报告 25

出行时间依概率可靠的路径搜索算法研究
Path Algorithm Based on the Reliability of Travel Time in Probability

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报告摘要 Abstract

随着城市化进程加快，城市交通供需矛盾日渐突出。如何提高城市居民的出行效率，缓解城市交通压力，成为交通科学关注的一个重要科学问题。具体到人们日常出行，如何找到出行时间可靠的路径成为亟待解决的交通科学问题。本文基于城市交通大数据探讨出行时间依概率可靠的路径搜索算法和基于该算法的公交出行方案规划问题。本文假设路段出行时间服从正态分布且路段间出行时间不相关性，借助出行时间的期望、方差和准点到达概率α，刻画路段及路径的出行时间概率可靠性。核心研究内容是设计实现高效率的启发式可靠路径搜索算法。面向未来研究结果应用，本文考虑实际交通状况与不同居民的出行需求，提出 3 种改进的启发式函数的定义。（1）回避拥堵：即利用路段的 85%高车速，估算当前节点至终点的路径出行时间。（2）历史最短：即利用路段历史平均通行时间的最小值，估算当前节点至终点的路径出行时间。（3）躲避信号灯：即以信号交叉口数量估算当前节点至终点的路径出行时间。我们利用北京市浮动车数据，对改进算法进行验证。研究发现，相对于已有搜索算法，三种改进的启发式搜索算法计算时间均明显减少。其中，历史最短和躲避信号灯两种改进算法，将计算时间效率提高到已有算法的 10 倍以上。本文考虑实际路况与居民出行需求，提出三种改进的启发式可靠路径搜索算法。北京实际交通运行数据测试结果表明，三种改进算法的计算效率均明显提高。本文提出的算法，将为人们获得出行时间可靠的路径规划方案提供应用理论基础。

With accelerated urbanization, the contradiction between supply and demand of urban traffic becomes more and more serious. How to improve the efficiency of urban residents' travel and ease the pressure of urban traffic have become an important scientific issue of transportation science. Especially for the people's daily travel, how to find a travel time reliable path becomes a scientific problem to be solved in transportation science. In this paper, based on the big data of urban traffic, path searching algorithm based on the reliability of travel time in probability is discussed in detail. In this paper, we assume that the links' travel time obeys normal distribution and is uncorrelated one and any other. Then the travel time reliability is characterized by the expectation and variance of travel time, and punctuality arrival α. The core research content is the design and implementation of the efficient heuristic reliable path search algorithm. For future application of the results in this paper, three modified heuristic functions are proposed to consider the actual traffic situation and the travel demand of different residents. (1) avoid congestion (AC, the 85% high speed is used to estimate the path travel time from the current node to the destination); (2) the minimal travel time in history (MTTH, the minimal travel in history is used to estimate the path travel time from the current node to the destination); and (3) least signal intersection (LSI, the path travel time from the current node to the destination is estimated by the number of the signalized intersection). Floating car data in Beijing is employed to verify the modified algorithm. The results show that, compared with the existing search algorithm, the efficiency of the three modified heuristic search algorithm are significantly improved. Among them, the computational efficiency of the MTTH and LSI algorithms are improved to more than 10 times of the existing algorithm. In this paper, taking the actual traffic conditions and the residents' travel demand into consideration, three modified heuristic reliable path searching algorithms are proposed. Tests on the actual traffic operation data in Beijing show that the computational efficiency of the three improved algorithms is significantly improved. The algorithms proposed in this paper will provide the theoretical basis for the path planning of travel time in future.