Tour-Based Urban Freight Travel Demand Models

by

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ABSTRACT

This dissertation is concerned with the enhancement of urban freight travel demand modeling by incorporating the trip chaining behavior of commercial vehicles. In this dissertation, two approaches were developed to accomplish the objective. One model focuses on estimating the tour flow distribution patterns in the aggregate level while the other attempts to simulate trip chaining behavior in the disaggregate level.

The first approach is aimed to estimate commercial vehicle tour flows distributed in urban networks using the concept of entropy maximization. The resulting entropy maximization formulations obtain the most likely set of tour flows that meet the system's aggregate-level constraints such as the number of trips produced by or attracted to each zone (trip production/attraction), and the total impedance of the entire network. The first-order conditions of the formulations show that the tour flow in a tour is a linear combination of the Lagrange multipliers associated with the trip productions/attractions along that tour, and the tour impedance variables.

The application of the tour-based entropy maximization approach requires a pre-specification of tours potentially visited by commercial vehicles and the associated impedances. In this context, a behavioral-based tour choice model was developed to generate a sufficient and effective set of tours as the input to the entropy maximization formulations.

The second approach is a tour construction model that generates commercial vehicle tours in order to satisfy a given commodity flow OD matrix as part of a hybrid micro-simulation framework. To shed light into key variables that affect trip chaining behavior, a behavioral approach was implemented, decomposing the tour decisions into two choices, i.e., the next destination choice and the tour termination decision. The corresponding discrete choice models were estimated to support the simulation of trip chaining decisions.

The test results show that both models reach good agreement with the trip chaining patterns observed in real world. The good performances of the two models indicate the feasibility of applying the proposed models to forecast urban freight travel demands.