A Chaotic Genetic Algorithm for Radio Spectrum Allocation

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Abstract - A Chaotic Genetic Algorithm (CGA) for Cognitive Radio (CR) spectrum allocation procedure is presented. The development of the Cognitive radio system puts emphasis on the efficient utilization of spectrum for both primary and secondary users. Secondary users make use of the spectrum without degrading the quality of service of the primary user(s) [1]. The CR is able to sense available spectrum, establish and maintain quality of service (QoS) requirements for user’s application, meet service level agreement (SLA) and understand its own operational capabilities such as radio parameters [2]. We assume that spectrum sensing has been done; thus a secondary user can specify the quality of service (QoS) requirements for a particular application at any given time.

Genetic algorithm (GA) is a subset of evolutionary algorithms that models biological processes to optimize highly complex functions. A GA allows a population composed of many individuals to evolve under specified selection rules to a state that maximizes the “fitness” (i.e. minimize the objective function). The main advantage of using GA over other stochastic techniques is its parallelism, which speeds up the simulation results leading to faster convergence. However, some notable drawbacks of the traditional GA (TGA) include slow convergence and a possibility of being stuck in local optimum solution. The TGA uses a random process to generate parameter values for the selection, crossover and mutation processes. Random number generators are designed to result in either uniform distributions or Gaussian distributions [3].

We conjecture that selection, crossover and mutation in genetics are driven by a random non-linear dynamics process rather than a random process. Therefore in the spectrum allocation process, a chaotic logistic map is incorporated into the initial population generation as well as in the crossover and mutation processes of TGA. The properties of a chaotic system that provide additional benefits over randomly generated solutions are sensitivity to initial conditions, topological density and topological transitivity [1]. These ensure that CGA is able to explore the entire solution space. Introducing chaos into the whole process of a traditional genetic algorithm may help improve convergence time and accuracy. This concept is termed Chaotic GA (CGA). Simulation was implemented in MATLAB to compare the results obtained for CGA and TGA.

REFERENCES