

Estimating truck travel speed from GPS spot speed

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Background

- Advantages of using probe vehicles equipped with GPS
- Application of truck GPS data
 - Measure freight corridor performance
 - Obtain information about commercial vehicle tours
- Most studies use space-mean speed instead of GPS spot speed
- Concerns with accuracy of truck GPS spot speed

Research Question

- Whether truck spot speed collected from GPS is accurate enough for estimating link travel speed and travel time?

Research Contribution

- Provide an alternative way for measuring freight corridor performance
- Shed light into estimating truck travel costs

Research Methodology

- Compare two different data sources
 - GPS spot speed
 - loop detector data
- Compare different methods for estimating speed with GPS data only
 - Average spot speed by segments
 - Use time/location data

GPS Data

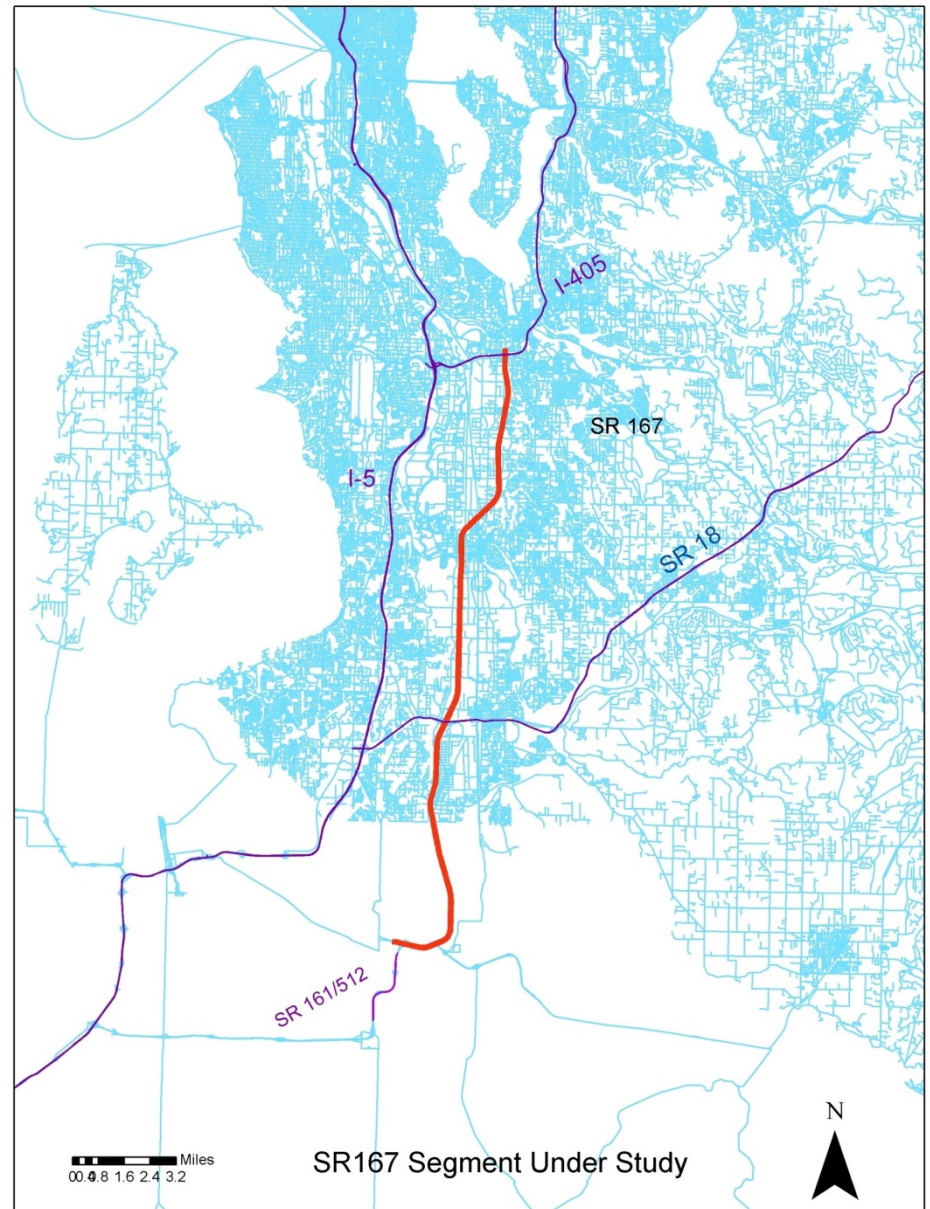
- 2,500 trucks in Puget Sound area from GPS device vendors
- Collected from September 2008 to present
- In-vehicle GPS with data read every 15 minutes, and stop
- Data content:
 - Vehicle ID, Location, Timestamp, GPS status, Mileage

Loop Detector Data

- Dual loop detector data from WSDOT
- Data content:
 - Speed, volume, vehicle count by length classes

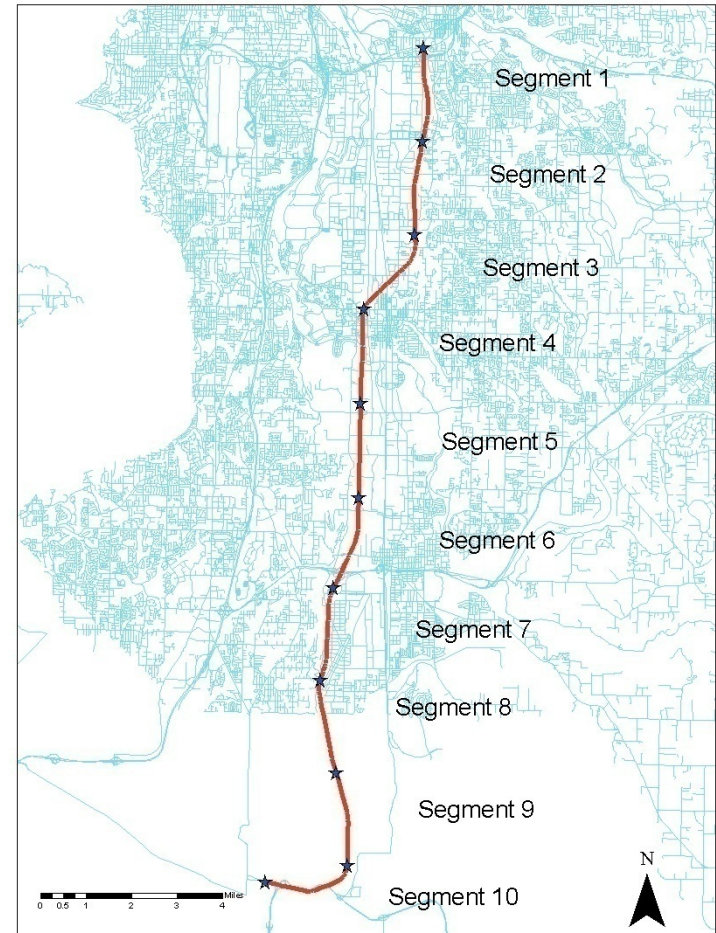
Case Study

- SR 167 connecting Renton and Tacoma
- Important freight corridor
- 20.857 miles in length

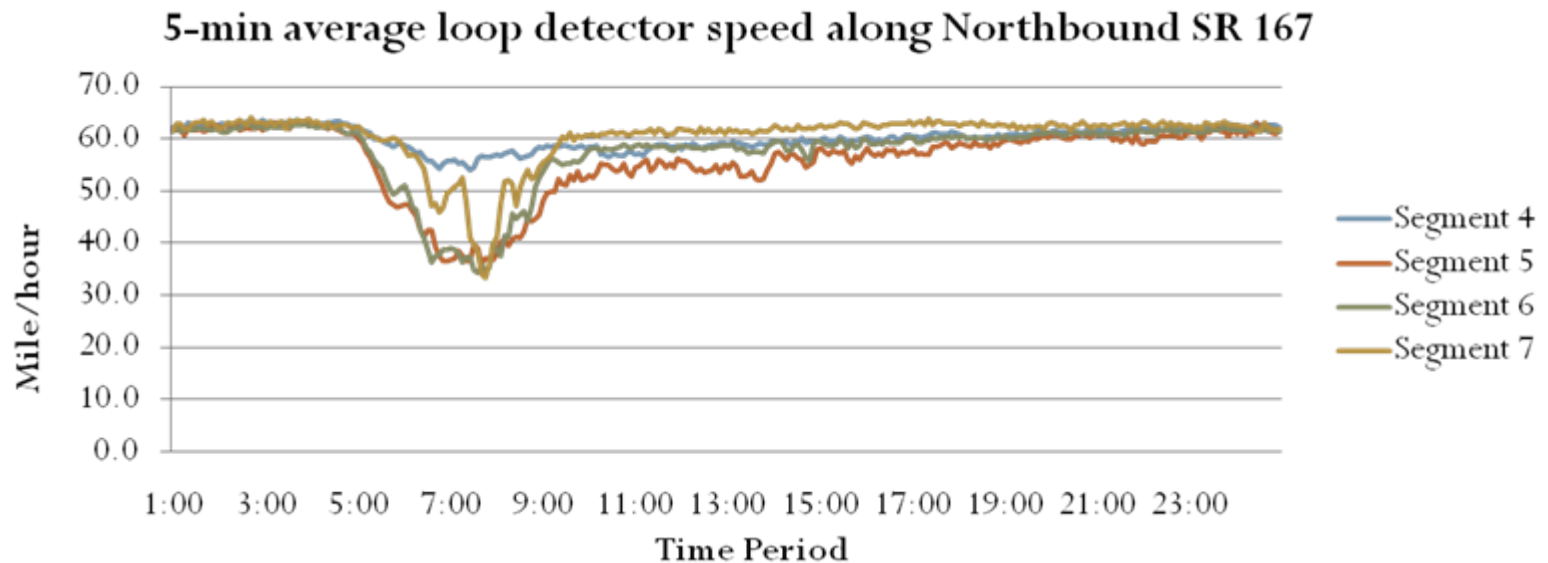
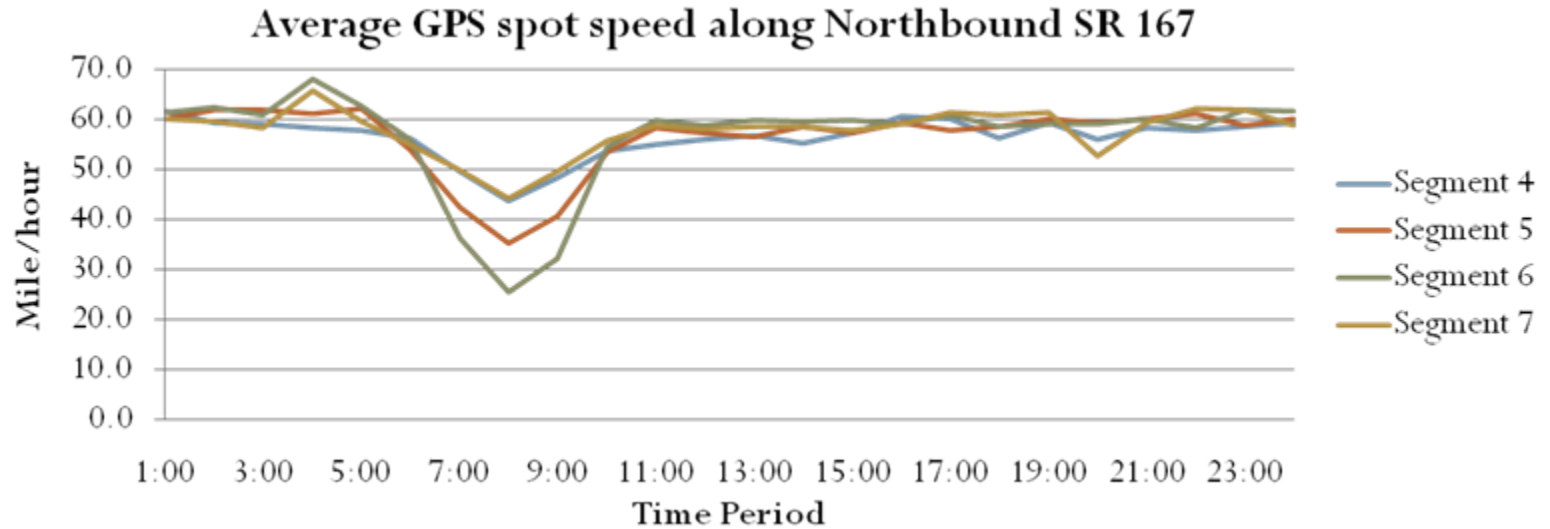


Data Analysis

- Use data collected in October 2009
- Divide SR 167 into ten segments for data comparison
- Aggregate GPS spot speed over segments and 1-hour time period
- Aggregate loop detector speed collected on rightmost lane over one month

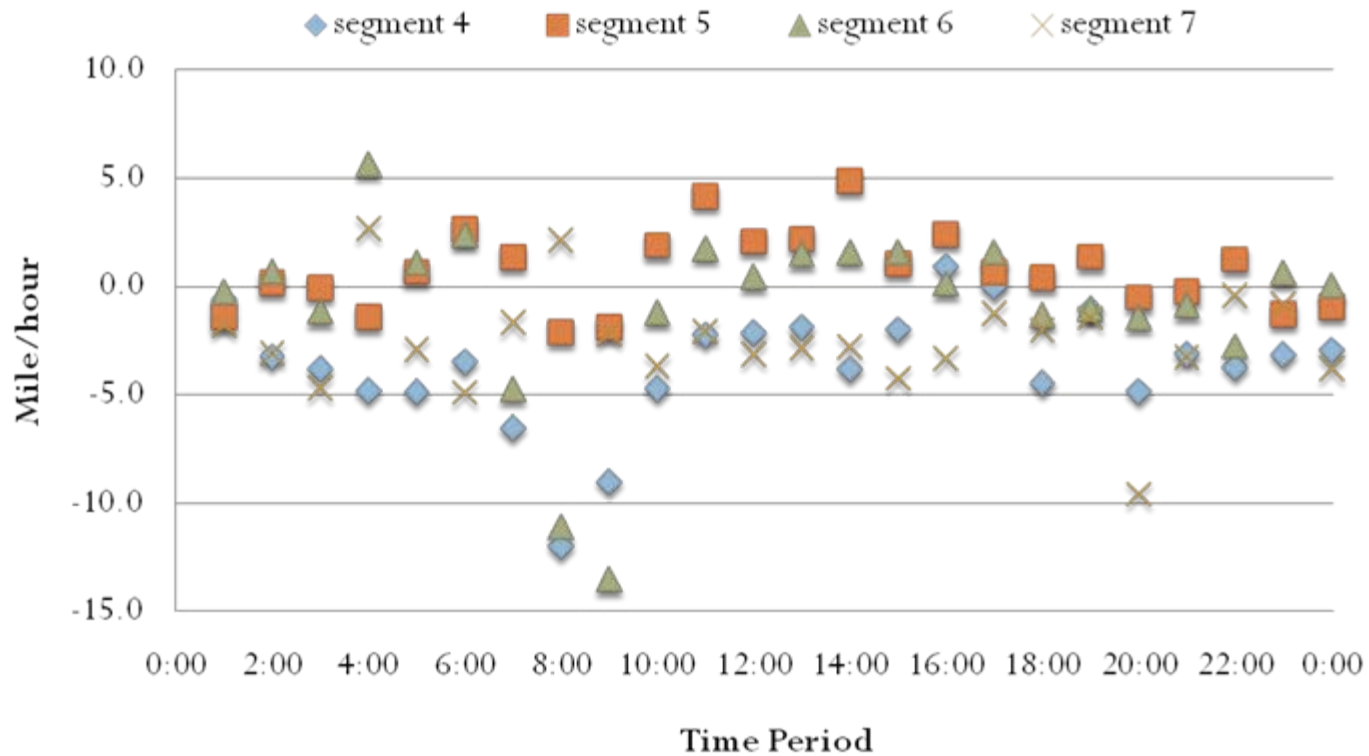


GPS speed and Rightmost lane Loop detector speed comparison



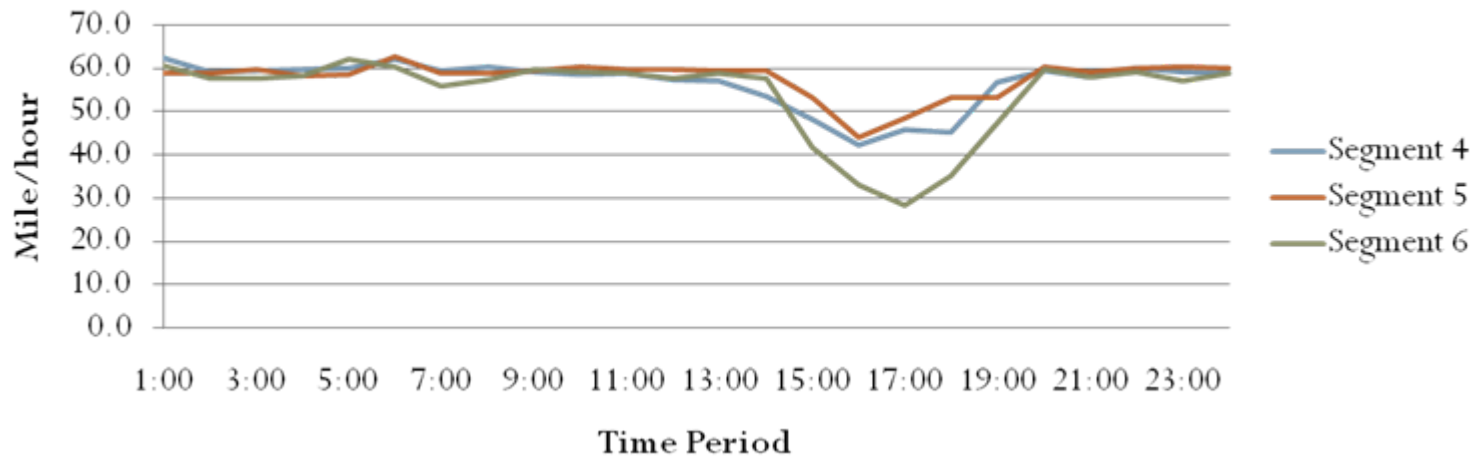
Speed difference

Speed difference between loop detector data and GPS data

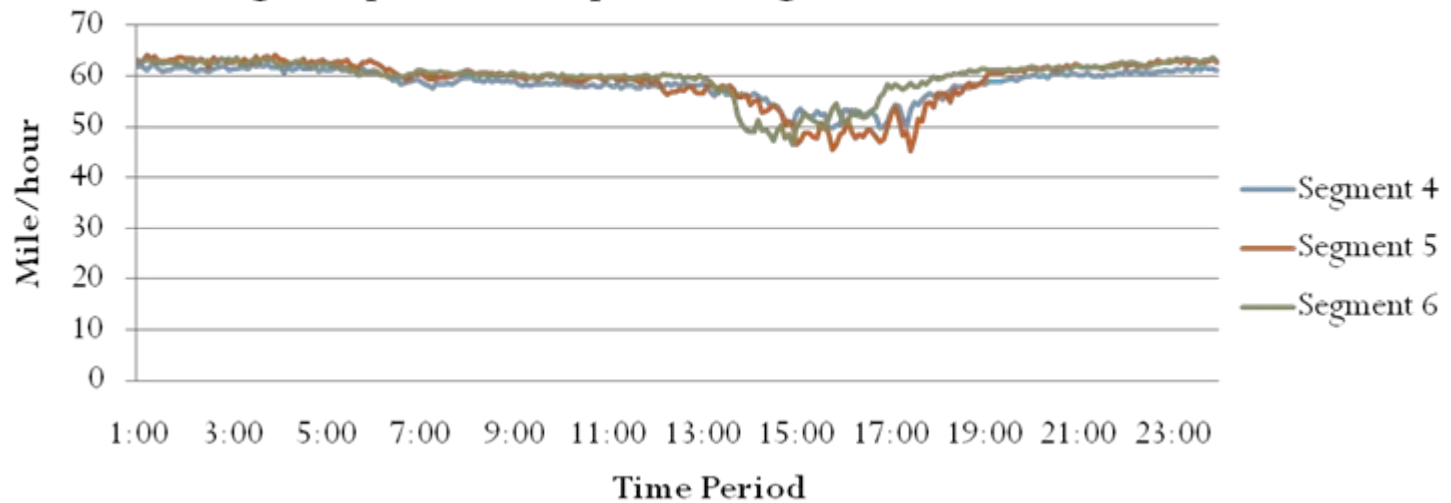


GPS speed and Loop detector speed comparison

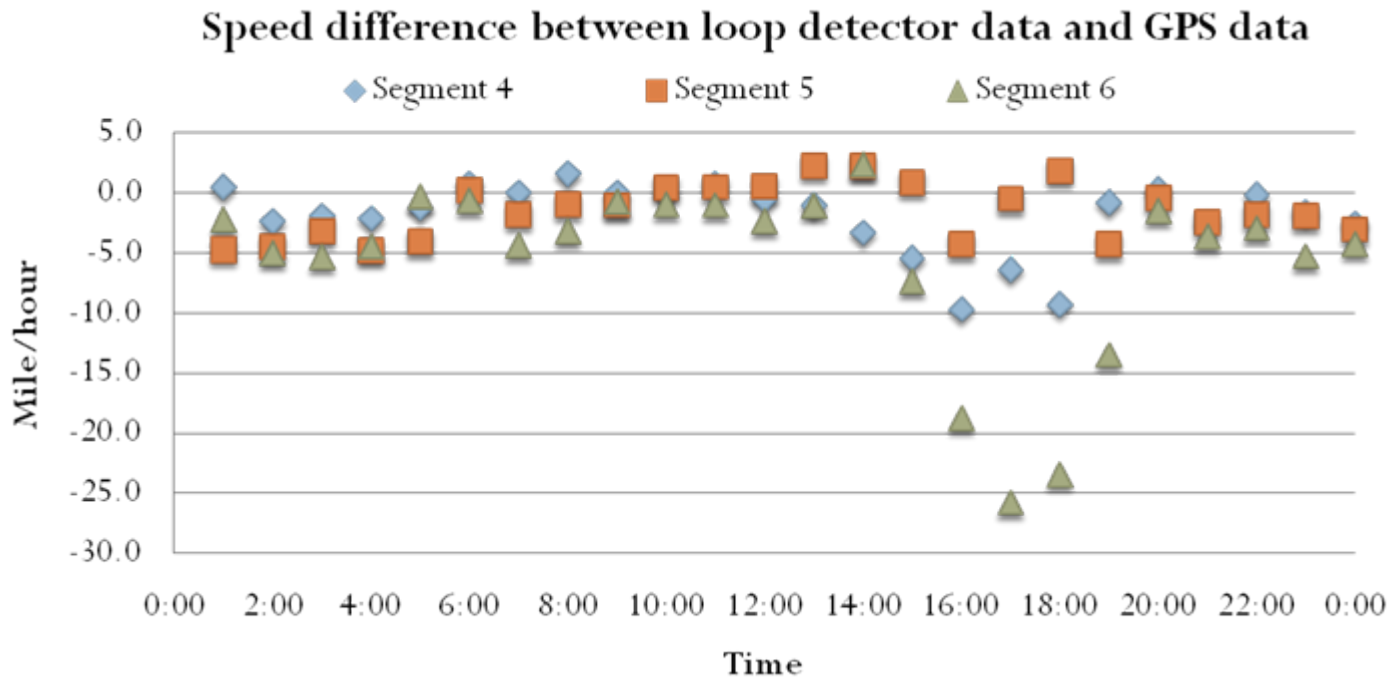
Average GPS spot speed along southbound SR 167



Average loop detector speed along southbound SR 167

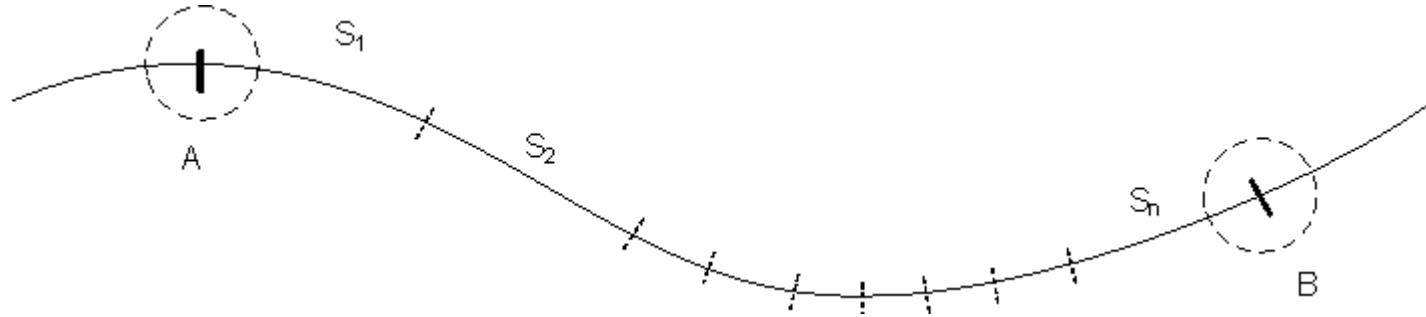


Speed Difference



- Generally truck GPS data matches with loop detector data
- Truck speed is lower during peak hours, depends on geometry
- However truck travels differently from passenger vehicles

Average Link Speed and Estimated speed



Average link speed— Use location/time data

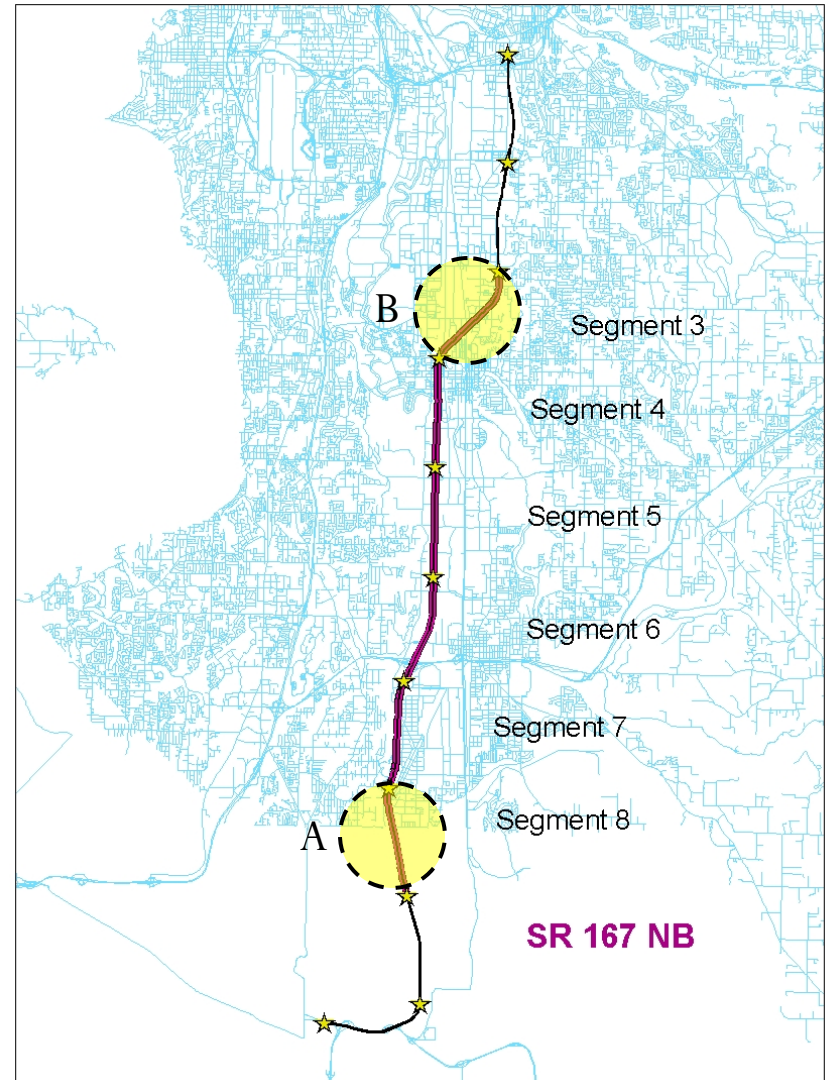
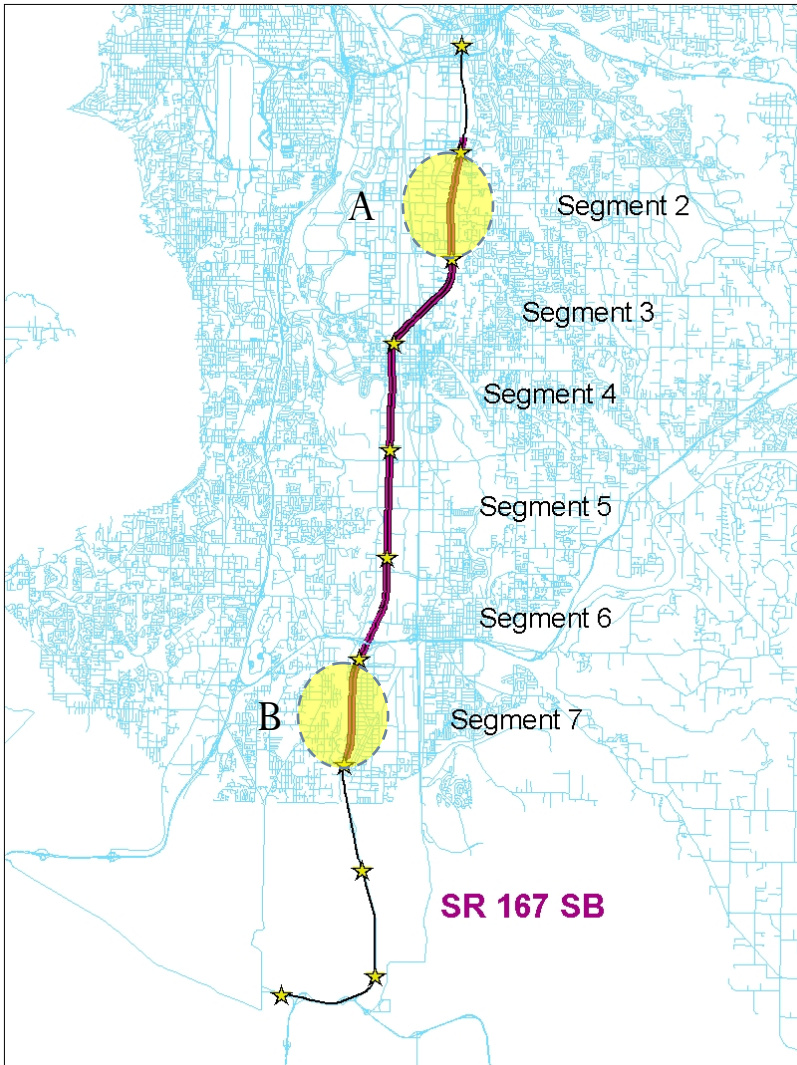
- Identify truck trips with data reads collected near A and B
- Calculate speed based on travel time between points

Estimated link speed— Use GPS spot speed

- Calculate link speed by averaging all observed spot speed per segment

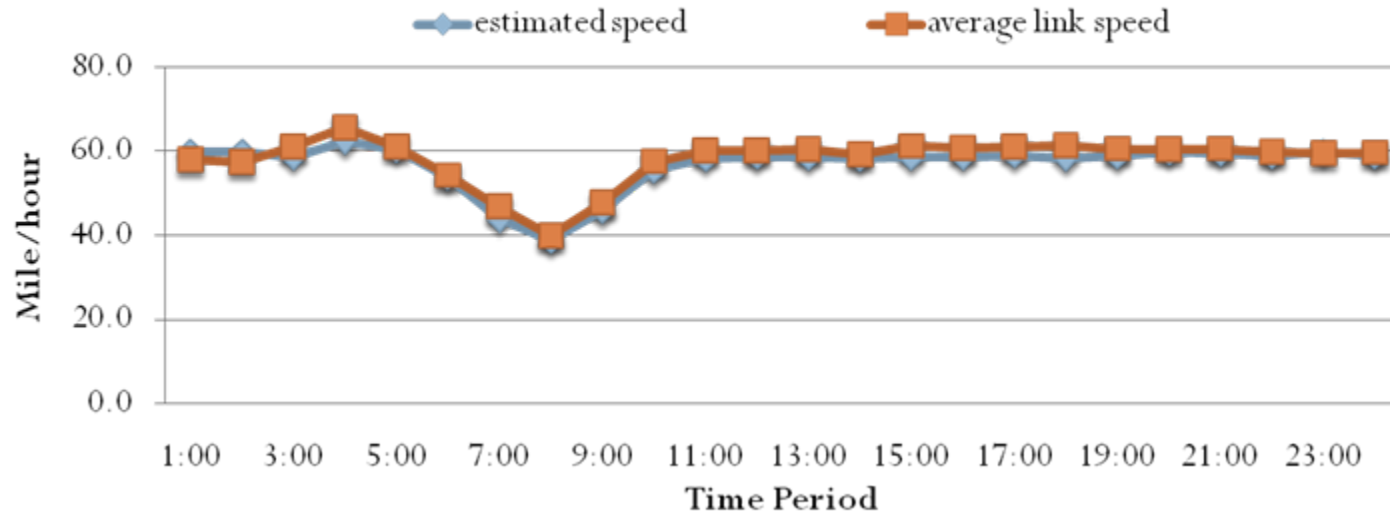
$$V_e = \frac{L}{\sum_{i=1}^n \frac{S_i}{v_i}}$$

Trip Identification

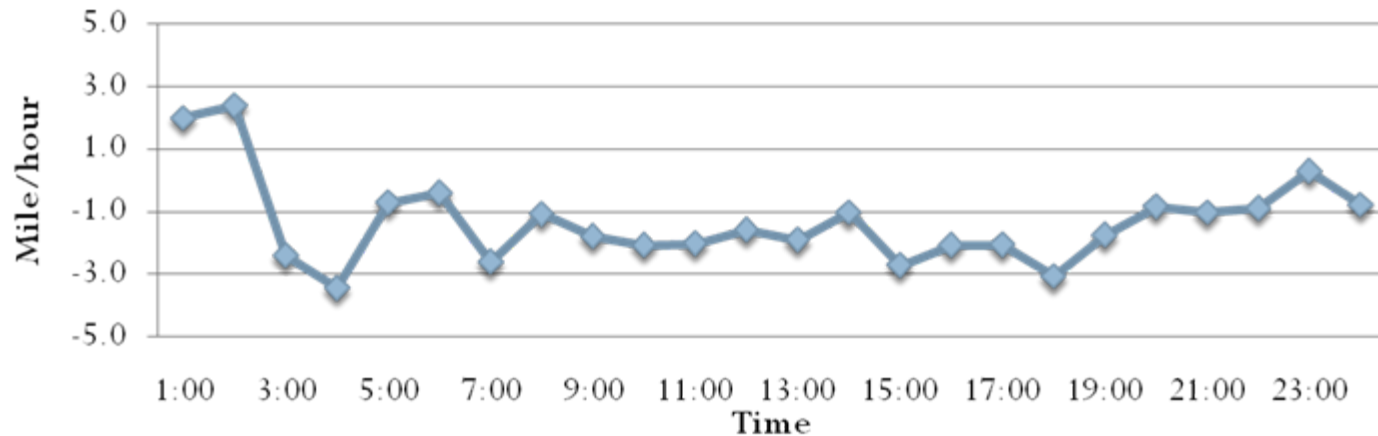


Speed Comparison for NB SR167

Comparison between estimated speed and average link speed

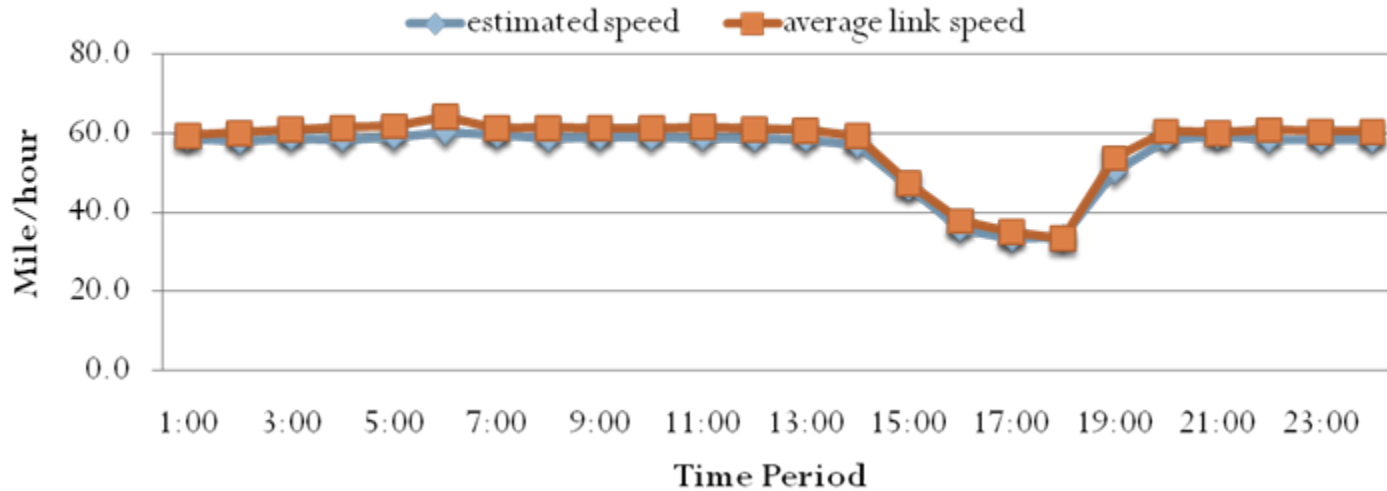


Absolute difference between estimated speed and average link speed

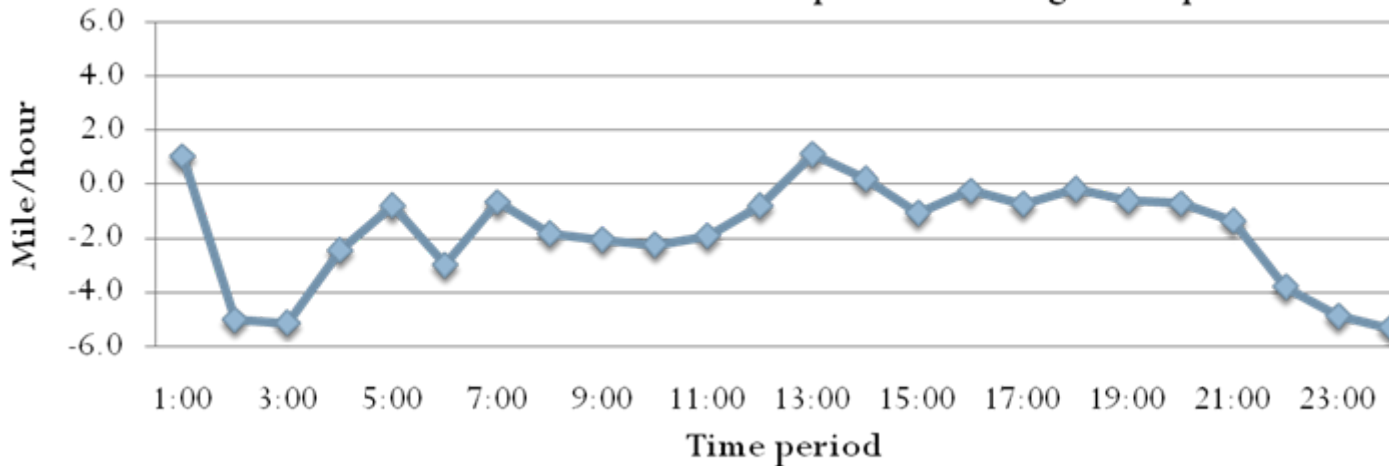


Speed Comparison for SB SR167

Comparison between estimated speed average link speed



Absolute difference between estimated speed and average link speed



Result Analysis

- Estimated speed is consistent with average link speed
- Estimated travel speed could capture typical travel condition
- The estimated trip speed is slightly lower than average trip speed
 - ❖ Sample is different for two methods
 - ❖ Existing traffic may travel slower than through traffic

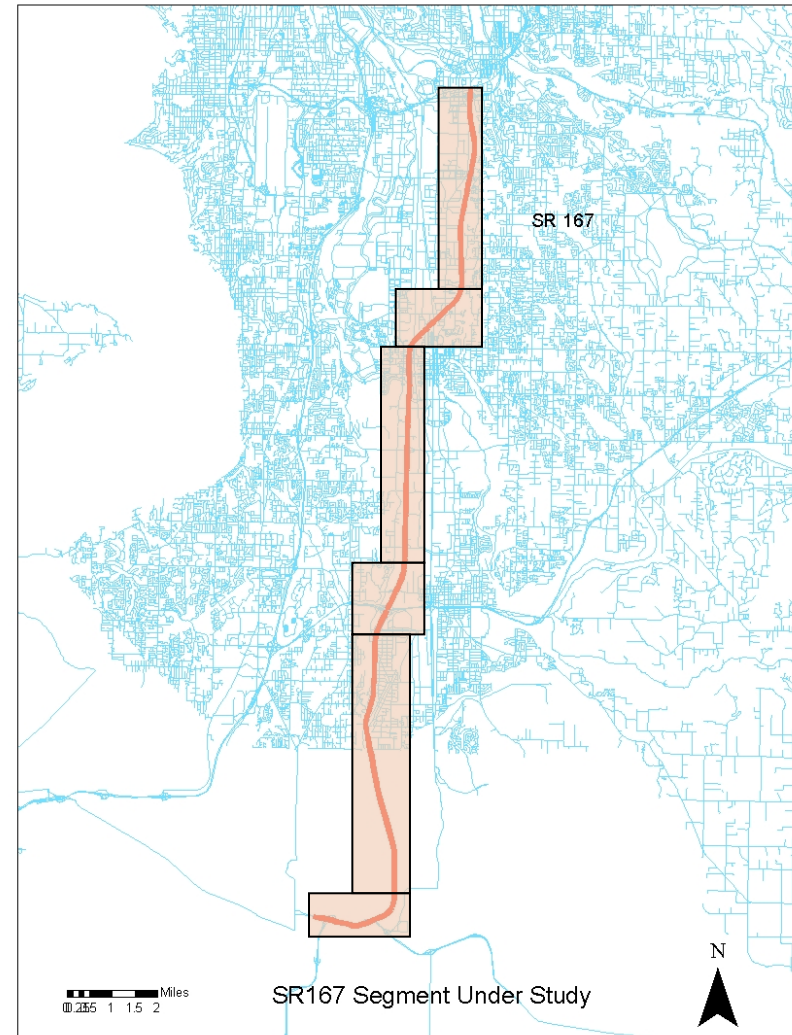
Conclusion

- GPS data is consistent with loop detector data
- GPS spot speed is consistent with time/location from GPS
- GPS spot speed is accurate enough for estimating link travel speed and time
- GPS spot speed can be used to estimate travel speed where data read frequency is low

Thank you!

GPS Data Processing

- Extract data from database by specifying latitude and longitude
- Data pre-processing:
 - Remove duplicate records
 - Remove erroneous records
- Geo-code candidate data points to road using ArcGIS



GPS Data Processing

- Generate 100-foot buffer area to further filter data
- Discard data points within 40 feet distance of underpasses or ramps
- Moving data type:
 - ❖ Check vehicle headings by comparing GPS travel heading with road segment's bearing
- Parking and other data types with zero-direction
 - ❖ Adopt narrower buffer area (70 feet)

