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Multi-Objective Optimization of Intersections

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Abstract : As the crucial component of city traffic network, intersections have significant impacts on urban traffic performance. Despite of the rapid development in transportation systems, increasing traffic volumes result in severe congestions especially at intersections in urban areas. Effective regulation of vehicle flows at intersections has always been an important issue in the traffic control system. This study presents a multi-objective optimization method at intersections with cellular automata to achieve better traffic performance. Vehicle conflicts and pedestrian interference are considered. Three categories of the traffic performance are studied including transportation efficiency, energy consumption and road safety. The left-turn signal type, signal timing and lane assignment are optimized for different traffic flows. The multi-objective optimization problem is solved with the cell mapping method. The optimization results show the conflicting nature of different traffic performance. The influence of different traffic variables on the intersection performance is investigated. It is observed that the proposed optimization method is effective in regulating the traffic at the intersection to meet multiple objectives. Transportation efficiency can be usually improved by the permissive left-turn signal, which sacrifices safety. Right-turn traffic suffers significantly when the right-turn lanes are shared with the through vehicles. The effect of vehicle flow on the intersection performance is significant. The display pattern of the optimization results can be changed remarkably by the traffic volume variation. Pedestrians have strong interference with the traffic system.

Keywords : cellular automata, intersection, multi-objective optimization, traffic system
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