Truck GPS Data to Support Transportation Planning

Presentation at Tennessee Model User’s Group
July 15, 2015

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Contents

- Commercial Vehicle GPS Data
- Data Description
- Tools to support probe vehicle use in transportation planning
- Freight Performance Measures
GPS devices are widely deployed in cell phones, and trucks

Truck fleet operators subscribe to GPS services for operational and maintenance purposes

Automatic Vehicle Location (AVL); Events Activated Tracking Systems (EATS); Fleet Telematics Systems (FTS)

Entities (e.g., ATRI) collect and store historical GPS from operators (2004 to present)

Condition of dissemination is that truck ID’s are anonymized

GPS information should be processed before it can be used for truck travel models
What do GPS devices provide?

- X and Y coordinates
- time stamp
- heading
- spot speed
- Vehicle ID
- Other data (e.g., emissions exist but not provided)
One Day of GPS Data
Statistics

- 60,962 unique truck id’s (whole 2012)

- 104,232,699 observations

- Maximum number of observations for a truck in a day: 1501

- Maximum hourly observations for a truck: 394 (stopped), 356 (moving)

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From txt to shp file

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Observation to Link

- Use function “NEAR” to associate (or snap) an observation with the closest link

Source: ArcGIS Resource Center
Direction Assignment

• Up to eight possible headings can be associated with a link: E, W, N, S, NE, NW, SE, and SW.
Direction and Outlier Identification (DOI)

- Designed to separate snapped observations in two groups
- Estimates bi-directional link freight performance measures (FPMs)
Data Processing

- Handle large datasets (4-5GB)
- Descriptive information
- Develop GIS and Excel files
- Query by Year, Month, Day, Time of Day
- Adjust for Time Zone
Connect data
Estimated FPMs

• Travel Speed (in each direction)
• Travel Time (TT)
• TT reliability measures
  - 90th percentile TT
  - 95th percentile TT
  - Buffer TT (BTT)
  - BTT index (BI)
  - TT standard deviation
  - TTCV
  - TT range
  - mean/median TT ratio
ArcGIS Toolbox

![ArcGIS Toolbox Interface](image-url)
FPM Example: Mean Speed Link

01/03-05: Mean Speeds AM (6AM-9AM)

Legend
Mean Speed (mph)
- Black: No Data
- Red: 0-10
- Orange: 11-20
- Brown: 21-30
- Yellow: 31-40
- Green: 41-50
- Dark Green: 51-60
- Cyan: >61

Tennessee

Memphis
Nashville
Knoxville
FPM Example: Link Total Volumes

01/03-05: Total Volumes AM (6AM-9AM)
TT Reliability Measures

Note: TTa – travel time in North East direction; TTb – travel time in South West direction; TTp95a – 95th percentile travel time in North East direction; TTp95b – 95th percentile travel time in South West direction; TTCVa – travel time coefficient of variation in North East direction; TTCVb – travel time coefficient of variation in South West direction;
Trip Detection

- "NO DESTINATION" Time: 23:59 The last observation
- "STOPPED" Car Wash Location Time: 20:59 – 21:19
- "ORIGIN AT FACILITY" Freight Facility Time: 12:23 – 20:46
- "STOPPED" New Getwell Rd – E Shelby Dr Time: 21:29
Origin-Destination

Number of Origins by TAZ for January 2012

Legend
Number of Origins
- No Data
- 1 - 10
- 11 - 35
- 36 - 60
- 61 - 150
- 151 - 300
- 301 - 450
- 451 - 600
- 601 - 900
- 901 - 1400
- 1401 - 9700
- >9700

Number of Destinations by TAZ for January 2012

Legend
Number of Destinations
- No Data
- 1 - 10
- 11 - 35
- 36 - 60
- 61 - 150
- 151 - 300
- 301 - 450
- 451 - 600
- 601 - 900
- 901 - 1400
- 1401 - 9700
- >9700

Counties
Mobility

Leaving Shelby 6-7am
Flows

Leaving Shelby 6-7am
Network Conditions: Flow

Time: 06/13/2014 01:00:00 AM

Hourly Truck Observations Using Links Across Tennessee at 06/13/2014

Hourly Truck Observations By Links
- 1 - 11
- 12 - 34
- 35 - 73
- 74 - 133
- 140 - 228
- TAZ TN
Network Conditions: Travel Time

Hourly Link Travel Times across Tennessee 06/13/2014

Average Travel Time in Hours

- 0.00 - 0.07
- 0.08 - 0.23
- 0.24 - 0.55
- 0.56 - 1.17
- 1.18 - 3.09
- TAZ_TN
Network Conditions: Travel Time Reliability (95th percentile)
## Facility Performance Measure

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Freight Facility Turn Times

**Turn Time Histogram for I4 (January)**

**Turn Time Histogram for I5 (January)**
Freight Facility Occupancy

Average Intermodal Facility Occupancy (January 2012)
Freight Facility Entry/Exit Volumes

Average Intermodal Facility Entry Volumes (January 2012)

Average Intermodal Facility Exit Volumes (January 2012)
Truck Parking
Truck Parking at SB I-75 MM16

- **Rest Area**
  - Occupancy
  - Frequency

- **On/Off**
  - Occupancy
  - Frequency
Limitations of GPS Data

- Sample size (small and varies by area)
- Error in GPS devices
- Limited attributes
  - Proprietary nature of the data
In progress

- Truck parking utilization (on- and off-site)
- Safety
- Capacity reliability
- Recurring and non-recurring freight corridor reliability
- Freight and land use integration
- TDM Calibration/Validation
Agency Acknowledgement

- Tennessee Department of Transportation
- Federal Highway Administration
- American Transportation Research Institute
- Wisconsin Department of Transportation
Thank you for your time

Q/A

Graduate Student Acknowledgment
Mania Flaskou, Alireza Naimi, Khademul Haque

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