

基于免疫克隆选择的认知无线网络频谱分配研究

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Immune-clonal-selection based Spectrum Assignment for Cognitive Radio Networks

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摘要

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摘要 该文提出了图论和免疫优化理论相结合的认知无线网络频谱分配方法。采用基于矩阵的二进制抗体编码,从效率和公平性考虑设计了随机约束满足算子和公平约束满足算子,提出一种基于免疫克隆选择(ICS)的频谱分配算法。对经典克隆选择算法进行改进,增加约束满足操作保证种群编码能够满足频谱干扰限制,实现了频谱分配的约束优化。理论证明了约束满足操作的有效性,分析了算法的计算复杂性和适用性。仿真结果表明:ICS算法与颜色敏感图论着色算法相比,网络带宽明显提高;在频谱干扰严重的情况下,采用公平约束满足算子的ICS算法能显著提高网络的公平性;与参考智能算法相比,ICS算法具有较快的收敛速度。

关键词: 认知无线网络 频谱分配 免疫克隆选择 约束优化

Abstract: A spectrum assignment scheme for cognitive radio networks is proposed by means of combining graph theory with immune optimization algorithm. A binary matrix coding scheme is introduced to represent antibody population. Two operators Random-Constraint Satisfaction Operator (RCSO) and Fair-Constraint Satisfaction Operator (FCSO) are designed to guarantee efficiency and fairness respectively. A novel spectrum assignment algorithm based on Immune-Clonal-Selection (ICS) is proposed, which is an improvement of the classical immune clonal selection algorithm. With Constraint Satisfaction Operation (CSO) applied to the encoded populations, the constraints can be satisfied to achieve the global optimization. The CSO is proved to be effective theoretically, and then the computational complexity and applicability are analyzed. Simulation results show that, compared to the Color-Sensitive Graph Coloring (CSGC) algorithm, the ICS can significantly increases the network utilization. Especially when the spectrum conflict is severe, the fairness reward is efficiently improved by using the ICS with FCSO. Meanwhile, its high convergence speed is validated by simulation.

Keywords: Cognitive Radio Networks (CRN) Spectrum assignment Immune Clonal Selection (ICS) Constrained optimization

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