Navigation System Optimization Implementation

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Background and Limitations: Existing navigation systems, such as Google Maps, only recommend routes for a single query, which may further deteriorate future traffic conditions. For example, if numerous routes are recommended for the same roads within a similar time, even if they represent the shortest distance or the minimal travel time, the increased future traffic flow can lead to congestion on those roads.

Objects: We aim to optimize the route recommendations by managing the future route data which refers to a sequence of connected roads along with their corresponding departure time. Specifically, the macroscopic simulation algorithms or deep learning frameworks can efficiently and accurately estimate the future traffic conditions on the road network. Then, by dynamically controlling traffic signal policies, we aim to investigate how rerouting a proportion of future route data can effectively reduce overall traffic congestion in advance.

Learning Tasks: (1) **Spatio-temporal data management**: We construct an index structure to store the estimated future traffic conditions. As time passes, it supports efficiently and accurately querying and updating in response to dynamic changes in future route data. (2) **Future route optimization**: By controlling traffic signals and rerouting portions of future routes with high predicted travel times, future traffic congestion can be alleviated in advance with minimal traffic intervention. (3) **Visualization**: A demonstration of the future route optimization procedure is required.

Expecting Results: A research paper will be on the top conference or journal, and a demonstration system for the top conference.

Required techniques: C++, Python, Visualization.