Path-based travel time reliability using truck GPS Data

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Motivation

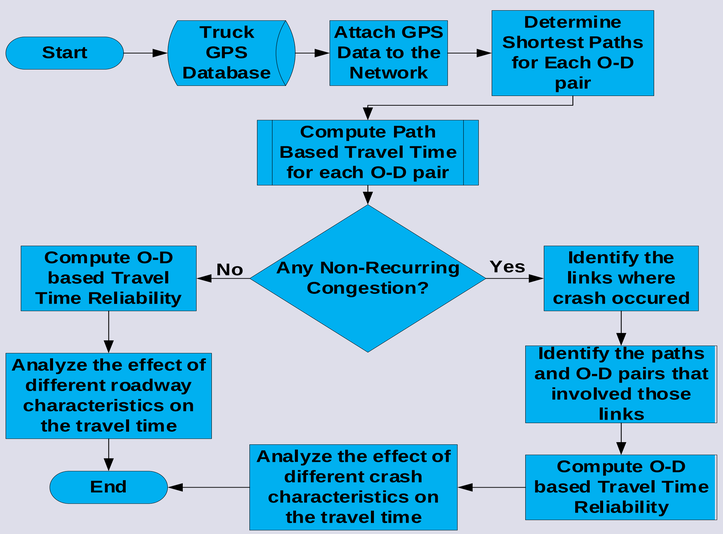
- Restrictions to trucks travel speeds, lanes, and on certain portions of the network because of height restriction or urbanization makes truck different than autos.
- How to estimate the Travel Time (TT) and Travel Time Reliability (TTR) of truck in recurring and non-recurring congestion.
- What are the relationships of various factors (roadway geometry, traffic exposure, crash characteristics) with TT and TTR of truck.

Assumptions

- Distance between O-D is reasonable (approximately 40 miles)
  - If distance between O-D is too large, the marginal effect of congestion on travel time is negligible.
- Shortest path (SP) is identified based on off-peak hour travel time.
- SP remains unchanged for the analysis.

Methodology and Estimation Approach

- Determination of observed travel time reliability from truck GPS data.
- Observation of truck travel time reliability for recurring and non-recurring congestion.
- Panel data approach to model travel time reliability.

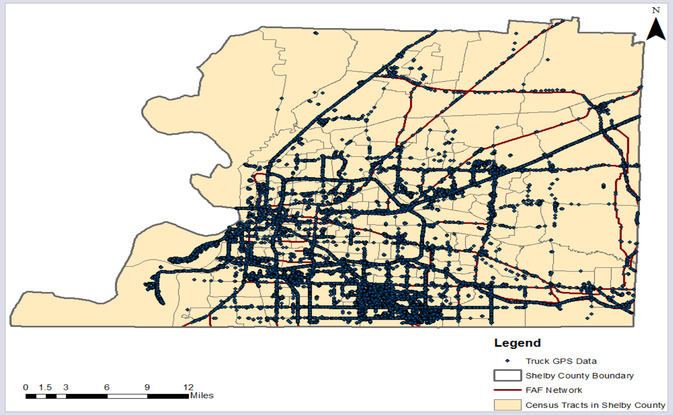


Methodological Framework for Computing and Predicting Truck Travel Time Reliability

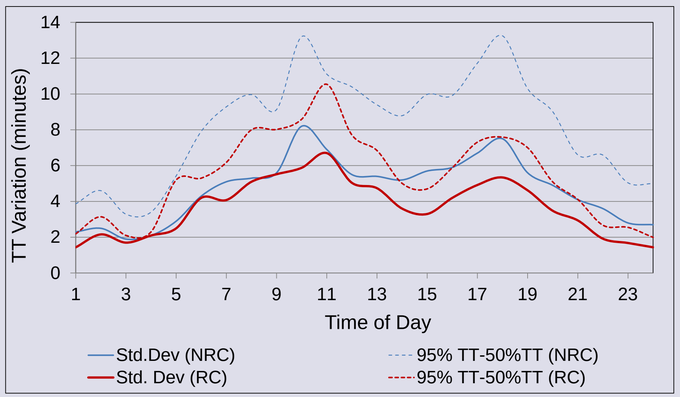
Data

- Case study is done in Shelby County.
- FAF network is used.
- 2 weeks of April and 2 weeks of June 2012 and 2013.

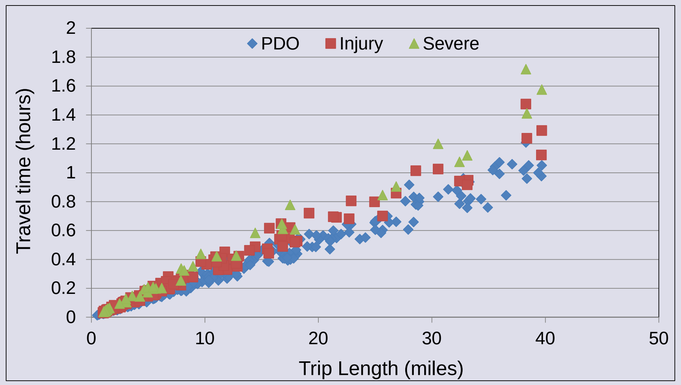
Data (cont..)



Shelby County with its census tracts, FAF network, and Truck GPS data for June 10, 2013



Recurring vs. Non-recurring Congestion



Effect of Crash Severity on Travel Time (TT)

Results

Panel Data Model Results

Variables	Model 1 (TT Variation) Coefficient	Model 1 (TT Variation) t-statistic	Model 2 (TT) Coefficient	Model 2 (TT) t-statistic
Roadway Characteristics				
Volume to Capacity Ratio (VCR) (%)				
AM Peak	0.287	2.341	–	–
PM Peak	0.523	1.551	–	–
Facility type: Arterial (%)	0.895	1.622	6.895	1.622
Area type: Rural (%)	-1.192	-2.901	-4.192	-2.901
Geometrics: 2 or more lanes	-0.225	-1.442	–	–
Crash Characteristics				
Number of vehicles involved in the crashes	3.348	1.96	23.489	1.96
Number of crashes occurred on the path	3.436	2.585	29.664	2.585
Crash Type				
Rear-end	2.893	3.691	12.893	3.691
Sideswipe	3.946	1.284	21.946	1.284
Angle	1.665	1.472	30.665	1.472
Crash Severity				
Injury	1.985	1.588	21.985	1.588
Severe injury	4.817	1.291	34.817	1.291
Crash Type and Crash Severity (Interactive)				
Rear-end and Injury	3.204	1.799	23.204	1.799
Roadway and Crash Characteristics				
Crash Type and Roadway Characteristics (Interactive)				
Rear-end and Arterial	3.012	1.818	14.012	1.818
Rear-end and Rural	3.347	1.623	13.347	1.623
Adjusted R2	0.541		0.418	
Number of observations	46,675,200			

- Congestion Overall
  - Non recurring congestion (NRC) increases TT by up to 200% during peak hours on weekdays but on weekends, the effect is less severe (+78%).
  - NRC causes significantly larger deviation in TT compared to recurring congestion (RC).
  - NRC severely affects midday (11am-12pm) and afternoon (5pm-7pm).
- Crash Severity
  - “Severe injury” has significantly larger effect than “PDO”.
  - “Injury” crashes increase TT by up to 63% more than PDO.
  - Effect of crash doesn’t only depend on severity but efficiency of traffic incident management and other crash characteristics.

Conclusions

- Critical factors affecting truck travel time reliability are Functional class, facility type, VCR, time of day, crash type, severity, and number of vehicles involved in crash.
- Weekend travel time is more reliable.
- The data can also be utilized in route guidance and incident management.

Acknowledgements

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