Bringing Freight Components into Statewide and Regional Travel Demand Forecasting

Center for Quality Growth and Regional Development

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Research Overview

Need
DOTs and MPOs need freight demand models that are reliable, accurate, and approachable.

Purpose
• Leverage new data sources
• Benchmark freight modeling best practices
• Develop long-term guidelines for freight demand models

Project Goals
• Study best practices and extent of usage of GPS data in freight modeling
• Build prototype tour-based truck models with GPS-based truck data
• Test model improvements compared with existing models
Problem Statement

• Lack of Urban Freight Demand Models
• Few practical freight forecasting models
• More significant in small and medium-sized MPOs
• Models missing freight component could overestimate capacity
• Incapability to provide adequate info to decision makers
DOT and MPO Survey
Summary of Results

• Freight models are still relatively rare – about half of DOTs and one quarter of MPOs

• Most models are vehicle-based

• GPS data remains rare – used in about one in five vehicle models

• Lack of data remains a large obstacle to freight modelers – GPS data can help

What primary obstacles do you encounter in modeling freight?

- Unavailable data
- Insufficient funding
- Insufficient staffing
- Lack of specialized knowledge

DOTs vs. MPOs
Tour-based Truck Model
Conceptual Framework

- Tour Generation
- Tour Main
- Destination Choice
- Intermediate Stop Model
- Stop Location Model
- Time of Day
- Trip Accumulator
- Traffic Assignment
GPS Data Source

Time

Date

Location

Feb ‘11     May ‘11     Jul ‘11     Oct ‘11
GPS Data Source

Atlanta TRUCK RECORD:
- ATL_1A_02.2011 (1,717,004 records)
- ATL_1A_05.2011 (1,540,362 records)
- ATL_1A_07.2011 (1,452,661 records)
- ATL_1A_10.2011 (1,349,400 records)
- ATL_1B_02.2011 (1,507,129 records)
- ATL_1B_05.2011 (1,973,480 records)
- ATL_1B_07.2011 (2,201,814 records)
- ATL_1B_10.2011 (2,321,084 records)

Total 14,062,934 records

ATRI provide 8 weeks of truck GPS data for 5,000 different trucks in 2011 (2 weeks in each season).
Birmingham TRUCK RECORD:

- BMH_1A_02.2011 (497,762 records)
- BMH_1A_05.2011 (465,937 records)
- BMH_1A_07.2011 (387,992 records)
- BMH_1A_10.2011 (400,817 records)
- BMH_1B_02.2011 (570,629 records)
- BMH_1B_05.2011 (688,292 records)
- BMH_1B_07.2011 (721,516 records)
- BMH_1B_10.2011 (755,895 records)

Total 4,488,840 records

ATRI provide 8 weeks of truck GPS data for 5,000 different trucks in 2011 (2 weeks in each season).
## GPS Data

### Truck Records

- **Truckid:** This is a unique truck ID.
- **Parking_from:** This indicates if the vehicle is in a known truck stop at the first point: 1 = at a truck stop, 0 = not at a truck stop
- **Readdate_from:** This is the first date/time stamp in a series
- **TAZ_2000_from:** This is the TAZ ID for the first position read in a series.
- **To_readdate:** This is the second time stamp in a series
- **To_TAZ_200:** This is the second TAZ ID in a series
- **To_Parking:** This indicates if the vehicle is in a known truck stop at the second point: 1 = at a truck stop, 0 = not at a truck stop
- **Distance traveled:** This is distance traveled in miles from point A to point B. It uses the great circle distance equation (i.e. it is not snapped to a roadway).

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GPS Data Processing

Delete records on weekends and holidays.

Remove records with improper geocoding

Determination on Stopped; Starting to move; in motion; or coming to stop

Converting TRUCK records to TRIPS

Converting TRIPS records to TOURS

Define “TOUR”
- All the movements from a Start location until the truck return to the same location
- From a Start location until midnight of that day
- Multi-day tours were NOT considered

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12,701,995 TRUCK Records
713,306 TRIPS
220,752 TOURS
Truck Tours
Example

**TRUCK ID:**
0014827042235482023 992

**DATE:** Feb. 16, 2011

**TOUR 1:**
- Starting from zone 401
- Taking stops at: 1440, 139, 143, 2057, 2077, 143, 881
- Ending at zone 1440
Truck Tours

Example

**TRUCK ID:**
0014827042235482023 992

**DATE:** Feb. 17, 2011

**TOUR 2:**
- Starting from zone 1440
- Taking stops at: 434, 1678, 1085, 1891, 143, 139, 432
- Ending at zone 410
**Truck Tours Example**

**TRUCK ID:**
00148270422354820 23992

**DATE:** Feb. 18, 2011

**TOUR 3:**
- Starting from zone 143
- Taking stops at: 1440, 344, 2034, 2033, 882, 1440
- Ending at zone 143
Truck Tours
Example

**TRUCK ID:**
00148270422354820
23992

**DATE:**
Feb. 16~18, 2011

**TRUCK:**
• 224 cleaned Truck Records

**TRIPS:**
• 23 trips

**TOURS:**
• 3 tours
Tour-based Truck Model Validation

Observed vs. Estimated Link-Level Volume

- Observed (Count)
- Estimated (Model)
Key Obstacles and Challenges

- GPS data is inconsistent
- Nothing is known about GPS sampling
- We have no description of truck or operator
- External station geocoding was not sufficiently accurate
Trip-based vs. Tour-based Model

Atlanta

Link Volume Comparison (54,560 Links)
Trip-based vs. Tour-based Model
Atlanta

Link Volume Comparison (54,560 Links)
Conclusions and Future Research

**Conclusions**

- GPS data can create robust tour-based freight models.
- GPS data requires extensive processing to be useful.
- Tour based structure reflects truck travel more accurately.
- Future steps will compare truck model results with existing freight models in Atlanta and Birmingham.
- The results are likely to provide new improvements and directions for future research.

**Future Research**

- Develop methodology and GPS data source that distinguishes different types of trucks.
- Work with modelers in practice to implement tour-based truck models with GPS data.
- Examine usefulness for wide-ranging applications – air quality models, traffic congestion forecasts, and investment decision making.