A Graph-Based Heuristic for Bus Route Planning Using Taxi Origin-Destination Data

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Abstract

As the global population ages and transportation resources become increasingly constrained, mid-sized suburban aging cities face growing challenges in designing efficient and sustainable public transit systems. This thesis addresses these challenges by introducing a comprehensive data-driven heuristic based on graph theory for bus stop selection and route planning, leveraging large-scale taxi origin-destination data. The methodological framework developed in this thesis features a density-based spatial clustering module that respects pedestrian networks and physical distances to identify candidate bus stops corresponding to mobility hotspots. Subsequently, a K-medoids clustering component based on road distances is employed to segment and assign bus stops to bus routes while adhering to road network constraints. Finally, a composite Hamiltonian path construction heuristic is applied to plan feasible bus routes for each segment. To validate the proposed approach, this thesis presents a comprehensive case study of Susono city in Shizuoka, Japan. The results demonstrate the effectiveness of the methodology in generating four practical, user-centric, and context-aware bus routes with high operational efficiency. Overall, this thesis contributes a robust, data-driven framework for effective and adaptive mobility planning, providing valuable insights for both local authorities and bus operators.