Intelligent Algorithms for Spectrum Sensing in Cognitive Radio

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***Abstract*- Frequency spectrum is scared resource and efficient use of it can easily fulfil the need of future applications. But its efficient use is not possible within the existing system, where the allocation of spectrum is done based on fixed spectrum access policy that causes under use of spectrum. For efficient utilization of spectrum new inventive techniques are needed. Using Dynamic spectrum access (DSA) policy we can manipulate the available spectrum. For this purpose Cognitive radio (CR) is a attractive solution to the spectral congestion problem by introducing strategic use of the frequency bands that are not heavenly occupied by licensed users. This paper presents the study of different algorithms for spectrum sensing techniques of cognitive radio networks (CRN). As we know CR is a form of wireless communication which detects vacant spectrums occupies it and avoids the busy one. However to detect vacant spectrum we use the spectrum sensing techniques and CR are known for their transfer values and rate of recognition of the secondary nodes. The problem with the CR is the maximum consumption of energy, so it prevents the system from the high consumption of power utilization.**

Keyword- Cognitive radio(CR), spectrum sensing, one way relaying, two way relaying, outage probability, genetic algorithm(GA), particle sworn algorithm(PSO).

I. INTRODUCTION

In wireless communication systems, the right way to access the spectrum is generally defined by frequency, transmission power, spectrum owner (to whom license is given i.e licensee) and the duration of license. Commonly, a license of frequency is assigned to one licensee, and the use of spectrum by this licensee must be coordinate to the specification in the license. In earlier spectrum license allotting schemes, the license cannot change the type of use or allow other user to use it. Furthermore, the radio spectrum is licensed for larger regions. All these factors in the current criteria for spectrum allocation and assignment restrict the use and result in low utilization of the frequency spectrum. Because the existing and new wireless applications and services require more transmission capacity and more data transmission, therefore the utilization of the radio spectrum needs to be improved. The problem with the CR is the maximum consumption of energy is there to prevent the system from the high consumption of power utilization. To solve this problem we can use different algorithms such as GA, PSO and by using PSO with support vector machine (SVM), Radial basis function (RBF) neural network and co evolution chaotic theory which maximize the secondary achievable sum rate and energy efficiency is improved. They used different algorithms to increase the sum rate throughput and spectral efficiency in underlay and overlay scenario which is improved by using a less number of iterations.

II. LITERATURE SURVEY

In 2009 Tevfik Yucek, et al. [2] explained the various aspects of the spectrum sensing task in detail. Different sensing methods are studied and collaborative sensing is considered as a solution to some common problems in spectrum sensing. **In 2010 Xiao Yu Wang, et al.** [3] by using Markov-Chain Monte-Carlo Scheme, proposed that it can achieve better sensitivity in the presence of traffic variation evidently due to the non-parametric design. **In 2013 Chao Yang, et al.** [5] demonstrated that the design of wideband hybrid access strategy in OFDM-based cognitive radio networks can balance the trade off between the maximum throughput of SU system and the protection of Pu's. **In 2014 Chandrakant.s.patil1, et al.** [7] concluded that the spectrum sensing time of Eigen value based detection method is very small and its realization is simple than **In 2014 Yuan geo, et al.** [8] proved that two way Relaying scheme performs better than the cognitive one way relaying scheme in terms of outage probability performance. At the same time outage probability can be degraded with the increase in detection probability of the presence of PU with increase in number of spectrum holes. **In 2014 Ahmad Alsharoa** [9] considered a multiple-input multiple output two-way cognitive radio system under a spectrum sharing scenario, where PU and SU operate on the same frequency band. It will maximize the sum rate of the secondary networks without degrading the PU performance by imposing interference constraints to the secondary network. **In 2013 Ahmad alsharoa, et al.** [4] have used the same approach as above but along with GA practical heuristic algorithm based on GA which maximizes the secondary achievable sum rate of a multiple relay selection scheme for TWR-CR system with discrete power distributions. **In 2014 Alsharoa, et al.** [11] introduced and solved a new optimization problem for multiple-input multiple-output two-way relaying operating in underlay cognitive radio networks. **In 2015 Lei Xu , et al.** [11] proposed that hybrid PSO (HPSO) could achieve the improved average weighted sum-rate throughput and satisfy the probabilistic interference constraint condition but HPSO has large computational complexity which would increase the cost of hardware & HPSO is a centralized resource allocation algorithm which needs large feedback overhead than **In 2015 Lei Xu a, et al.** [12] by using hybrid quantum PSO which includes Quantum PSO (QPSO) and RBF neural network improves the power

consumption and also satisfies the outage probability requirement finally **In 2016 Meiqin Tang , et al.** [13] concluded that by using coevolution chaotic PSO even small number of iterations can achieve more energy efficiency than other algorithms.

Sr. No.	Topic	Summary
1.	A Survey of Spectrum Sensing Algorithms for Cognitive Radio Applications (2009) [2].	In this Various aspects of the spectrum sensing task are explained in detail. Several sensing methods are studied and collaborative sensing is a solution to some common problems in spectrum sensing.
2.	Spectrum Sensing in Cognitive Radio Using a Markov-Chain Monte-Carlo Scheme (2010) [3].	By applying this nonparametric approach, the reliance on specific traffic models is improved and we get improved performance in terms of overhead and percentage of missed spectrum opportunities.
3.	An efficient hybrid spectrum access algorithm in OFDM-based wideband cognitive radio networks (2013) [5].	The design of wideband hybrid access strategy in OFDM-based cognitive radio networks can balance the trade off between the maximum throughput of SU system and the protection of Pu.
4.	Dynamic Spectrum Sensing Techniques for Cognitive Radio-Based Wireless Communication (2014) [7].	Sensing time of eigen value based detection method is very small and its realization is simple.
5.	Outage performance for cognitive One Way and Two Way Relaying network (2014) [8].	This will maximize the sum rate of the secondary networks without degrading the PU performance by imposing an interference constraints to the secondary network and along with the amplification factor of the relay side is analyzed for different system parameters but the Outage probability can be degraded with the increasing of detection probability of the presence of Pu & with increment in number of spectrum holes.
6.	Optimal Transmit Power Allocation for MIMO Two-Way Cognitive Relay Networks with Multiple Relays using AF Strategy (2014) [9].	Maximize the sum rate of the secondary networks without degrading the PU performance by imposing interference constraints to the secondary network. In future Will focus on the optimization of the sum rate by dealing with the relay amplification factors simultaneously with the transmit power allocation either by deriving an optimal solution or by employing a heuristic approach.
7.	A Genetic Algorithm for Multiple Relay Selection in Two-Way Relaying Cognitive Radio Networks (2014) [4].	They have used Practical heuristic algorithm based on GA to maximize the secondary achievable sum rate of a multiple relay selection scheme for TWR-CR system with discrete power distributions but The algorithm may get stuck on local maxima and may not provide optimal and complete solutions.
8.	Near-Optimal Power Allocation with PSO Algorithm for MIMO Cognitive Networks using Multiple AF Two-Way Relays (2015) [10].	Introduced and solved a new optimization problem for multiple-input multiple-output two-way relaying operating in underlay cognitive radio networks. In this they have consider multiple amplify and forward relays and optimized the relay amplification factors adaptively with the terminal transmit powers.
9.	Resource allocation algorithm based on hybrid particle swarm optimization for multiuser cognitive OFDM network (2015) [11].	HPSO could achieve the better average weighted sum-rate throughput and satisfy the probabilistic interference constraint condition but it has large computational complexity which would lead to add the cost of hardware & HPSO is a centralized resource allocation algorithm which needs large feedback overhead.
10.	Resource allocation based on quantum particle swarm optimization and RBF neural network for overlay cognitive OFDM System (2015) [12].	Improves the power consumption and also satisfies the outage probability requirement but at the same time it is not time efficient and cost is high.
11.	Energy efficient power allocation in cognitive radio network using co evolution chaotic particle swarm optimization (2016) [13].	Needs a smaller number of iterations and can achieve more energy efficiency than the other algorithms.

III. CONCLUSION

In this paper, different spectrum sensing methods have been discussed. In which it has been observed that the Eigen value based detection method is best method. One way relaying and two way relaying scheme has been analysed and have concluded that cognitive two way relaying is better than cognitive one way relaying scheme in terms of outage probability performance. It can be summarised that the spectrum sensing can be improved by using different algorithms such as genetic algorithm, particle swarm optimization and by using particle swarm optimization with SVM, RBF neural network and co-evolution chaotic theory maximize the secondary achievable sum rate in underlay an overlay scenario and improved the energy and spectrum efficiency.

ACKNOWLEDGMENT

I would like to express my sincere gratitude to respected guide Dr. Charanjit Singh for his continuous support, valuable suggestions and for his patience, motivation and immense knowledge of my M.tech study and related research. I am also grateful to my esteemed university for providing the facilities and opportunity for this work. I am also thankful to my parents for their moral support.

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