link utilize spectrum exclusively.

The CR link senses the spectrum to seek spectrum holes for opportunistic spectrum access.To maximize the efficiency of spectrum usage, the CR link senses the spectrum with an optimal sensing strategy and inters sensing duration. In spectrum sharing, the PU and CR links utilize spectrum simultaneously. The CR link utilizes spectrum with an opportunistic power scale under a given interference constraint [4].The fuzzy-based power control scheme considers the interference level caused by the CR link to the reclaiming PU link, the distance from the PU link to the reclaiming PU and the received power difference of the PU link at base station. With this power control scheme, the CR link can select an optimal spectrum band and transmit with an optimal power scale [3]. This paper proposed the concept of interference radius and discussed the relationship between the interference and relative distance. Based on the proposed interference radius of the PU link, the CR transmits with an opportunisticpower scale depending on its relative distance. The power scaling law of single-hop cognitive radio networks was introduced in power management principle in the spectrum sharing network.According to the model, when the PU link is considered as idle or robust, the CR transmits with its peak power. Otherwise, when the PU link is considered as sensitive to interference, the CR transmits with a fraction of its peak power. Using this opportunistic power control strategy, the efficiency of spectrum usage is optimized. (those assigned to specific services) from being used by unlicensed users, even when their transmissions would not interfere at all with the assigned service.This paradigm for wireless communication is known as opportunistic spectrum access. A novel fuzzy logic based dynamic power management with improved QoS parameters in cognitive radio and efficient bandwidth allocation technique is proposed in the present work.

II. PROPOSED SYSTEM

The efficient use of available licensed spectrum is becoming more and more critical with increasing demand and usage of the radio spectrum. Recent contributions suggested efficient use of licensed spectrum. One of the ways is the use of “Cognitive Radio”.A cognitive radio (CR) employs software to measure un-used portions of the existing wireless spectrum (so-called white space) and adapts the radio's operating characteristics to operate in these unused portions in a manner that limits interference with other devices.

We know that only fixed part of spectrum is utilized by primary users and rest of the spectrum is unused. The proposed model which works on the improvement of QoS parameters in cognitive radio with efficient power management as well as bandwidth allocation. The proposed model works in three steps. In step one the QoS parameters in cognitive radio is improved by using Genetic Algorithm with efficient spectrum utilization . In step two the fittest function from step one is taken on which the fuzzy rule for the power management is applied & in step three, the bandwidth is allocated to cognitive user in the network in an efficient way.

Genetic Algorithm:

Genetic algorithm (GA) is a technique based on evolutionary computation to find the approximate solutions to the optimization problems[2]. Genetic algorithms are inspired by Darwin’s theory of evolution and the best or simply the survivor among the available pool is an evolved solution. The concept of genetic algorithm lies on the fact that the measure of success of an individual is its fitness i.e. “survival of fittest”. It states that the best combination of genes and their resulting chromosomes yields the strongest individual, which will survive the longest.The first step of GA requires the solutions to be encoded into chromosomes.

In case of cognitive radio scenario,the GA uses a population of chromosomes that represent the search space that determine their fitness by a certain criterion (fitness function). In each generation (iteration ofthe algorithm), the most fit parents are chosen to create offspring, which are created by crossing over portions of the parent chromosomes and then possibly adding mutation to the offspring. GA is proved to be able to achieve very good performance in multi-objective optimization problem.four performance measures which are taken into consideration in this work are: QoS, RSSI,bandwidth and noise delay.The genetic algorithms may have a long convergence time for an optimal solution but normally do not take much time to give very good solutions [7].

Outline for the Genetic Algorithms :

1. Start: Generate a random initial population of n chromosomes that consists of the available solutions for the problem.
2. Fitness: Emulate the fitness of each of the chromosomes in the initial population.
3. New population: Reproduce,according to the following steps until the next generation completes.
4. Selection: Select two chromosomes that have the best fitness level among the current population.
5. Crossover: Crossover the two selected chromosomes considering the crossover probability, to form the off springs for the next generation. If this operation were not performed the offspring would be the exact copy of the parent chromosomes.
6. Mutation: Mutate the new offspring at each defined mutation point, considering the mutation probability and place it in the new population.
7. End Condition: Repeat the above steps until certain condition (maximum no of population or the desired optimum has been reached), has been met.

Fuzzy Based Power Management:

Spectrum sharing is an important task of cognitive radio systems. The optimal power control is an important research topic in spectrum sharing[1]. In this step the proposed model apply the fuzzy rule for the power management. The fuzzy rule is applied on three fittest functions available from Genetic Algorithm i.e., QoS, bandwidth,RSSI and noise delay, which are considered as input variables. The transmission power is managed in cognitive radio using Fuzzy Rule.

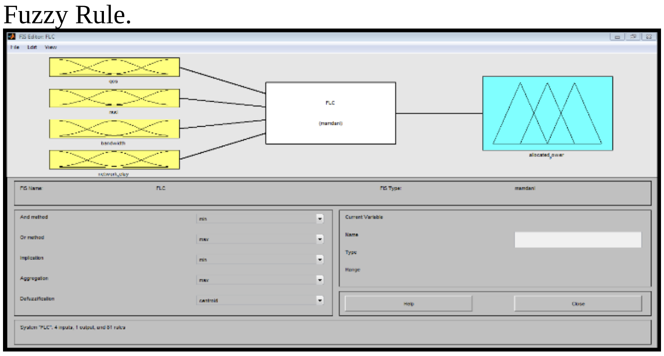

Fig1:fis editor

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Bandwidth Allocation:

As report of FCC shows that the use of bandwidth allocated to primary user is not utilized efficiently[5].In this technique we allocate the bandwidth to secondary user which is left from primary user.In this section we utilized the unutilized part of bandwidth efficiently.How this will happen see following fig:

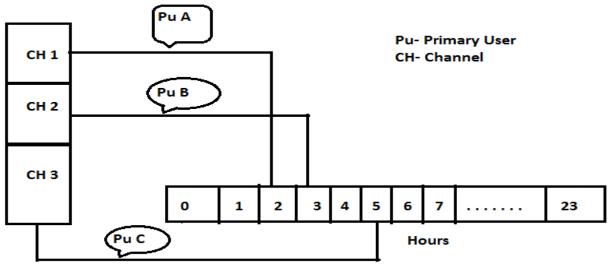


Fig2:bandwidth allocation

III. SIMULATION RESULT

The proposed model fulfills all the aspect of communication in cognitive radio. This model provides an improvement in the QoS points, manage power& efficiently utilizes the bandwidth. Simulation result shows in sections A section shows the result of Genetic Algorithm fitness function section B shows fuzzy rule based power management & the last section shows the bandwidth allocation of each user.

Section A: Overall Fitness Function

Four performance measures which are taken into consideration in this work are: QoS , RSSI , Bandwidth and N/W Delay. The genetic algorithms may have a long convergence time for an optimal solution but normally do not take much time to give very good solutions.

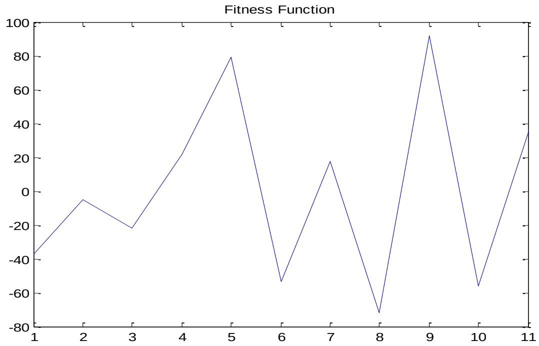
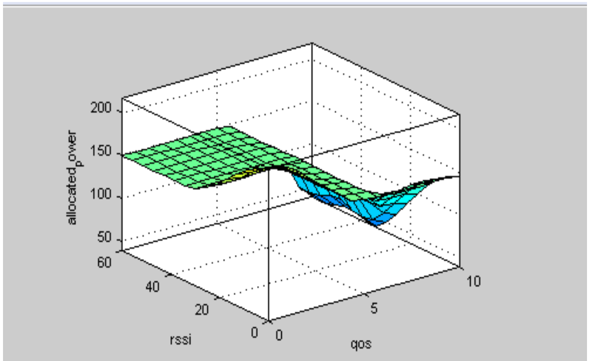


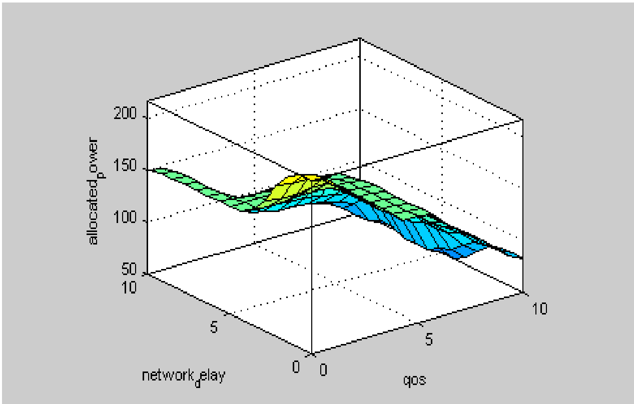
Fig3:overallfitnesss

Section B:Fuzzy Rule Power Management

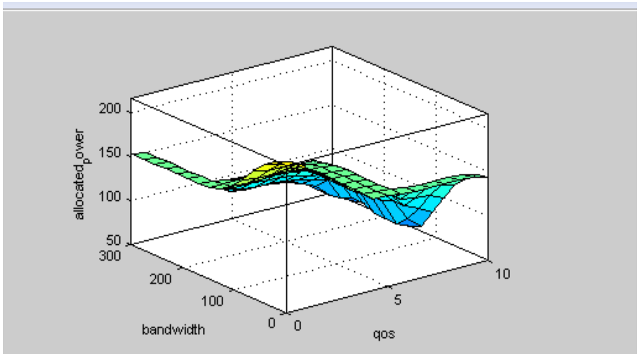
The fuzzy rule is applied on four fittest functions available from Genetic Algorithm i.e. QoS, Receive Signal strength Indication(RSSI), Bandwidth and Network Delay, which are considered as input variables. The transmission power is managed in cognitive radio using Fuzzy Rule. The transmission power is managed in cognitive radio using Fuzzy Rule



Relative power bet QoS&RSS



Relative power bet QoS&Network delay



Relative power bet QoS& Bandwidth

Section C:Bandwidth

In cognitive Radio most preference is given to Primary Users because of this allocation of bandwidth to each user is inefficient.In this section we use the unutilized part of by bandwidth by primary users for this calculate:

bandwidth_factor = bandwidth / total_bandwidth;

power_factor = out_power / total_power;

out_bw(count)=bandwidth(count)*(1+(bandwidth_factor * power_factor));

To allocate bandwidth to secondary users we use remaining part from Primary Users: bandwidth_available = total_bandwidth - sum(sum(out_bw(1:PrimaryNodes)));

out_bw(count)=bandwidth(count)*(1+(bandwidth_factor * power_factor));

Using these formulae we calculate the bandwidth of each primary user and then it will allocate the bandwidth to secondary user.

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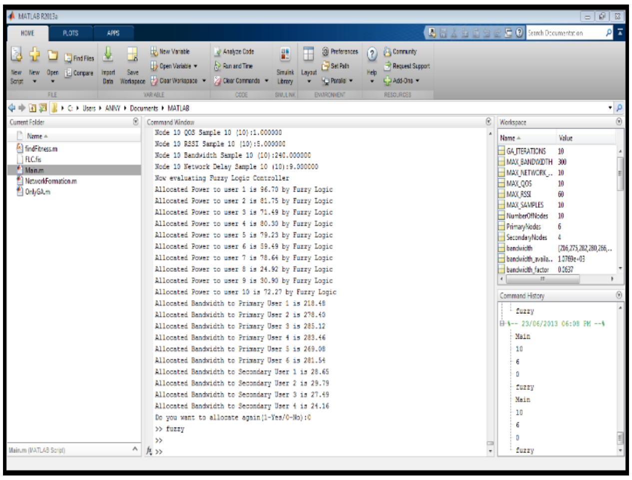

Fig4 :Bandwidth Allocation to each user

IV. CONCLUSION

The proposed concept for cognitive radio network with a fuzzy-based opportunistic power control strategy has advantages over the network without power control strategy. Another advantage of this proposed model is that it improves the QoS parameters in Cognitive Radio using Genetic Algorithm and efficiently utilized the bandwidth. The proposed system is very easy to implement. The Genetic Algorithms are very easy to implement and can be reused to solve other problems. Once a basic G.A. is implemented, a new object can be added(i.e. another chromosome) using the same encoding scheme by changing the existing fitness function to solve another optimization problem.

FUTURE WORK

With the explosion of wireless voice and data traffic that is expected over the next 10 years, we must be willing to embrace this highly innovative approach to optimizing spectrum access and utilization. The proposed model consider a few parameters only, in order to maintain the simplicity in the research. These are the spectral efficiency, interference; system-to-noise ratio .

Some other parameters such as data rate, frequency bands, the modulation scheme, power and BER etc can be introduced in the research at the advanced stages.

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