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Implementation of Genetic Algorithm in Dyamic Channel Allocation

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Abstract— **Genetic Algorithm is a family of computational models inspired by evolution. These algorithms encode a potential solution to a specified problem on a simple chromosome like data structure and apply recombination operators to these structures so as to preserve critical information. Due to its outstanding search strength and high designable components, GA has attracted great interests even in the wireless domain. This paper gives the application of GA to solve various difficult problems spotlighted from the wireless systems.**

Keywords- wireless communications, wireless domain, search algorithm, genetic algorithms

I. INTRODUCTION

After decades of research on GA, it is used to solve a wide range of problems. GA is a heuristic search method introduced by John Holland . It is shown to be superior to many alternative methods [1]. GA attracts as it performs multi -directional search by manipulating and maintaining a population of potential solutions and tends to focus increasingly on areas with deeper minima. In contrast to other heuristic approaches, such as SA, which only examines one point at a time (one-dimensional) in the search, GA is not biased toward local minima. Although GA has been studied for over two decades, implementing it is often as much an art as designing efficient heuristics. Much of the GA literature is devoted to relatively simple problems. Simplistic application of GA to particular problems often produces reasonable results, but naive application of GA to more realistic problems often results in poor performance. This is due to both the nature of the genetic search and the relationships between the genetic representation and the genetic operators

The paper primarily focuses on the optimization problems in wireless communication systems and the problem- specific GA approaches has been proposed. A practical improvement to the implementation of GA will be attempted in areas where knowledge of the problem domain is available. Therefore, various modified GA approaches are designed according to the different requirements that the specific problems exhibit. The main work concentrates on formulating the optimization problems, choosing the appropriate genetic representation of the problems to be solved, employing specialized initialization, and devising the appropriate genetic operators, etc. The primary goal of the research is to investigate the theory and the application of GA by solving realistic wireless optimization problems.

II. OPTIMIZATION PROBLEMS AND ALGORITHM

A. *Optimization Problems*

As in all empirical sciences, optimization. Problems are abundant in wireless systems, which can be perceived and modeled by optimizing the value of an objective function, under stated feasibility constraints. In many cases of practical relevance, and particularly in most highly nonlinear models, the optimization. Problems do In not warrant the global optimality of solutions found by local scope search approaches. Since the number and quality of the local solutions are typically unknown, there is a Strong motivation for seeking the globally best solutions, which is the main objective of Global optimization algorithms .

The goal of an optimization problem can be described as follows. Find the Combination of variables (independent parameters), which optimizes a given quantity, possibly subject to some restrictions on the allowed parameter ranges. The quantity to be optimized(maximized or minimized) is termed the objective function, the Parameters which may be changed in the quest for the optimum are called decision or Control variables, and the restrictions on allowed parameter values are known as constraints.

B. *Optimization Algorithms*

The most common approach to solve an optimization problem is to apply gradient based Search methods like the well-known Quasi-Newton methods [3]. These methods are highly efficient and well developed for general applications. However, the main drawbacks are that these methods make strong assumptions on the continuity and differentiability of the objective function fix. Additionally, the solution strongly depends on the initial design because only local solutions are possible.

Unlike gradient-based algorithms, global optimization algorithms circumvent these restrictions, which are very useful when the search space is likely to have many minima, making it hard to locate the true global minimum. It should be noted that global optimization approaches usually involve a stochastic element, and may therefore not guarantee to give the true Z- global minimum, nevertheless in almost all cases they are able to find very good solutions, where other techniques fail completely. A great many methods have been proposed for global optimization, these include greedy methods, exhaustion, branch and bound, random search, and methods inspired by the natural world.

III. Genetic Algorithm

GA is a heuristic search algorithm inspired by the genetic mechanisms of natural species evolution [5], [6]. The basic idea of GA is to represent solutions to a particular problem as individuals in a competing population. As generation passes the 4- more fit individuals, representing better solutions, evolve to produce an optimal solution. Two of the most common GA implementations are simple and steady state. The simple GA is a generational algorithm in which the entire population is replaced each generation. In contrast, in the steady state GA only a few individuals are replaced each generation, which is often referred to as overlapping populations. The main procedures of GA can be identified .Usually, individuals are Encodes as chromosome-like string. GA simulates the evolutionary process by generating an initial population of individuals (P) and iteratively applying genetic operator's i.e. selection, crossover, and mutation, in each reproductive cycle. First, selection is executed to select a couple of individuals for crossover (with a probability of p) and mutation (with a probability of p) operations. The new generated children are put into an intermediate population, called offspring P'. The reproduction process is repeated until the offspring is full i. e. a predefined number of children have been produced [7]. The offspring- can either replace all, or a part of the individuals in the initial population. The so-called incremental replacement is commonly used, in which the less fit individuals are replaced. The execution terminates when the population is convergent or a given number of generations have been run through.

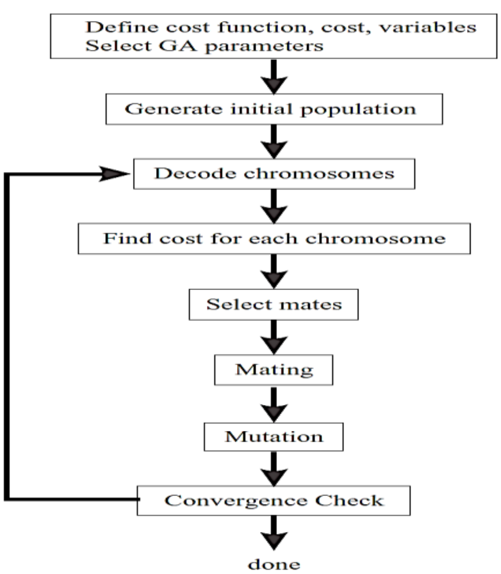

Figure 1. Main procedures in GA

IV. GA-Based Channel Allocation Schemes For Wireless Networks

GA is an adaptive and robust optimization and search technique, which borrows the ideas of natural selection and 'survival of the fittest' from natural evolution. Therefore, GA can easily search for potential solutions to solve complex problems in a general, representation- independent manner. Such a search is not guided by stringent mathematical formulation but often requires balancing two conflicting objectives: exploiting the best solutions and exploring the search space. For all studied cases in this we choose real-coded GA, which has many advantages over binary GA [4]. It should be noted that real value chromosomes should be converted into integer ones when they are evaluated in the fitness function also called energy function. In the following figure, we outline the development of the GA approach in channel allocation schemes, whose structure is depicted in Figure 2.

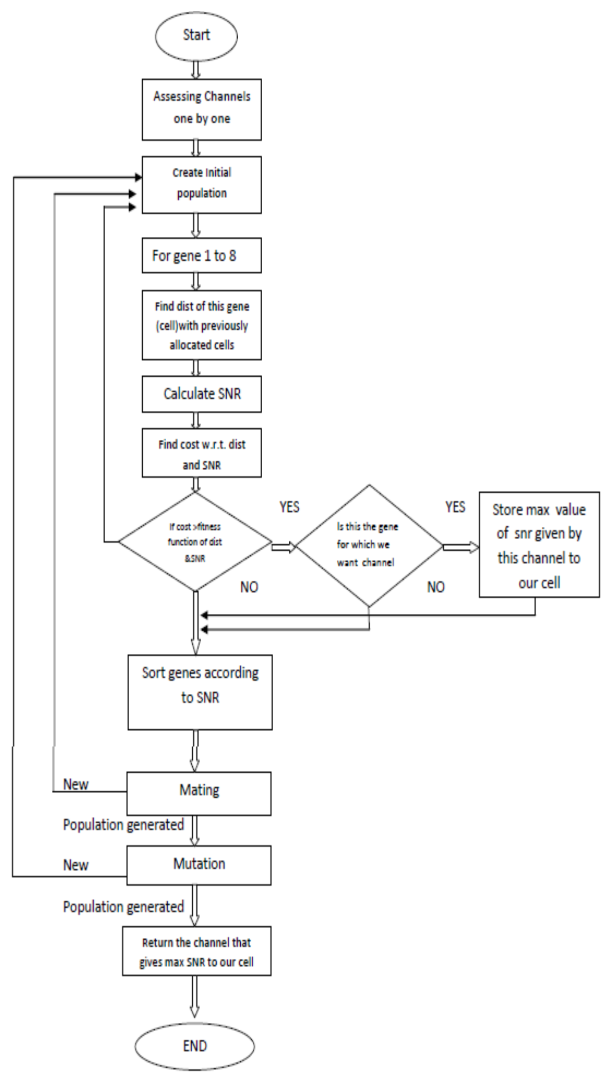

Figure 2. Flowchart depicting the structure of the proposed GA channel allocation Approaches

A. *Chromosome Representation*

The encoding scheme of chromosomes has a major impact on the performance because it can severely limit the search space observed by the system. This study use real-valued representation for all cases under consideration.

B. *Initialization*

The population of real-coded chromosomes is initialized randomly, where K is the number of chromosomes, Q is known as the population size. The purpose of using random generation is to distribute the initial trial solutions to a highly diversified search space.

C. *Fitness Evaluation*

The objective function provides the mechanism for evaluating the fitness of each chromosome. By convention, the fitness function should be a positive value. Since GoS is non-negative, the fitness value (which is to be minimized) of each chromosome is calculated directly.

V. SIMULATION ENVIRONMENT

The analytic models are validated by using discrete event simulation experiments. To simulate a very large wireless network, wraparound hexagonal topology, is employed, which is shown in Figure 3.

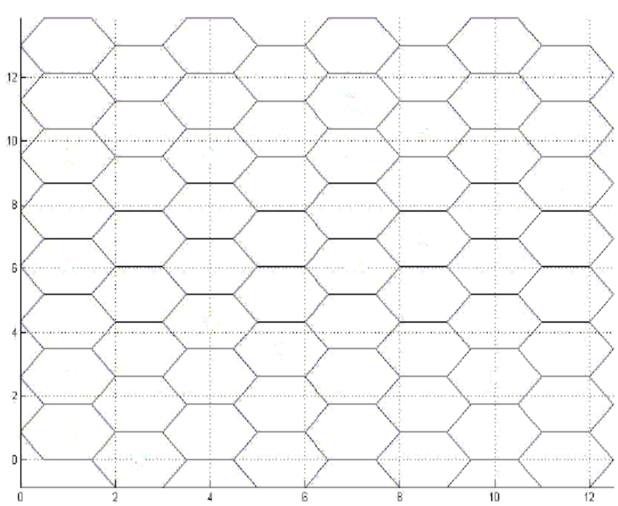

Figure 3.Simulation Environment Wraparound Topology of Cellular Network

This approach eliminates the boundary effect that occurs in an wireless topology. There are 64 cells in the simulated network. The mobility behavior of mobiles in the simulation is described by a model, a mobile stays in the coverage area of a cell for a period of time. The number in each cell represents the offered load and ranges from 0.5 to 20 Erlangs/cell and the average traffic load is 10 Erlangs per cell. This data is used as the network traffic representation for a given time period. This base load is changed proportionately to investigate other offered traffic load conditions.

VI. RESULTS

We present the results obtained for 64 cells with 124 channels and the traffic is increased up to maximum of 1300 users.

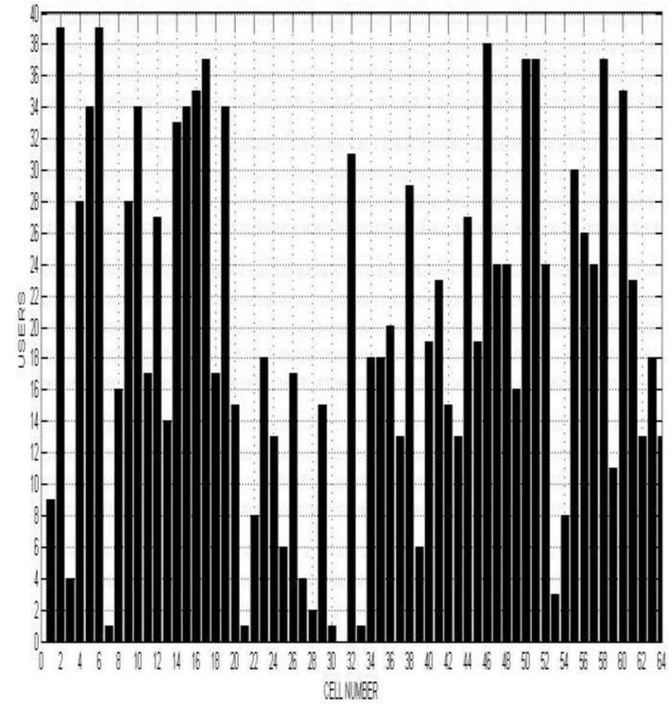

Figure 4 Traffic in each cell

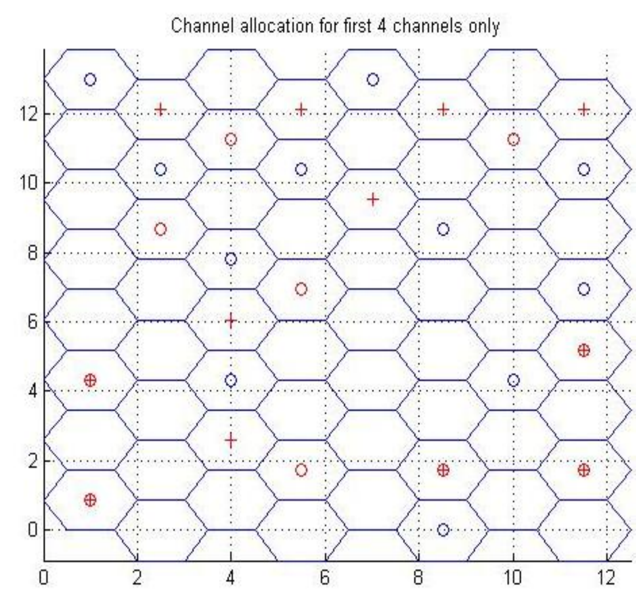

Figure 5 Channel allocation for 4 channels

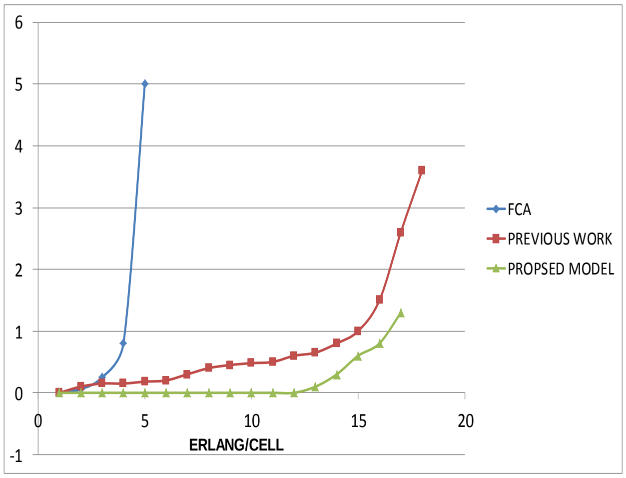

Figure 6 Previous work v/s proposed model

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