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Modulation Recognition in Cognitive Radio Networks using Genetic Approach

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ABSTRACT

The spectrum or the whitespaces that are not being used by licensed or primary users (PUs) can be sensed and operated by the unlicensed or the secondary users (SUs) in the cognitive radio networks (CRN) in such a way that there is no impact on the activities of the primary users. One mechanism for topology management is referred to as clustering. This organizes the nodes in logical sets so that the performance of the network is enhanced. In this paper for obtaining optimal radio configurations and performance improvements, the genetic algorithm comprising selection, crossover and mutation is embedded in the CR. In order to optimize the allocation of spectrum for greater efficacy and fairness.

Keywords: Cognitive radio networks (CRN), Primary users (PUs), Secondary users (SUs), Neural network, Genetic algorithm (GA).

INTRODUCTION

With the recent growing increases of wireless devices, radio spectrum scarcity occurs and mandates the establishment of methods for developing technical description to access efficiently the available radio spectrum. For this, cognitive radio (CR) techniques [1] can be used to provide a promising solution to increase the spectrum utilization. There has been a paradigm shift in the usage of radio spectrum from conventional command and control allocation technique to an open scheme of spectrum allocation. Intensive research in the field of open spectrum sharing was driven by the report that was published by the spectrum policy task force of federal communications commission (FCC) in 2002, whose objective is improvising the manner in which the spectrum resource is utilized. This scheme of open spectrum sharing can be achieved both flexibly as well as efficiently by cognitive radio (CR), which was initially coined by Mitola in 1999.

Primary user and secondary users are the two types of CRN. The former is a licensed user who has absolute access to the radio spectrum. The latter, however, is referred to as an unlicensed or cognitive user. Whenever a PU wants the spectrum, the SU must stop using the same. Thus, in CR systems, the SU seeks to use the spectrum whenever the PU is not using it. In effect, whenever the PU is idle, the SUs make use of the spectrum holes or free spectrum and this cognitive user uses the licensed spectrum at the given time and location. This system autonomously coordinates the usage of spectrum. The CR intelligently makes use of the unused spectrum based on observation. The spectrum can be temporarily used by the SU in CRN. Hence, an important component in the CRN architecture is the SU [3].

Routing is one of the most difficult challenges in CRN and several researchers have been studying routing protocol for CRNs. The logic of the routing protocol in the CRNs aims at finding the path to the destinations as well as the channels to be utilized along this route. Additionally, it makes sure that the routes that are being used do not collide with the licensed PUs. Hence, various forms of routing are being explored by the research community in the CRNs, which has resulted in many of the routing protocols for suiting these objectives. There is, however, a common assumption that is present in the routing protocols being used. This severely restrains the process of routing and inhibits the CRNs to efficiently work in the real world applications. One such assumption in the existing protocols is that the secondary users within the range of interference of a certain primary user may not use its licensed channel during its active periods [20].

The rest of this paper is organized as follows in the first section we describe an introduction of about cognitive radios. In section II we discuss about the approaches for cognitive radio, In section III we discuss about the genetic algorithm cognitive radio. In section IV we present the proposed work using the genetic approach and finally in section V we conclude and discuss the future scope.

II APPROACHES FOR COGNITIVE RADIO

Cognitive radio offers a promising solution for an efficient and full use of radio channel resources. It has attracted much research attention, and both distributed and centralized schemes have been proposed to facilitate the spectrum sharing between SUs and Pus [19]. Then, the concept of machine learning was applied to maximize capacity and dynamic spectrum access. Different learning algorithms can be used in CR networks such as Fuzzy Logic, Neural Networks, Genetic Algorithms, or Classification Algorithms.

The multilayered neural networks were used to model and estimate the performances of IEEE 802.11 networks. They come in the form of a set of interconnected elementary processors that can perform the entire processing information chain. Each neuron adapts its parameters with its neighbors to achieve the objective for which they have been designed.

Fuzzy logic is a far powerful and flexible method, based on learning in transmission rate and prediction. It has potential in either specific problem-solving areas or as a part of cognitive radio system, to reduce its complexity. Fuzzy logic can approximate the solutions independently for certain input, but it does not provide accurate solutions. Other parameters could be included to predict the best radio configuration; it should establish a rule related to the specific situation in which it is used, and these rules may involve some limitations in programming.

III GENETIC ALGORITHM

A genetic algorithm is a robust evolutionary algorithm that models biological processes to solve a highly complex computational problem to find optimal solutions. Crossover and mutation are two basic operators of GA. Performance of GA depends tightly on these operators, and new solutions are found based on old solutions through the use of crossover and mutation processes. Crossover and mutation perform two different roles. Crossover is a convergence operation; it is intended to pull the population toward a local minimum/maximum. Mutation is a divergence operation; it is intended to occasionally break one or more members of a population out of a local minimum/maximum space and potentially discover a better minimum/maximum space. GA has been applied to spectrum optimization in cognitive radio networks. For example, genetic algorithms have been investigated through CR test-beds under certain controlled radio environments.

IV PROPOSED WORK

Genetic algorithm based cognitive radio network optimization method that replicates the biological evolution and the natural selection is the genetic algorithm which is performed when the population that consists of a chromosome set evolves, when subject to certain selection criteria. There are three phases of the GA algorithm procedures-initialization, evaluation, and genetic operation.

Initialization

This refers to the generation of initial search points or the initial set of chromosomes. Population size and string length are the two parameters to be selected for this phase. The performance and the efficacy of the GA are predominantly affected by the population size. Although a large population is needed, a very large population may lead to divergence. Hence, when the population size is being selected, a search space must also be considered. It is from this initially generated random population that the chromosomes are first decoded. Then for each chromosome, all the parameters related to the optimization problem are computed.

Evaluation

This phase involves determining the fitness of a solution from initial population making use of ‘‘fitness function’’. Based on the closeness of the solution that is being investigated, the evaluation of fitness is done, to the global optimum value which may be either maximum or minimum.

Genetic operation

Three genetic operators—selection, crossover, and mutation are used for forming a new population. The fittest members of the initial population, referred to as elite members are migrated to the newly generated population.

Selection

By generating population using the previous population's chromosomes leads to the preservation of the population size. The new offspring can be spawned by selecting a pair of chromosomes.

Crossover

This form of mating involves generation of a new population from an already existing population and is employed in the GA. After a chromosome pair is chosen by any of the schemes mentioned before, offspring is generated using the process of crossover. These have traits of both the parents and are expected to be of a better quality. Single/simple point crossover, multipoint crossover and uniform crossover are the various techniques using which crossover can be performed.

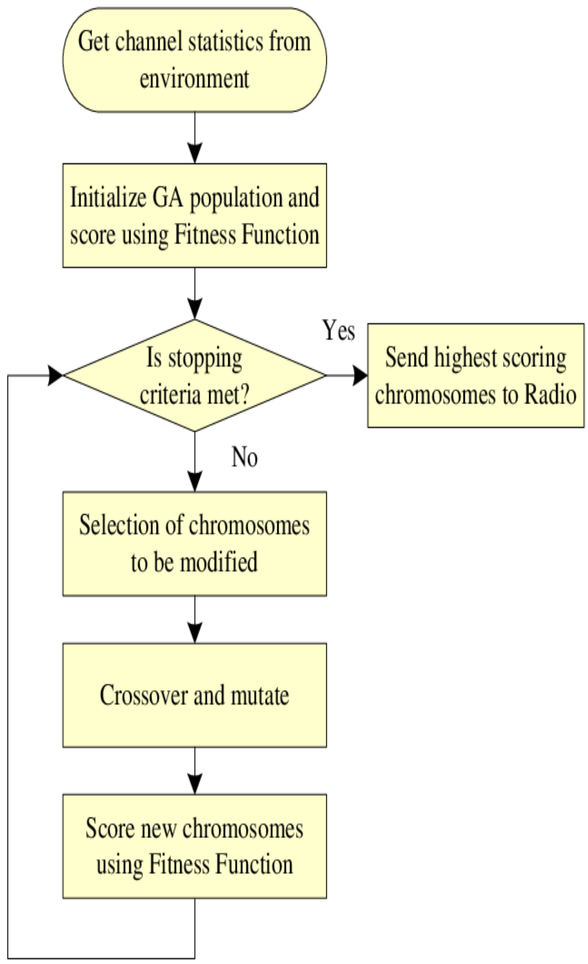

Fig 1: Proposed model for cognitive radio using genetic approach.

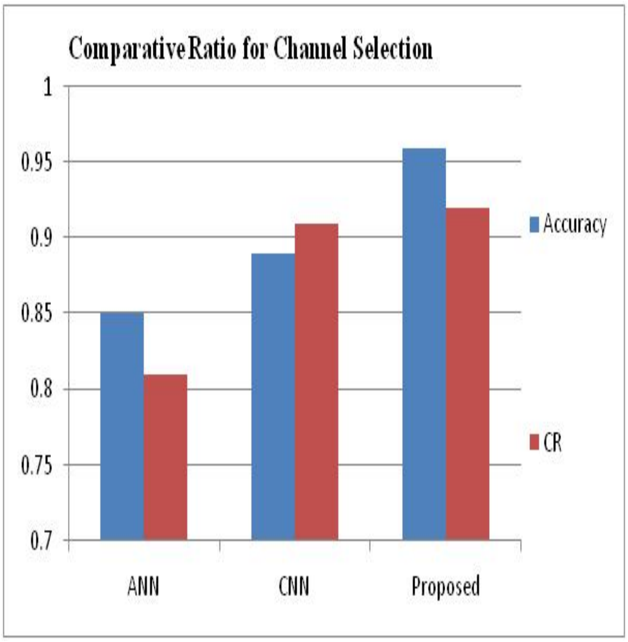

Fig 2: Comparative result for comparative ratio of channel selection using different approach.

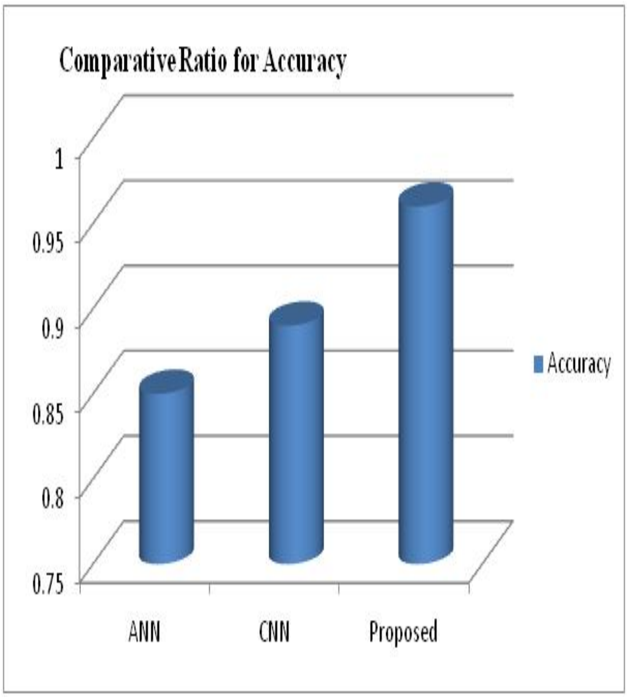

Fig 3: Proposed model for comparative accuracy for channel selection using different approach.

V CONCLUSION AND FUTURE SCOPE

After sensing the RF parameter from the environment by the CR, the required decisions are taken by the reasoning engine so that the new spectrum allocation is supplied in accordance with the user's demand. For solving various issues like QoS, Probability of detection, signal to noise ratio, complete problem etc., Genetic algorithm are proposed in this work. GA has been shown to be the fastest optimization approach for the search space, generating optimized outcomes.

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