

ABSTRACT

Resource allocation has been considered a multi-objective optimization issue in cooperative cognitive radio networks with regard to channel capacity and other problems like power transmissions and Qos limitations. Many researchers have attempted to address such issues individually. However, a comprehensive approach on resolving multi-objective problems still remains untouched. Multi-objective issues such as energy consumption, queuing problems, priority levels of traffic classes, fairness, throughput, and user quality requirements have been analyzed in this research in order to provide suitable solutions. A hybrid optimization algorithm for CCRNs (HCCRN) that enhances resource allocation has been proposed as a novel concept in this research. Various problems related to hybrid optimization algorithms have been identified, and appropriate investigations have been carried out to resolve such problems. The energy-efficient cluster formation is performed by load balance that includes particle swarm optimization algorithm, which has been developed from conventional particle swarm optimization algorithm. The cluster comprises SU members with an individual SU base station, and it maintains multiple metrics for each member in the clusters that are considered to be the primary factors (such as delay, throughput, energy consumption, delivery ratio, loss ratio, the maximum number of resource allocation done, maximum/minimum channel utilization time, channel request exact time, the distance between channel-required SUs and SU base stations).

The examined multiple metrics are evaluated as the input of a differential evolution optimization algorithm, which strengthens the queue stability problem and helps to differentiate SUs from Pus substantially. First,

a modified multi-factor optimization algorithm is evolved from the conventional differential evolution algorithm. Then, the modified gravitational search algorithm is appropriated to figure out the channel-required SUs for establishing an efficient routing path between the PU base station and SU base stations. Thirdly, a remodeled gravitational search algorithm has been evolved from the conventional gravitational search algorithm, which augments resource allocation throughput. All three modified algorithms are combined to transform the proposed system into a hybrid entity, enabling optimum resource allocation for multiple users.

The primary objective of this research is to enumerate the load balance enhanced particle swarm optimization algorithm for energy-efficient cluster formation, which helps to resolve issues of queuing problems. The Proposed algorithm has been compared with existing algorithms like MPSO, GA-PSO, HPSO-SA and the experimental simulations affirm that throughput and fairness index increased by 40%, 20%, 10%, correspondingly with respect to the above-mentioned algorithms. Accordingly, the load balancing ratio is also found to increase by 0.33%, 0.23%, 0.11% in terms of MPSO, GA-PSO & HPSO.

In the second approach, numerous factors were regarded as the input of a multi-factor differential evolution optimization algorithm for prioritizing the traffic levels. To achieve this, the data generation rate, the average delay in generation and energy consumption were observed. The average delay for the proposed MDEO is found to be 2.90s, 1.77s, 1.02s less than the conventional differential evolution algorithms like SA-DE, IDE-LCDM, CCRN and energy consumption of the MDEO is 5% less than the SA-DE, IDE-LCDM and CCRN.

The third approach proposes that the fair routing path is formulated by a modified gravitational search algorithm that improves resource allocation throughput. The suggested MGSA has a 92.5 % higher throughput than the already available PSA, FGSA and HSA. The fairness index of the MGSA has resulted in an increase of 2.29% than that of PSA, 1.60% higher than the FGSA and 1.30% more than the HSA.

As an experiment, the proposed HCCRN algorithm has been applied in IEEE 802.11 WLANs and the findings were recorded. The simulation results make it evident that the users achieved the required resources through the proposed HCCRN, resulting in enhanced energy efficiency, fairness, throughput, and QoS. The average delay of the CCRN algorithm was found to be 3.58s and the HCCRN was 2.48s. The mean throughput of the CCRN algorithm reached up to 49Mbps and HCCRN to a maximum of 66Mbps. The experimental results confirm a substantial throughput increase in the HCCRN; however, it declines with the increase in the number of nodes.

It has been observed that the average energy consumption of CCRN is 535 J and HCCRN is 475 J. By utilizing the HCCRN algorithm, a total of 30% of the energy is consumed collectively. The summary of the Packet delivery ratio illustrates that 67 more packets can be received by using the HCCRN algorithm. It also evidently proves that CCRN has a low packet delivery ratio, when there is a decrease in the number of nodes.

HCCRN algorithm helps achieve an optimized fairness index and favors increasing the network lifetime contrary to its counterpart CCRN algorithm. In test scenario 2, it is analyzed with a fixed number of users (500) with different data rates. The different parameters were also examined and the findings were recorded.