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A Linear Cooperative Spectrum Sensing Techniques for Spectrum Allocation of Secondary Users in CRN

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ABSTRACT: Spectrum allocation is used for complete utilization of frequency spectrum in cognitive radio networks. To maximize capacity is current research problem because of the many practical limitations such as transmission power, interference threshold of primary users and traffic demands of secondary users. In this paper consider spectrum access scenario which consists of two groups of users, namely Primary Users (PUs) and Secondary Users (SUs) in Cognitive Radio Networks (CRNs). Cognitive radio has attracted a lot of attention recently due to its superior spectral efficiency and could play a vital role in improving the capacity of future networks. This paper presents Linear Cooperative Spectrum Sensing Techniques for spectrum allocation of secondary users in CRN. Simulation is done in MATLAB software and results shows that resource allocation gives complete utilization of spectrum bandwidth.

KEYWORDS: Cognitive Radio, OFDM, MATLAB, Power.

I. INTRODUCTION

Cognitive radio (CR) is known to be a promising technology to improve spectral efficiency of a communication system by sharing the licensed spectrum of Primary User (PU) to the unlicensed Secondary User (SU) [1]. Conventionally, it does so by listening to the received signals and identifying the spectrum holes. These spectrum holes can then be used by the SUs for their transmission provided that they do not interfere or cause minimal interference to the PU. Two major challenges of Cognitive Radio Networks (CRNs) are the PU detection and the transmission opportunity exploration. CRs may operate in three different modes i.e., overlay, interweave and underlay modes [2]. In the interweave mode, the SU searches for spectrum holes and then obtain access to these spectrum holes opportunistically [3]. By contrast, simultaneous PU and SU transmissions are legitimized in underlay mode if the interference caused by the SU transmission does not worsen the performance of the PU. The overlay mode relates to a class of more sophisticated scenario, where the CR nodes are equipped with advanced signal processing capabilities are capable of decoding the PU messages. In addition, they are capable of maintaining or even improving the quality of PU transmission, while simultaneously obtaining spectrum opportunities to transmit their own SU messages [2].

Cognitive nodes can interact with their surrounding nodes and make decisions to improve their communications. These smart nodes will be employing their neighboring nodes to assist in their communications and in return will pay them back either in the form of monetary benefits or might trade with them their bandwidth, power or any other resource that their neighbors might need. These complex interactions provide new areas and challenges for the researchers to explore. One of the best tools for defining and modeling interactions between different participants or entities is game theory. Game theory found its roots in economics and now it is being widely used in different fields of social, behavioral and natural sciences [4].

Cooperative communications constitute a powerful technique that combats channel fading due to multipath propagation in a wireless environment. Cooperative communications technique was first conceived by Van der Meulen back in 1970s [8], where he constructed a three-terminal relay channel and derived both upper and lower bounds on its capacity. It gained ample interest 30 years later and has been seen as an essential technique for its significant capacity and multiplexing gain improvements. Many relaying protocols have been developed, including Amplify and Forward (AF), Decode and Forward (DF), Compress and Forward (CF), Selection and Dynamic Relaying (SDR) and Incremental Relaying (IR) [9].

Allocation in cognitive radio is the concept of distribution of resources such as power, channel availability, frequency and so on. Spectrum resource allocation for cognitive radio networks (CRNs) presents many unique challenges in which the mutual interference between Primary Users (PUs) and Cognitive Radio (CR) users. Resource allocation must maximize the efficiency of the spectral resources utilization and minimize the risk of overlapping the

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coverage of CRNs with adjacent primary networks. Resource allocation is of two types, dynamic and adaptive resource allocation. Conventional mobile communications systems are moving towards faster digital wireless technologies based on advances in semiconductor devices as described below.

Figure 1: Cognitive radio architecture

Daily increasing demand for new wireless services with higher data rate and QoS level makes the upgrade of the physical layer modulation techniques inevitable. OFDMA is a common multiple access multicarrier modulation technique that is usually used in cognitive radio (CR) systems.

II. RELATED WORK

Y. Huang et al., [1] Gadget to-gadget interchanges innovation can be utilized to permit unapproved users to acquire the frequency groups of unique approved cell users (CeUEs), and to improve the data transfer capacity deficiency issues. In this investigation, it is propose a heuristic subcarrier allocation strategy to set the UE throughput edge which fills in as a necessity to D2D multicasting (D2DM) subcarrier allocation.

S. Alwan et al., [2] propose a novel plan named Joint Multicast Steering and Remote allocation in D2D interchanges (JRW-D2D-MC). The conceived plot comprises of two-phase algorithm which, first, plays out a pre-induction separating of streams that can be directed thinking about the present status of the network. At that point, it utilizes the branch-and-slice technique to explain the diminished ILP model. To assess viability of our proposition, it is actualize the LTE-D2D standard in a network test system NS-3. The outcomes are excellent regarding stream acknowledgment rate and idleness.

J. Kim et al., [3] shows a channel allocation conspire utilizing halfway data of gadget areas. For this, it is determine the blackout likelihood and a compelling throughput of D2DC interchanges in rough structures. Numerical outcomes uncover that, when the quantity of D2DC recipients is enormous, the proposed conspire accomplishes the close to ideal entirety successful throughput, which can be gotten by utilizing full data of gadget areas.

A. Bhardwaj et al., [4] fundamental commitments are the specific count of blackout likelihood experienced by a D2D collector in the multicast gathering and a plan to share channels among D2D MGs and CUs by limiting these probabilities. Numerical outcomes show the effect on the total throughput of the quantity of MGs offering the ch annel to a CU, geological spread of MGs, and the most extreme communicate intensity of cell users.

J. Xie, W. Melody et al., [5] is assess three methodologies for the planned issues, including a voracious algorithm, a heuristic algorithm dependent on Lagrangian unwinding, and a completely polynomial-time guess plot (FPTAS), separately. Reproductions are led to look at the exhibition in the static and dynamic situations as far as all out cost, unit cost, D2D offload ratio, and administration dormancy. The outcomes show that the MCKP based methodology beats the other two on the grounds that the estimation assurance of the FPTAS brings about arrangements nearest to the ideal.

T. Hou et al., [6] it is study the D2D-helped two-phase multicast that permits D2D correspondence to reuse Prompts' uplink resource blocks. it is pick the multicast delay as the primary execution objective and assess two transfer UE determination plans in their viability in limiting the multicast delay in contrast with one-phase multicast. Our outcomes show that two-phase multicast performs better than one-phase multicast in both limiting deferral and augmenting resource effectiveness when the bunch is far away from the base station and the group size is small1.

K. Wu et al., [7] Gadget to-gadget multicast retransmissions in cell networks assists with improving otherworldly effectiveness and to offload traffic. Existing strategies have uncovered the connection between the quantity of transfers and resource usage productivity on retransmissions as far as hand-off choice and bunching. Notwithstanding, hardly any examinations think about the effect from the lost packets on resource use, which is anyway significant for improving the general productivity of D2D frameworks. In this paper, it is first detail an overall resource proficiency

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optimization issue in D2D multicast retransmission situation, where the lost-packet diversity (LPD) of far off user types of gear (UE) and connection nature of D2D joins are together thought of. At that point, it is propose an effective close ideal algorithm to take care of the new optimization issue.

P. Zhao et al., [8] In the joint optimization, a two-advance plan is intended to initially ascertain the ideal force allocation by geometric nearness and afterward select appropriate cell channels for each D2D multicast group using an all-encompassing one-to-numerous bipartite diagrams coordinating algorithm. Reproduction results exhibit that, contrasted and heuristic algorithm and stochastic algorithm, the proposed plan can expand the throughput of the general social-mindful network by about 5% and half, individually

P. Zhao, et al., [9] the determined optimization is a blended integer nonlinear programming issue with high computational intricacy, it is separate it into two sub-issues. At that point the proposed conspire is made out of two stages. In Stage 1, power allocation plot for each D2D gathering and each phone user (CU) is explained with geometric programming technique.

A. Bhardwaj et al., [10] devise an uplink resource reuse technique for various multicast D2D gatherings and different cell users (CUs), with the target of amplifying the whole throughput, while ensuring a specific degree of nature of administration (QoS) to CUs and D2D users. it is set up the viability of the proposed plot for variable gathering sizes and geological spread.

III. PROPOSED APPROACH

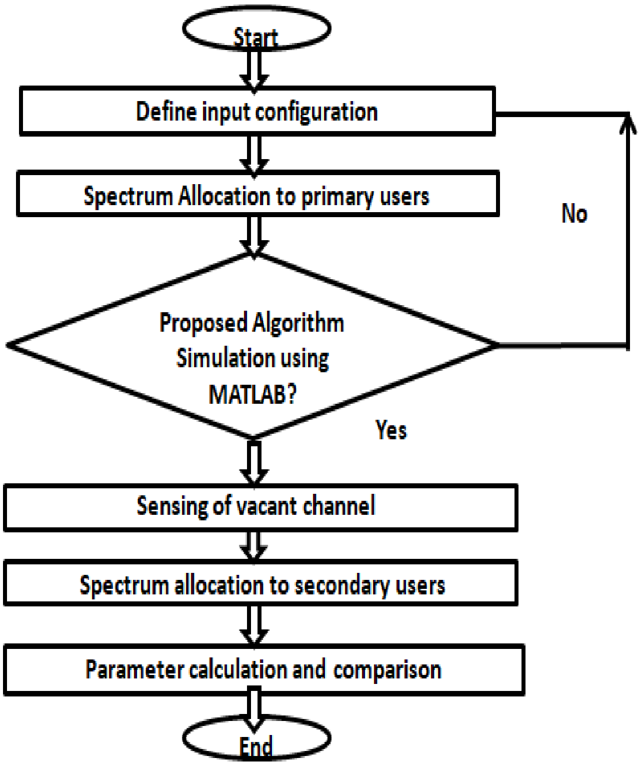

Figure 2: Flow Chart

1. To Spectrum sensing is the key to coordinate the secondary users in a cognitive radio network by limiting the probability of interference with the primary users.
2. Linear cooperative spectrum sensing consists of comparing the linear combination of the secondary users' recordings against a given threshold in order to assess the presence of the primary user signal.

Algorithm-

1. The spectrum is allocation to primary users first.
2. Then sense vacant place by proposed algorithm.
3. Now allocation to secondary user in place of vacant space.
4. Proposed algorithm gives proper allocation in vacant space.

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5. Add noise level and allocation to secondary users.
6. Calculate power, frequency and other parameters.
7. Compare generated result from existing techniques result.

IV. SIMULATION RESULTS

The implementation of the proposed algorithm is done over MATLAB 9.4.0.813654 (R2018a). The signal processing toolbox helps us to use the functions available in MATLAB Library for various methods like Windows, shifting, scaling etc.

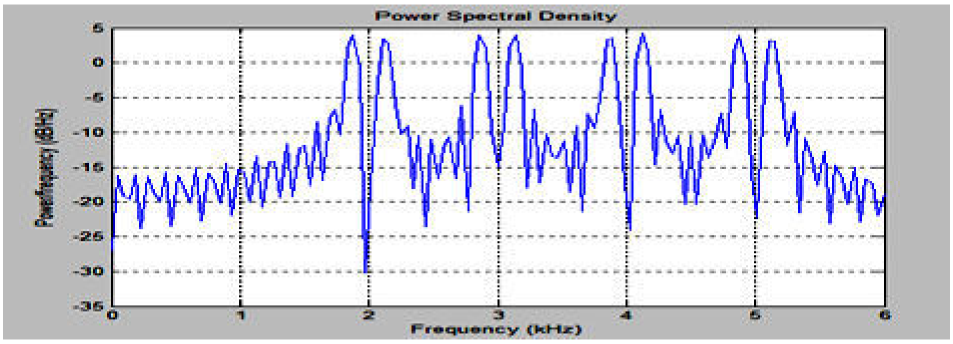

Figure 3: Allocation to primary users (Free 1)

In figure 3, show the spectrum allocation to primary users in network. Here spectrum is allocated to primary users 2,3,4 and 5 while user 1 is empty.

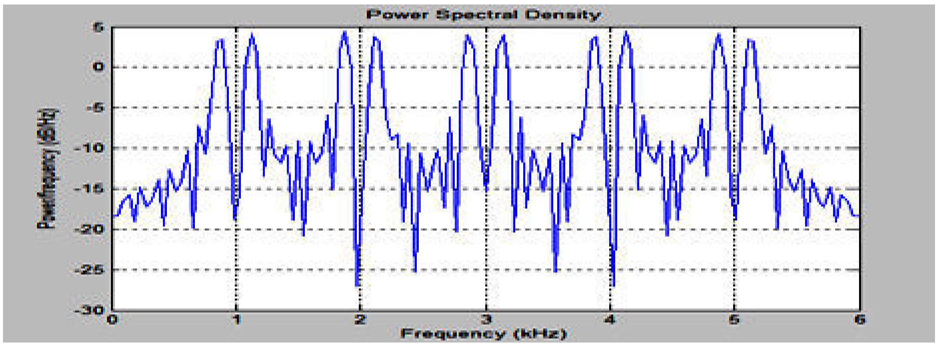

Figure 4: Allocation to secondary user in place of primary user 1 (free)

Figure 4 presents spectrum allocation to the secondary user. In this case first proposed algorithm find the vacant space in network and spectrum is allocated to the vacant user 1.

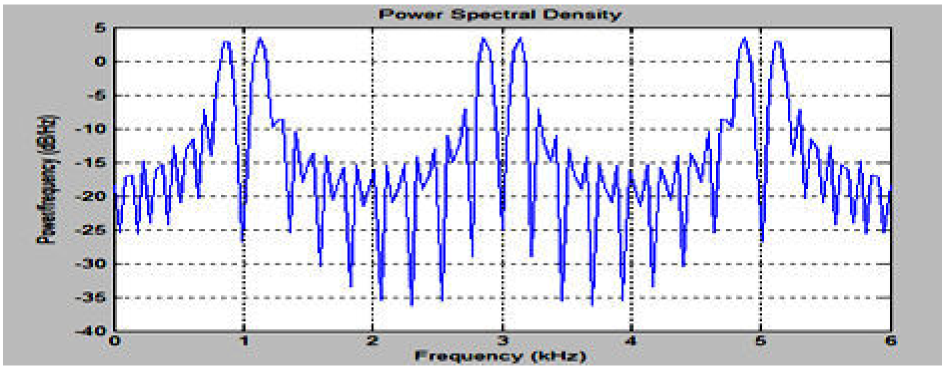

Figure 5: Allocation to primary users (Free 2 and 4)

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In figure 5, show the spectrum allocation to primary users in network. Here spectrum is allocated to primary users 1,3and 5 while user 2 and 4 is empty.

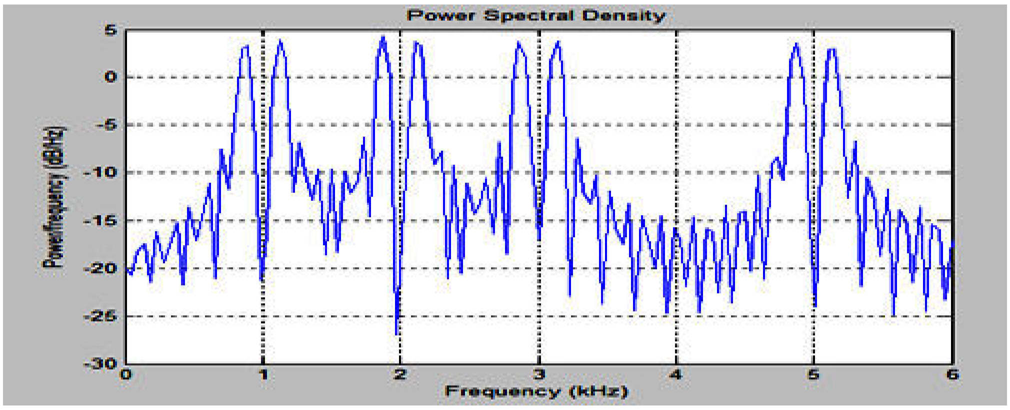

Figure 6: Allocation to secondary user in place of primary user 2 (free)

Figure 6 presents spectrum allocation to the secondary user. In this case first proposed algorithm find the vacant space in network and spectrum is allocated to the vacant user 2.

Table 1: Simulation Parameter

Sr. No	Parameter	Value
1	Channel	9
2	No of primary user	8
3	No of secondary user	1 to 7
4	Peak Power	5 dB

Table 1 is showing the total number of maximum channel i.e. 9 channel. Number of primary users allocates upto 8 and secondary users allocate upto 7. The total peak power is 5dB.

Table 2: Comparison of our Research work and previous work

Sr. No.	Parameter	Existing Work	Proposed Work
1	No of primary users	6	8
2	No of secondary users	6	8
3	Total channel	7	9
4	Allocated Power	4 dB	5dB
5	Throughput	180 MHz	240 MHz
6	SNR	40	55

Table 2 is showing the comparison of our proposed research work and previous work results. The number of primary and secondary users is representing the maximum population size of users. The allocated power shows the spectrum availability in network. The maximum throughput and SNR presents the reliability of user's performance with respect to the network performance. Therefore proposed algorithm gives the significant better performance than previous approaches.

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V. CONCLUSION

This paper is proposed the spectrum allocation of secondary users using optimization problem of linear cooperative spectrum sensing techniques. Simulated results show that the number of primary and secondary users is representing the maximum population size of users. The allocated power shows the spectrum availability in network. The maximum throughput and SNR presents the reliability of user's performance with respect to the network performance..

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