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# 論　文　内　容　要　旨

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| 学位論文題目 | Research on Cognitive Engine Design for Cognitive Radio Networks<br>(コグニティブ無線ネットワークに対するコグニティブエンジン設計に関する研究) | | |

内容要旨

Cognitive radio technology is the key technology to solve the current shortage of spectrum resources and low spectrum utilization. Cognitive engine is regarded as the brain of a cognitive radio system. Cognitive engine always include decision making mechanism and learning algorithm. In this dissertation we studied centralized cognitive communication system and distributed cognitive radio system respectively. For centralized system, we proposed a modified PSO based adaptive resource allocation algorithm for cognitive radio in LTE-A frame. The general problem of resource allocation in communication system is modeled. Through the combination of the proper relaxation of the restrictive conditions and the design of the penalty function, the constraints of the communication system and the requirements of the system are designed in the adaptive function value, and the relationship between the two is intuitively reflected by the size of the adaptive value. In order to provide effective algorithm flexibility guarantee for decision adaptation of cognitive radio systems, we introduce an evolutionary algorithm based on particle swarm optimization (PSO), which has very strong generality and can provide sufficient algorithm flexibility to support the adaptation needs of cognitive radio systems. When analyzing the advantages and disadvantages of common evolutionary algorithms, we start with the complementarity of particle swarm optimization and genetic algorithm on the advantages and disadvantages, and propose an improved particle swarm optimization algorithm, which inherits the fast convergence characteristics of the particle swarm optimization and has a higher global search ability in the genetic algorithm. In addition, the restart mechanism is introduced on the basis of improved particle swarm optimization (PSO). When the system has not updated the global optimal solution and the global optimal position for the continuous N generation, it is considered that the whole population has lost its vitality and falls into the local extremum. At this point, the method of reboot is used to maintain the diversity of the system. And this proposed algorithm designed by combining PSO and GA's advantages. Simulation results proved our proposed algorithm can get a better performance than original PSO and perfectly fit for a centralized cognitive radio system. For distributed cognitive radio system,

because there is no central controller, it's hard to globally control these secondary users' strategy. Cooperative spectrum sensing with secondary users can achieve a better performance than individually sensing without cooperation in centralized cognitive radio networks both in speed and accuracy are proved by lots of work. However, in distributed cognitive radio system how to collaborate in cooperative spectrum sensing is still an open problem, because selfish secondary users don't want to contribute their energy and time on sensing instead of transmitting. So we proposed an evolutionary game based cooperative sensing strategy for distributed cognitive radio. As the secondary users are selfish and they overhear other's spectrum sensing results, we add a priority system into replicator dynamics which makes secondary users can try different strategies and learn a better strategy through strategy interactions and ensure secondary users' relative fairness to make the whole system work properly and deal with congestion problem effectively. In this strategy, we can clearly study secondary users' strategy interaction process and through this process we can get an evolutionary stable strategy (ESS). All the secondary users in this game intend to choose ESS and get their best interest out of the game. And based on this evolutionary stable strategy, we proposed a distributed learning scheme. This leaning scheme can make sure a secondary user achieve ESS without knowing other user's strategy. From the simulation results, the proposed spectrum sensing and congestion control strategy has a better performance of total throughput than fully cooperative strategy which have all secondary users sense at every time slot. Moreover, the proposed spectrum sensing strategy also has a better fairness performance than single user sensing strategy in order to reduce the effect of free-riding and congestion problems.