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Final Report

Project Title:

Trajectory-Adaptive Route Choice Models: Specification, Choice Set Generation, and Estimation

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Problem Addressed

The objective of the research is to investigate adaptive route choice behavior using individual-level route choice data from GPS (Global Positioning System) observations in a real-life network, where a traveler could revise the route choice based upon trajectory information, defined as experienced travel times along the traversed road segments. Traffic networks are inherently uncertain with random disruptions such as incidents and bad weather, and real-time information on realized traffic conditions could potentially help reduce the uncertainty and thus travelers could adjust route choices accordingly. Previous studies have shown that an adaptive route choice model can be estimated in hypothetical, simplified networks with SP (stated preferences) data, and this research aims to investigate whether such a model can be estimated and explain adaptive route choice behavior under trajectory information using RP (revealed preferences) data. The major tasks are to specify a random utility model for adaptive route choice in a general network, design and implement computer algorithms to generate the choice set where the alternatives are trajectory-adaptive routing strategies, and estimate the model against GPS data using existing estimation software.

Approach and Methodology

Data Acquisition
We work with two data sets of GPS taxi trajectories, one from Stockholm in collaboration with KTH (Royal Institute of Technology of Sweden), and the other from Singapore in collaboration with SMART (Singapore-MIT Alliance of Research and Technology).

Choice Set Generation
An efficient algorithm to generate the choice set of strategic route choice is designed for real-life large scale networks. Important changes have been made to an existing optimal routing policy algorithm to make it practical in a real-life network, which includes piece-wise linear travel time representation, turn-based, label-correcting, and dynamic-blocked links.

Map Matching and Link Travel Time Distribution Generation
The two tasks are carried out by our collaborators from KTH and SMART.

Model Estimation
The strategic route choice model has been tested using synthetic data in a real life network obtained from the Pioneer Valley Planning Commission of Massachusetts. It is shown that there are enough addictiveness in the choice alternatives and the true model parameters can be recovered. Model estimations with real data from Stockholm and Singapore are still ongoing given the level of complexity in dealing with real life data.

Conclusions and Recommendations

The conclusions are based on our computational tests of the choice set generation. Model estimation is still ongoing given the level of complexity of handling real life data.

Compared to a hypothetical simplified network, there are many new issues in generating optimal routing policies (critical elements in generating a route choice set) in a large and complex real-life network. The first major issue is random access memory (RAM). In order to alleviate this issue, a piece-wise linear link travel time distributions has been adopted to represent the dynamic link travel times, which is more efficient than a discrete-time representation of link travel times. The second major problem is that in a real-life network cycles might be a problem due to the complexity of the network and the data when there are no turning penalties. Therefore, the algorithm is changed from node-based to link-based, so that turning penalties can be implemented to avoid cycles in traveler´ route choices. The third issue is that an old algorithm requires positive link travel times therefore time period length needs to be one (1) second. In doing so, there might be too many time periods. This will cause RAM issues in a real-life network. In order to minimize runtime, label-setting has been changed to label-correcting which allows longer time period length. A new feature has also been added to the algorithm in order to work with stochastic time-dependent blocked links, which takes into account road closures in real-life caused from events as incidents and bad weather.

The implemented choice set generation algorithm can generate choice sets for over 1000 ODs with a runtime of two days on a typical PC for the Stockholm network with over 3000 links, 36 time periods, and 69 support points of the discrete joint travel time distribution. This is acceptable given that the choice set generation procedure is carried out offline only once.

Outcomes

Conference Proceedings

Ding, J. and Gao, S. An Optimal Adaptive Routing Algorithm for Large-scale Stochastic Time-Dependent Networks. The 92nd Annual Meeting of Transportation Research Board Compendium of Papers DVD. Paper #13-4273. Washington, DC, Jan. 13-17, 2013.

Conference Presentations

Ding, J. and Gao, S. An Optimal Adaptive Routing Algorithm for Large-scale Stochastic Time-Dependent Networks. The 92nd Annual Meeting of Transportation Research Board, Washington, DC, Jan. 13-17, 2013.

Ding, J. and Gao, S. Adaptive Route Choice Models: Choice Set Generation and Model Estimation. The Annual Meeting of the Institute for Operations Research and Management Science, Phoenix, AZ, Oct. 14-17, 2012.