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Enhancement in Spectrum Sensing Algorithms for Cognitive Radios

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***Abstract*— In modern era, we need a wireless communication which is flexible and robust too. The available spectrum is static and used inefficiently due to licensing. Cognitive radio gives a smarter and fair way to use the licensed band. The most important function of cognitive radio network is that they scan that the primary user is present or absent. This is referred to as spectrum sensing. Both secondary user and group of secondary user can function it. Investigation is done on Nakagami fading channel. Appropriate expression of closed form for average probability of detection and average probability of wrong alarm is derived. ACSS and optimization technique of cuckoo search (CS) are compared in terms of spectrum's detection probability. The comparison shows that the in networks of cognitive radio, the spectrum sensing sensitivity are improved by the use of method called ACSS i.e. asynchronous cooperative spectrum sensing. This is done by the application of optimization technique of cuckoo search. Evaluation is also done of wrong alarm probability or of spectrum sensing detection by the use of method called energy detection.**

***Index Terms*—Cognitive radio, energy detection, cuckoo search algorithm, fading channels.**

I. INTRODUCTION

1.1 Definition

In many different contexts like communications, cognitive networks and cognitive radio etc. the word 'cognitive' has been used. Example is cognitive network vision. In this networks should be able to make decision of configuration regarding any ission and particular environment. Cognitive technology is required by the managed networks. The accomplishment of application should be understandable by the network and at a particular moment the work of network should be understandable by the application. So by learning requirements of application, allows network to use new capabilities and these requirements will meet by network protocol which will dynamically chosen. If the language is domain specific, users and operators could be enabled for goals description and its requirements. Resources balanced can be determined properly by cognitive networks by statements used in such languages.

The users of cognitive radio are present in the spectrum band which remains unused or empty mostly. We can say that cognitive radio gives a way to utilize empty licensed spectrum by temporarily accessing it to the secondary user in such a method so that they will not interrupt primary user or minimize the interruption. Following measures are taken for the use of licensed band by unlicensed or secondary users:

☐For the determination of various empty bands, thorough scanning of frequency bands should be there.

☐For secondary users the available band should be best. This selection is based on secondary user' s requirement.

☐ To avoid interference or minimizing it, before transmission on specified bands the level of power must be minimized. This will further help in increasing no. of secondary users.

☐Sharing of spectrum should be there so that empty bands are accessed by secondary users.

1.2 Vision

Cognitive radio aspires to achieve the aim of having a flexible wireless communication and efficient use of the available spectrum. This is required as the scarcity of spectrum is increasing due to increase in demand. By use of cognitive radio efficiency of spectrum will be increased and radio spectrum is enabled to be used dynamically.

Cognitive radio gives a way to utilize empty licensed spectrum by temporarily accessing it to the secondary user in such a method so that they will not interrupt primary user or minimize the interruption.

1.3 Motivation

Research fields area offer by cognitive radio is rewarded due to under utilities of the spectrum which is available, more spectrum is needed, this is the main objective of cognitive radio. Management of spectrum should be there because of scarcity of spectrum.

1. Talking about world today, nothing is there without communication, so it is essential.

2. To transfer any information far away, wireless communication is needed.

3. Spectrum scarcity is faced now-a-days due to increased users.

4. Management of spectrum is essential in today's world. So, to have users in a particular band, sensing of spectrum is required.

1.4 Features of Cognitive radio

Wireless network which are existing like wireless LAN IEEE 802.11 are having common security building blocks in cognitive network, they are very important.

1.4.1 Availability

For network of any type, the requirement which is

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fundamental is availability. The existence purpose of network will be defeated is it is unusable or down. Network becomes unavailable either for some time or all the time due to some targeted attacks like overflow of buffer attacks, jamming attacks etc. Data availability is an issue which is related to availability of network closely. In network, this is the data available to the user like information of users etc. If we talk about the network which is wireless, here availability means availability of medium of wireless transmission.[10-11]

In terms of cognitive networks, availability means primary and secondary users are able for spectrum access. The term availability, for primary users means transmission with any secondary user interference in licensed band. If we considered policies of dynamic spectrum access, the guaranty is there for primary user availability. The term availability, for secondary user means chunks are present of spectrum where transmission can be done without any interference caused with primary user. To use an opportunity, the large chunks are available of spectrum. There is no guarantee for secondary user of spectrum availability. In cognitive network which are centralized, availability means appropriate countering of attacks should be ensured by security mechanisms. [12]

1.4.2 Integrity

To protect the data from any deletion, modification etc, and integrity is used. It is the method in which between the process of sending and receiving data by an authorised user, it does not get changed. But there is some data which is variable; it means modification has to be done when data moves from one place to another place. Examples of variable fields are information of next hop, counting of hops etc So, selective field integrity is performed in which one some selected non-variable fields will be provided with integrity. In wireless network, the integrity is important as violators can easily access the wireless medium. For, the same reason security is added as the additional layer at link layer in wireless LAN's so that it becomes secure. The protocol used for security in this layer is CCMP. To verify the message integrity, MIC is used in this protocol. MIC is message integrity check. In cognitive radio network, these techniques can be used. [13-15].

1.4.3 Identification

For any communication device one basic requirement for security is identification. In this method, a user or a device gets associated with their identity. Example-IMEI i.e. international mobile equipment identifier is provided in cellular networks. This is equipment used for identification. This identifies uniquely identifies the devices of mobile in cellular network similarly. In cognitive network, in the devices of secondary user mechanism of tamper proof identification is built.

1.4.4 Authentication

In this scheme assurance is done of that the entity is what it should be. In this unauthorised user cannot access the system. Both the identity of entity and whether it has authority or not is checked in this, so this producer is necessary. If we talk in view of service provided, the scheme of authentication helps in protection of the service provide so that no intrusion which is unauthorised can enter into the system. Centralized certificate authority (CCA) is the authority on which mostly every authentication relies and user in the network also true this authority. The protocol of authentication requires that the squint entities should have signed identities by this CA and the certificates which are digitally signed will get verified and also exchanged by the squints for correct authenticity. Once establishment of squint authenticity is done, initiation of regular communication will be there. If we talk about cognitive radio network to distinguish the users whether they are primary or secondary is an important requirement. So, we can say that one of the basic requirements for this network is authentication. Cognitive networks which are centralized have wired backbone for connection of base stations of primary and secondary. So, here connection of CA will be easier i.e. connection to the wired backbone. But the cognitive networks which are distributed, over a wide geographical area, there are many dispersed secondary users. So, here the CA function will be difficult. [17]

1.4.5 Authorization

The authorization level varies for various entities. Example-removing a hostile user i.e. not giving access to network is the authorization of wireless access point. But other users are not having this authority in network. The policy called network access control tells the authorization level each entity has. Condition authorization is required in case of cognitive network. Conditional here is due to the fact that here the users who are unauthorized or called secondary users can transmit in authorised band or licensed band only till no interference is there with the primary user in communication in same band. It is very difficult to know about the particular secondary user who has interfered in communication of primary user. So, enforcement of authorization is hard. It is much harder in distributed network. So, in dynamic spectrum access, this authorization gives a unique challenge.

1.4.6 Confidentiality

This is similar to integrity. The work of integrity scheme is that it ensure that the does not get changed maliciously and the confidentiality scheme works for the assurement of unaccessed data by the way it is transformed. This is possible if the data which is transmitting is encrypted and cipher are employed there. The encrypted data should have a security key which is known by recipients only. So that the recipients can only decrypt it and data can be read by them. As we know, that the wireless medium is open to everyone, so encryption AES is emphases by IEEE 802.11 LAN with protocol CCMP to provide additional security layer at link layer for data encryption. The challenge faced by integrity and confidentiality is due to wireless med. Nature which is noisy and prone to errors. This is due to rely on ciphers which are very error sensitive. This property of sensitivity, consumes very large bandwidth if the conditions are noise as more retransmission occur. The above issue is very noticeable in cognitive networks where opportunistically access is there by secondary users to network and availability of spectrum is

also not guaranteed. [18-19]

1.4.7 Non-repudiation

Either sender or receiver is prevented from denying message transmitted in this technique. So, if message sent can be proved of having a claimed sender by the receiver and also received message can be proved of having claimed receiver by the sender. In setting of cognitive radio network, if any harmful unauthorised user is identified of violating protocol, then these techniques can be used to give prove of its misbehaviour and can band that user from secondary network. [20]

1.5 Cognitive Radio Networks

1.5.1 Spectrum Sensing

The cognitive networks has many primary requirements. One of them is spectrum sensing. It is the ability of spectral band scanning and identifying the unused channel which re used for transmission opportunistically. As the primary uses and secondary user are physically separated, no direct feedback is given to secondary user from primary user about the transmission. For detecting the transmission of primary user. The dependence is on ability of cooperative sensing or on the individuals of secondary users. As , the separation of primary users across a grand geographical area is spread, the challenging task is here is to sense accurately the whole spectral band. The rely of secondary user is on week signal of primary transmission for their presence estimation. The three categories in which techniques of spectrum sensing research falls are –detection of transmitter, detection based on interference and cooperative detection. Three techniques are used mainly for avoiding interference of transmission with primary. Interference temperature at a point is the amount of caused interference at some point in space by the secondary users. When transmission of primary user is occurring, the threshold which is near to primary receiver should be more than interference. But achieving this is not an easy task as secondary user do not know the location of receiver. The scanning of spectrum of secondary user should not confused with transmission of other secondary network from secondary users with primary transmission when many network are pre-secondary overlap.

1.5.2 Spectrum Analysis and Decision

There are some features of every spectrum band which are unique according to the user's number which are using the band and also according to the range of frequency. The available list of spectrum is determined by spectrum sensing. However, from the different bands which are available most appropriate band is decided by secondary user. There are many parameters of SNR which are commonly used, but evaluation of effectiveness is done by some spectrum bands characteristics which are: loss of path, interference errors in wireless link, delay in link layer and time taken for holding i.e the duration for which band can be used by the secondary user.

1.5.3 Spectrum Mobility

Switch between different spectrum accesses dynamically is the cognitive radio network agility. This refers to spectrum mobility. The continuity of spectrum access is not guaranteed to the secondary users in any of the bands which are licensed and the spectrum bands availability changes with time frequently, for designing protocols which are cognitive, the most important factor is spectrum mobility. During handoff of spectrum, the incurred delay is primary factor which affects mobility of spectrum. The employed protocols at different layers of stack of communication protocols are affected adversely by this delay. The difference in time between network belonging to secondary is the another factor which is important in spectrum mobility. It detects the transmission of primary and vacating of the spectrum band by secondary user. Harmful interference is caused to primary users during the period in which secondary users do transmission. To avoid this interference to get prolonged, the upper bounds are set by FCC on duration of spectrum handoff.

1.6 Methodologies

Cuckoo search implementation is explained. This is the sensing algorithm based on optimisation. In the work methodology, the comparison of this algorithm and spectrum sensing asynchronous cooperative technique is done. MATLAB implementation of this model is also performed. The methodology is as follows:

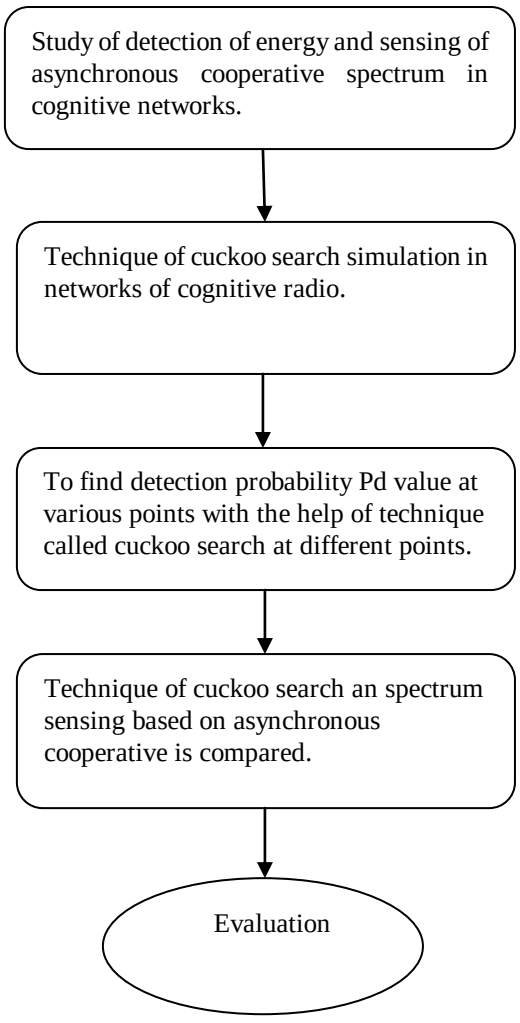

Figure1: Research methodology for SS over ACSS technique

A network of cognitive radio has secondary users who can use spectrum which is unused by performing spectrum sensing. In spectrum sensing technique some radio

waveform characteristics are measured and decision is taken after that of the usage of spectrum by primary user. In this technique we use the method of detection of energy and its block diagram is as shown in figure. The signals which are out of band are removed by input filter of band pass. This is done by selecting the frequency fc called centre frequency and bandwidth W. Assumption is taken here of that the information is with secondary users so that they can perform sensing of spectrum. The convertor analog to digital is used to digitized the signal and for estimation of signal frequency which is received the device used is simple square and average. It is assumed that the signal is real from input to energy detector without any generality loss. The energy which is estimated is compared then with threshold denoted by λ, to take decision of H1 as output if signal is present and H0 as output if absent.

The two principles based on which we can calculate threshold is rate of wrong alarm and rate of constant detection. In both the cases need of noise power for threshold determination is essential. Assumption of exact noise variance is done and this is utilising in threshold calculation. The spectrum sensing is performed uniquely by each user of CR and it can be a formulation of test of binary hypothesis which is performed between any two hypotheses.

As the subscriber's growth in modern communication systems of wireless is increasing day by day, the bandwidth scarcity is faced as a major problem to meet the needs of users. To make this task an easy one the existing system is utilised. The technique used for this is Cognitive Radio in which the white spaces of spectrum are determined and used by the secondary users for instantaneous communication. By use of methods of sensing the spectrum determination of occupied spectrum of frequency in cognitive radio is determined. So this technique is key front end block for the systems of cognitive radio. The sensing technique based on energy is very simple to implement. In conventional PCA the signal to noise space power does not match with actual ratio of signal to noise. Then a correction factor is used to apply to decomposed ratio of signal to noise space power which is equated with actual SNR. This technique is referred to as modified PCA. The obtained noise power through this technique and wrong alarm probability value will determine the threshold for algorithm called EBSS. This method which is combination of both PCA and EBSS is used for wide SNR ranges, various wrong alarm probabilities and interest frequency. This process is used for computation of threshold energy.

The energy detection problem of signal which is unknown over the channel of multipath stars with no diversity case and then some expression for closed form is presented for detection probability. The capability of detection is boosted by implementation of two schemes: square law selection diversity and square law combining. The estimation of noise variance is done and is then used to determine threshold based on energy detection in spectrum sensing.

1.6.1 Technique of Cooperative spectrum sensing in cognitive radio network: detection of primary user as early as possible is one of the main spectrum sensing requirement. So monitoring continuously of primary user spectrum should be done by the CR user and also make is free when detection is there of primary user. Two stages are there of spectrum sensing: sensing and reporting. This is shown by the following figure. In Sensing stage of spectrum sensing, sensing of spectrum is performed individually by the CR user and decision is made according to the primary user observation. The results of local observation are reported at fusion centre (FC) and final decision is given whether the primary user is present or not.

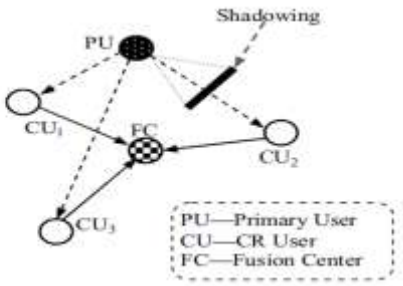

Figure 2: Cooperative spectrum sensing

The issue is that unlicensed users use reliability for sensing of cooperative spectrum in systems of cognitive radio by analyzing algorithm of Huffman encoding. Finally performance of potential spectrum sensing of cooperative is improved by use of unlicensed user reliability.

1.6.2 Technique of Cuckoo search in cognitive radio networks:

An optimization algorithm called Cuckoo search (CS) is an inspiration of brood parasitism of few species of cuckoo which lay their own eggs in hosts bird nests. Some birds of hosts nest involve in conflicts with cuckoos. Such as, if host bird get to know that the egg doesn't belong to her then she will either make decision of throwing that different egg or she will simply vacant her own nest and build it somewhere else. Such behaviour is idealised by cuckoo search and hence used to solve the problem of optimization. Applications of it shows that other algorithms which are meta heuristic can be performed.

In technique of meta heuristic optimization, implementation of the optimization technique called cuckoo search is done. The technique uses minimum nodes of energy as subordinate chains. The technique feasibility is checked by the simulated results when compared with traditional techniques.

Algorithm -
Target function f(x), x = (x1,..., xd)T
create beginning population of
n host nests xi (i = 1, 2,..., n)
while (Maximum Generation > t) or
(stop basis)
Get a cuckoo by Levy
flights randomly
check its quality/fineness Fi
pick up a nest among n (say, j) randomly
if (Fi > Fj),
exchange j by the new solution;
end
Fractions (pa) of worse nests are deserted and new ones are built;
Keep the good solutions (or nests with best quality solutions);

Assign number according to the quality of the solutions and find the current best
end while
Post process results and examine
The worse nests are deserted in normal Cuckoo Search. In order to equalize the unequal energy dissipation, the best nets (or) energy users can also take part in the process.

II. LITERATURE SURVEY

The research work performed in this field by different researchers is presented as follows:

Dipak P. Patil et al. [31] Investigated on fading channel(MIMO) which is memory less and have discrete time conventionally. Evaluation of performance of sensing of spectrum in cognitive radio is also done. Cognitive radio has one crucial task called sensing of spectrum. The adding channel-MIMO is used to enhance performance of different techniques of spectrum sensing to be focused are-ED (energy detection), MED (maximum Eigen value detection), GLRT (generalized like hood radio test).

James D. Gadze et al. [34] Researched on the study of performance of detection of energy which is based on sensing of spectrum for networks of cognitive radio. If the environment is noisy and faded then the performance of detection of energy relays of techniques of sensing of spectrum. Investigation is done for both detection of single user and cooperative. Derivation is also performed of solution in closed form for wrong alarm and detection probability. Monte carlo method of MATLAB is used for verification of analytical results by computing them numerically.

Seema M Hanchate et al. [36] Discussed the algorithm of spectrum sensing and its implementation in cognitive radio. The latest advancement in revolution is cognitive radio. The future of wireless world will be governed by it. The main aim of this radio is efficient use of spectrum available and also the usage should be fair, cost effective and it should provide a good communication for all network users. Different technique of non- cooperative sensing of spectrum are discussed and comparison is done of the implemented algorithm.

Mikio Hasegawa et al. [38] discussed the centralized network and decentralized network of cognitive radio and their optimization. The usage of radio as a resource is improved in technology of cognitive radio. This is done by reconfiguring connection settings of wireless as per the decisions which are optimum. The decision depends on the information collected related to the context. The algorithm used for the decisions taken is an algorithm which optimizes the usage of radio as a resource in cognitive networks which are heterogeneous in nature.

Matthew R. Tolson et al. [39] Discussed networks of cognitive radio with multicast reliability and ordered fully with multicasting.The architecture proposed here employs multicasting for CR node so as to exchange mapping of radio environment and performing dynamic access to spectrum.

Bharat D. Deore et al. [42] Discussed techniques of spectrum sensing in wireless network of cognitive radio for next generation. Policy of dynamic spectrum allocation is used for efficient spectrum usage. To solve problem of networks of wireless, the cognitive radio technology is used. As wireless network has limited spectrum and usage is also inefficient. The key requirement of policy of dynamic spectrum allocation in network of cognitive radio is sensing availability of spectrum. At physical layer, various techniques of spectrum sensing are there. These are-detection by matched filter, detection of cyclostationary feature and detection analysis of these techniques with different gamma value is presented.

Lalit Bhanwrela et al. [43] Investigated on energy detection performance and cooperative technique of spectrum sensing over channels of fading and AWGN. To find the spectrum which is not used, the operation which is important in cognitive radio is spectrum sensing. The focus is on detection of energy as it is easy to be implemented and also on cooperative sensing of spectrum as properties of signal transmitted is not required like information of channel, type of modulation energy detector performance over AWGN and fading Nakagami and Rayleigh is concluded.

Yasir Abdelfatah Merghani Ahmed et al. [44] Discussed the approach of cooperative sensing in network of cognitive radio, in network of wireless communication, the base considered is radio spectrum. As a medium of transmission, it has an important role and technologies which are dealing with radio spectrum are rapidly improved.

Gyanendra Prasad Joshi et al. [45] Investigated wireless sensor network of cognitive radio with its application, disadvantages and trends in research the wireless sensor network of a cognitive radio is one where for accessing spectrum efficiently, usage of cognitive techniques is done.

Pal Greensand et al. [47] Researched on aids of spectrum sensing i.e. management of spectrum for long term in network of cognitive radio.The three function of selection of spectrum are evaluated which uses the results of spectrum and gives usage of statistic of spectrum for long time. This is the basis of selection of channel so that the performance can be made good by reduction of interference and increase in throughput.

Sajjad Ahmad Ghauri et al. [49] proposed technique of spectrum sensing over fading channels in cognitive radio. The main issue is of usage of spectrum efficiently as wireless communication is getting advanced day by day and applications are also getting broader in today's world.

Prabhat Prakash Singh et al. [51] researched on schemes of spectrum sensing in cognitive radio. The emergent

technology in cognitive radio is spectrum sensing and it is used to find spectrum if available and not in use. So that spectrum can be utilised fully and no more spectrum scarcity problem is faced with any interference also.

Alireza Attar et al. [52] surveyed challenges of security in networks of cognitive radio, their solution and future scope. The major known threats of security is also presented within framework of cognitive network. When all the attack strategies are elaborated, solutions to combat these attacks are discussed.

Sine Malachi et al. [55] explained about spectrum sensing which is distributed and energy efficient for sensor of cognitive networks. The key objective of distributive sensing in cognitive networks is reliability and consumption of energy in detection with increase in radio number, performance of detection get improved and energy consumption also get improved in approach of distributed conventional sensing.

III. PROPOSED WORK

Popularity is increasing of meta heuristic algorithms emerging today which are naturally inspired. Cuckoo search algorithm is a new algorithm which is based on breeding behaviour like for efficient performance brood parasitism is done for certain species. Cuckoo birds are very intelligent and fascinating due to their beautiful sound and most importantly due to strategies of their reproduction. Eggs are laid in communal nests by cuckoo species such as Aru etc. Removal of others egg is done by them so as to increase probability of haltering of their own egg. A solution is represented by each egg in the nest and the new solution is represented by eggs of the cuckoo. The aiva is the usage of new and a solution which is better potentially so that not good solution if there in the nests is replaced. CS has three idealised rules to be based upon-

1. One egg at a particular time is laid by each cuckoo and is dumped in any nest which is chosen randomly.
2. The nests which having good quality eggs and is best is carried to next generation.
3. Fixation is there of no. Of hosts nests which are available. The probability that host bird discovers the cuckoo laid egg is Pa=(0,1) so sets of nests are worst where discovering is operated and for further calculation it is dumped.

IV. RESULTS AND ANALYSIS

The probability of wrong alarm and probability of detection are compared using graph. These are based on cuckoo search technique used.

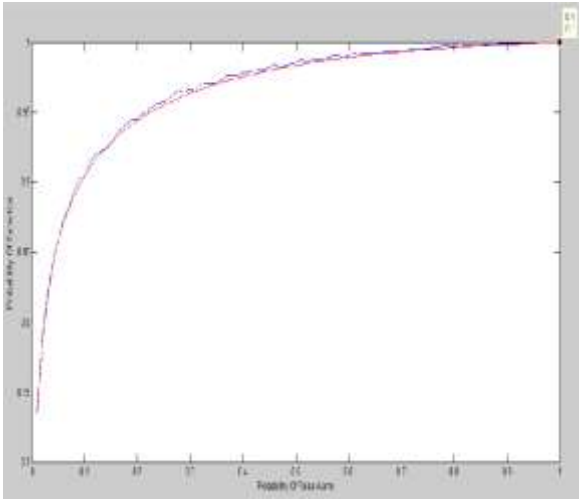

Figure 5.2: Detection vs wrong alarm probability to find values at different points.

Here, red line shows wrong alarm probability and blue line shows detection probability. A simple implementation that says a solution is represented by each egg and the eggs of cuckoo gives a new solution. The technique of cuckoo search can be used for multiple eggs that represents the solution. Nest with a single egg is used in this dissertation. The figure reveals that the detection probability is increased more in comparison to wrong alarm probability; this is due to the cuckoo search scheme applied. So the sensing performance is improved of the spectrum in CRs.

Taken the points between 0 to 1 we find that in cuckoo search technique of optimization the detection probability of the spectrum is more than the sensing technique of asynchronous cooperative spectrum.

The table 1 shows the different Pd and Pf values.

Wrong alarm probability (X)	Detection probability (Y)
0.1	0.9046
0.2	0.9442
0.3	0.9637
0.4	0.9755
0.5	0.9835
0.6	0.9891
0.7	0.9932
0.8	0.9962
0.9	0.9984
1	1

The figure below details the ACSS and optimization technique of cuckoo search (CS) compared in terms of spectrum's detection probability. In ACSS, the user with high SNR of cognitive radio performs detection faster that low SNR. The final result depends on who gives local decision earlier and is given by fusion centre. The more generic algorithm is CR used for many problems of optimization.

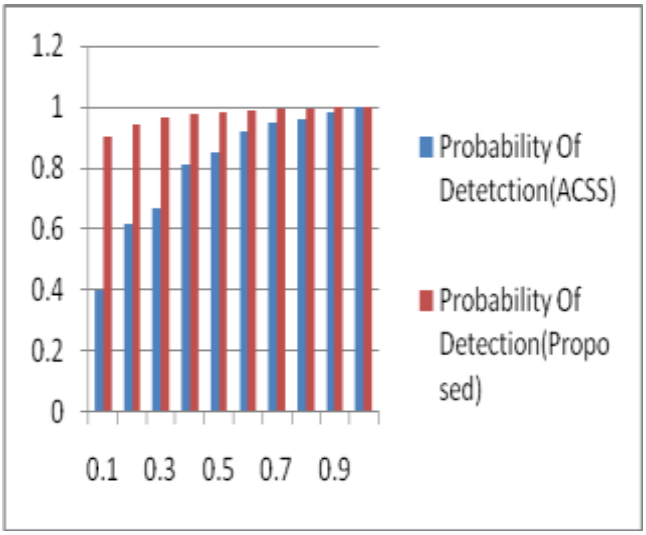

Figure 5.12: Comparison of Probability of detection in ACSS & CS(proposed)

The figure gives the comparison of detection probability of ACSS and CS(proposed) technique. The blue graph is the graph of ACSS detection probability and red colour graph is the graph of proposed detection probability. The graph of both the detections clearly shows that if we move from 0 to 1 detection probability of proposed technique is increasing if comparison is done with technique of ACSS. The major difference in both is shown by points 0.1 to 0.4. At points 0.5 to 0.7 the difference is less and moving to 0.8 and 0,9 point the values are very complex here but the difference is not much between detection probability of ACSS and proposed CS.

The table below reveals that moving from 0 to 0.9 the higher value of cuckoo search detection probability is than ACSS detection probability. To have good sensing performance the detection probability of spectrum shouid be always high. The improvement done in detection probability of CS is also shown in the table given below:

Table 2: Comparison of detection probability (Pd) in ACSS and CS and the importance of Pd in technique of CS

Values	Values of Pd in ACSS	Values of Pd in CS	Pd Improvement in CS Technique
0.1	0.4	0.9046	0.5046
0.2	0.62	0.9442	0.3242
0.3	0.67	0.9637	0.2937
0.4	0.81	0.9755	0.1655
0.5	0.85	0.9835	0.1335
0.6	0.92	0.9891	0.0691
0.7	0.95	0.9932	0.0432
0.8	0.96	0.9962	0.0362
0.9	0.98	0.9984	0.0184
1.0	1.0	1.0	0

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V. CONCLUSION AND FUTURE SCOPE

5.1 Conclusion

Today's network of cognitive radio has many technologies for making intelligent wireless system computationally. The increase in communication networks complexity is dealt with a very powerful solution given by networks of cognitive radio. This is done by the emphatically networks with the decision making ability of cognitive networks.

In networks of cognitive radio, the spectrum sensing sensitivity is improved by the use of method called ACSS i.e. asynchronous cooperative spectrum sensing. This is done by the application of optimization technique of cuckoo search. Evaluation is also done of wrong alarm probability or of spectrum sensing detection by the use of method called energy detection.

5.2 Future Scope

As known that the algorithm if cuckoo not much old and it is in early development phase still and also before comparing it accurately to other matured algorithms, necessity of initial tuning is there. For the improvement and stabilization of the algorithm of cuckoo search, comparison is done with other meta heuristic algorithms. In future investigation will be done on modified cuckoo search to perform in many other benchmarks and other problems of real life and also optimization problems which are unconstrained are parallelized implemented can be applied in algorithm of CS.

In present situation, there is random replacement of some fraction of nests. Prioritization of poorer solutions can be done for the removal. Also the removal probability can be changed and the correct value can be sought. CS improved version can be used for constraining the problems o optimization so that its performance effect can be checked. Accuracy and rate of convergence can be enhanced by an improved algorithm of cuckoo search.

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