Project Summary

Texas Department of Transportation

0-4080: Second Generation Activity-Based Travel Modeling Systems for Metropolitan Areas in Texas Accommodating Demographic, Land Use, and Traffic Microsimulation Components

Background

The trip-based travel demand models used in Texas and other states today were developed with the primary objective to evaluate major capital improvements. While this continues to be an important objective of travel demand models, there has been a shift in the emphasis from evaluating long-term investment-based strategies to understanding travel behavior responses to shorter-term congestion management policies. The limitation of traditional trip-based travel demand models in examining important congestion-mitigation policies, along with growing dissatisfaction with the statistically oriented trip-based models from a predictive accuracy viewpoint and a behavioral validity viewpoint, has led to the emergence of a more behaviorally oriented activity-based approach to travel demand modeling.

In an effort to advance and operationalize the activity-based approach, the objective of this research was to develop an activity-based travel demand modeling system that can be used for metropolitan areas in Texas.

What the Researchers Did

Researchers developed the Comprehensive Econometric Microsimulator for Daily Activity-Travel Patterns (CEMDAP). CEMDAP is a microsimulation implementation of a continuous-time activity-travel modeling system. It takes as input the disaggregate agent level socio-demographics, land-use patterns, transportation system level-of-service characteristics, and model parameters for a study area to provide as outputs the detailed individual-level daily activity-travel patterns for all the individuals in the study area.

The salient aspects of CEMDAP are listed below:

- The activity-travel patterns of workers, non-workers, students, children (persons under 16 years of age), and adults are all explicitly modeled, while also accommodating space-time constraints and interactions. The predictions are made at a continuous-time level (at the level of 1 minute), which enables the assessment of time-of-day specific transportation policies such as dynamic pricing mechanisms.
- CEMDAP is a generic system that can be applied to any metropolitan area, and at any level of spatial and temporal resolution, as long as the appropriate models are estimated for the local area.
- The software design philosophy is to create a generic library of routines that form the building blocks of an object oriented (OO) activity-based travel demand modeling system so that variants of modeling systems can be rapidly implemented.

Research Performed by:

Center for Transportation Research (CTR), The University of Texas at Austin

Research Supervisor:
Chandra Bhat, CTR

Researchers:
Rachel Copperman, CTR
Naveen Eluru, CTR
Jessica Guo, CTR
Abdul Pinjari, CTR
Ipek Sener, CTR
Sivaramakrishnan Srinivasan, CTR

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- The system has built-in data caching routines to store frequently accessed data items in random access memory (RAM) to reduce the number of data queries and disk accesses. The system computational efficiency is further enhanced by running the simulation over multiple threads.
- PostgresSQL is used as the database management system (DBMS) for it is known to be stable under large data loads. CEMDAP is connected to the DBMS through an Open Database Connectivity (ODBC) interface.
- A user-friendly menu-driven interface provides a visualization of the model structure to facilitate analyst input.

An evaluation of CEMDAP was carried out, in conjunction with the North Central Texas Council of Governments (NCTCOG), by applying it to predict the activity-travel patterns of the population in the Dallas-Fort Worth (DFW) area to assess (1) the accuracy of the predicted activity-travel patterns, and (2) the sensitivity of the predicted activity-travel patterns to various policy scenarios.

Researchers developed the synthetic population generator (SPG). The synthetic population generator synthesizes the households and individuals that, together, represent the entire population within a given study area. These households and individuals can be used as the inputs for an activity-based travel demand modeling system such as CEMDAP. SPG is designed to be used as an off-the-shelf product for any metropolitan area.

What They Found

The following are the important findings from the evaluation of CEMDAP.

- The predicted activity-travel patterns from CEMDAP indicate reasonable accuracy against the observed link counts in the DFW area.
- A sampling rate analysis suggests that 5% of the population may be adequate to reasonably represent the activity-travel patterns of the entire DFW population.
- The predicted activity-travel patterns from CEMDAP show reasonable sensitivity to modifications in socio-demographics, transportation system level-of-service, and land-use characteristics of the DFW area. Furthermore, our analysis indicates that an activity-travel micro simulator such as CEMDAP allows policy actions to be analyzed in ways that are generally not possible with the conventional trip-based models.

What This Means

- CEMDAP can be integrated into the travel models used by the metropolitan areas in Texas by replacing the first three of the four steps (trip generation, trip distribution, and modal split) of current trip-based models. Subsequently, traffic assignment methods can be applied to determine the travel demand patterns on the transportation network.
- The researchers particularly recommend the implementation of CEMDAP in urban regions of the State that are seeing rapid growth, and changing demographics and activity-travel conditions. Urban areas can utilize the information from this research to evaluate their needs when deciding whether to use activity-based modeling.

For More Information:
Research Engineer - Duncan Stewart, TxDOT, 512-465-7403
Project Director - Janie Bynum, TxDOT, 512-486-5107
Research Supervisor - Chandra Bhat, CTR, 512-471-4535

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Texas Department of Transportation
Research and Technology Implementation Office
P.O. Box 5080
Austin, Texas 78763-5080
512-465-7403