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一种基于博弈论的交通系统最优调度策略学习方法

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A game-theory-based approach for learning the optimal scheduling strategies in traffic systems

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摘要 交通网中,最大化车流量和最小化平均等待时间是每一个路口调度的目标.交通调度中,各路口与其它路口发生博弈关系.博弈过程中,相邻路口之间为使其自身利益最大化而存在一种策略间相互协调的约束.针对复杂的交通调度控制问题,基于多智能体多阶段博弈论对交通系统进行建模.考虑动态博弈交通环境的实际特征,进一步基于博弈的增强学习算法,提出一种以惩机制为约束条件的交通系统博弈策略的学习方法,最终使参与交通博弈的多个路口达到Nash均衡,从而得到交通系统的最优配时调度策略组合.实验验证了所提出方法的可行性和有效性.

关键词： 交通调度 博弈论 增强学习 协调约束 Nash均衡

Abstract： In traffic networks,the target of intersection scheduling is to maximize the flow rates and minimize average waiting time of all concerned vehicles.Game relationships exist between each intersection and the other ones in the traffic scheduling.In the process of this traffic game,there is a constraint of mutual coordination among strategies so that the maximal profits of neighboring intersections can be achieved.In this paper,we focus on the complex traffic scheduling problem,and give the modeling approach for traffic systems based on the multi-agent multi-step game theory.Considering the practical characteristics of dynamic traffic game environments,in this paper we further propose an approach for learning traffic scheduling strategies from historical traffic scheduling data based on the reinforcement learning algorithm in game theory.Then the Nash equilibrium of multiple intersections that participate in the traffic game can be achieved ultimately.Therefore,the optimal scheduling strategies of traffic systems will be obtained.Experimental results show the feasibility and effectiveness of our method.

Key words:

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