Map-Matching Truck GPS Data:
Harnessing Open-Source Software

Innovations in Freight Data Workshop
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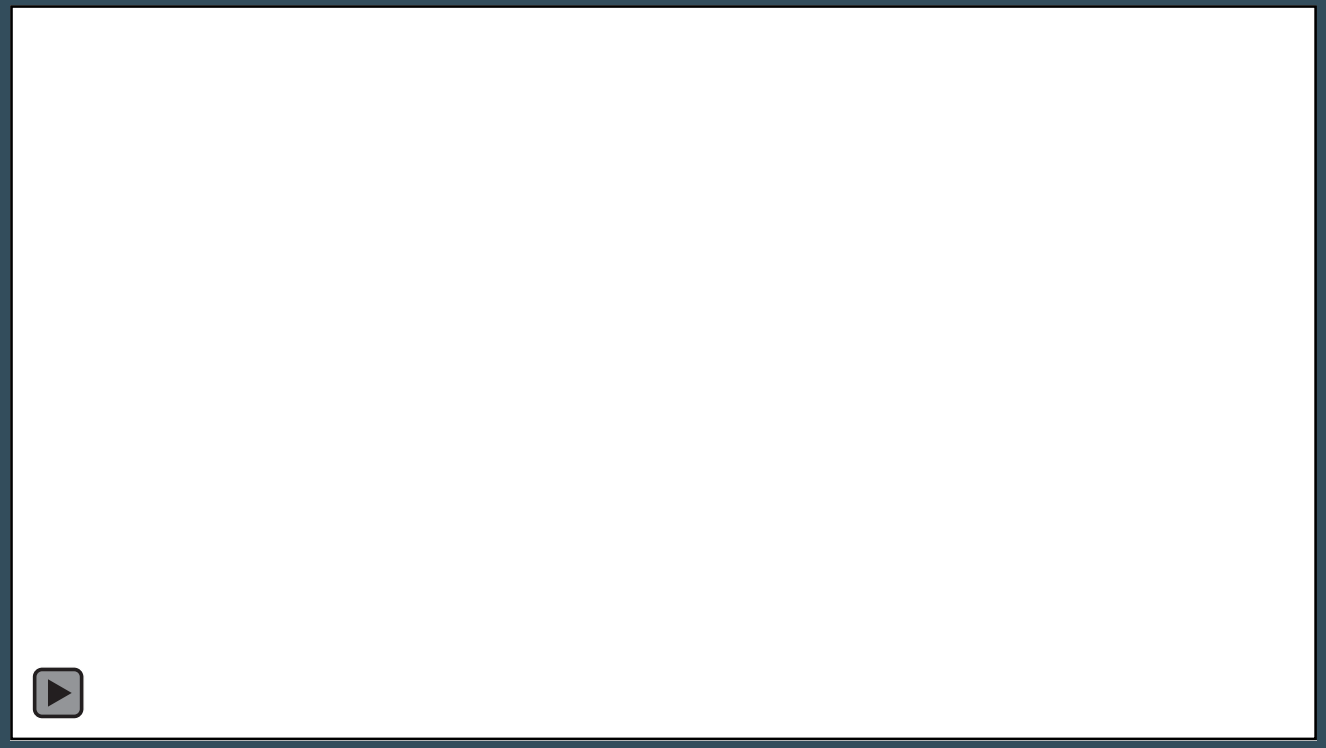


Dealing with Truck GPS Data

Large streams of truck GPS data are becoming ubiquitous

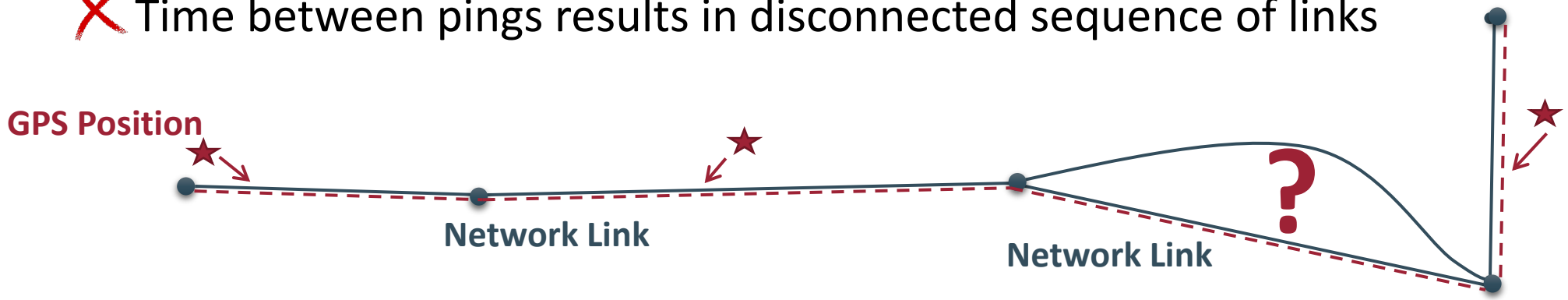
….but to uncover their real value requires special analysis tools.

Challenges
Matching GPS positions to the network can be complex given network geometries
Re-creating routes is more difficult than mapping GPS positions to network links
Requires tools not available in packaged GIS products

Enhanced Map-Matching

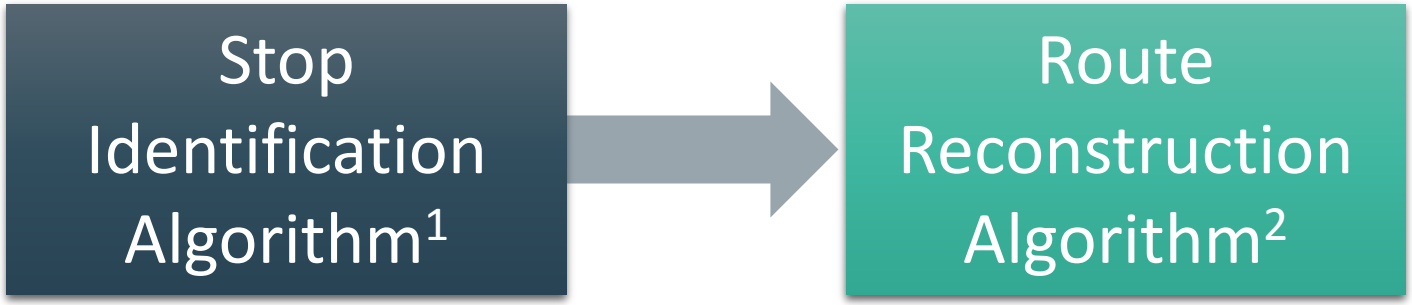
Standard: Match each GPS position to the closest network link

- ✗ Sparseness of GPS positions does not allow for positive identification of links
- ✗ Time between pings results in disconnected sequence of links



Enhanced: Apply path-building procedures to reproduce complete vehicle trajectory based on GPS positions

Algorithm for Enhanced Map-Matching



Key Steps:

1. Chose a network node closest to each stop.
2. Compute shortest path between stops.
3. Links along the shortest path are the route.

- Python Code
  - Pandas (Data framework)
  - AequilibraE (Path computation)
  - Rtree & Shapely (Geographic operations)
  - Available through GitHub → https://github.com/pedrocamargo/map_matching

1. Zanjani et al., "Estimation of Statewide Origin–Destination Truck Flows From Large Streams of GPS Data" (2015)
2. Camargo et al., "Expanding the Use of Truck GPS Data in Freight Modeling and Planning Activities" (2016)

Application Example: Phoenix, Arizona

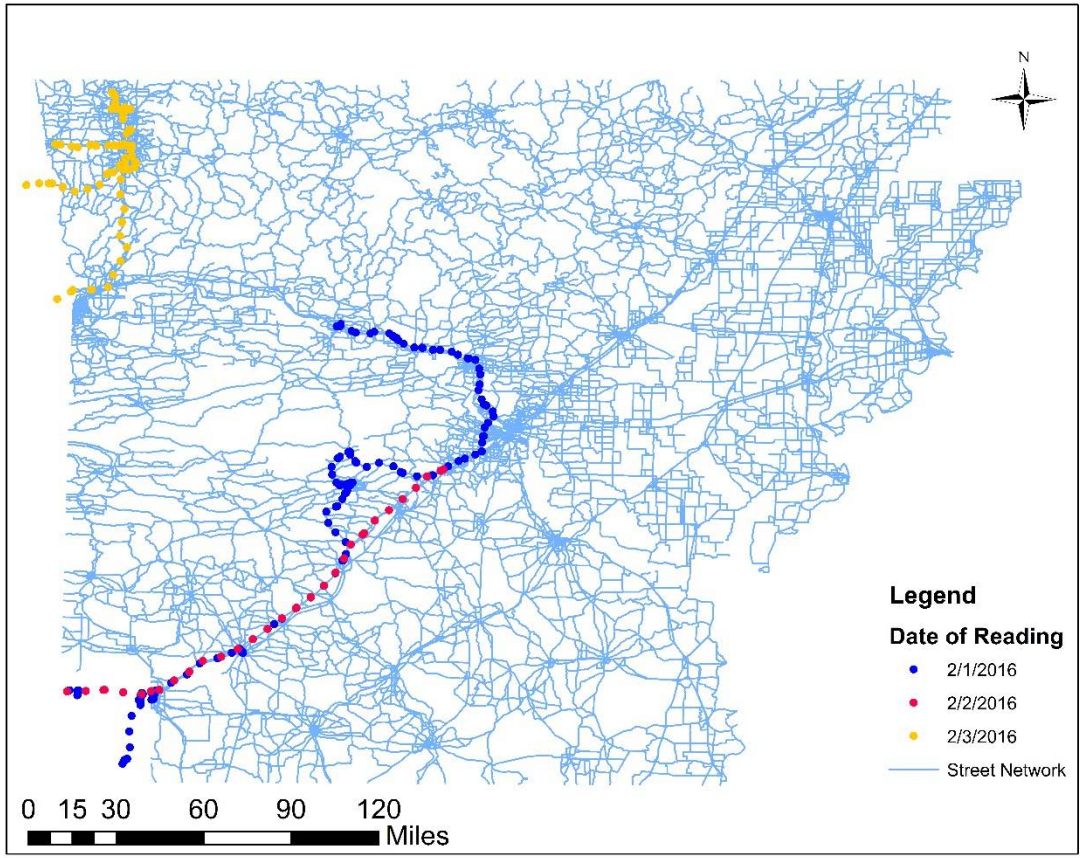
- MAG's Truck GPS Data inventory:

	Heavy Truck	Light and Medium Truck
Temporal Coverage	6 weeks in 2014	4 weeks in 2015
# of GPS Pings	53 million (48 million after data cleaning)	22 million
# of Unique Vehicle IDs	125,000	17,000

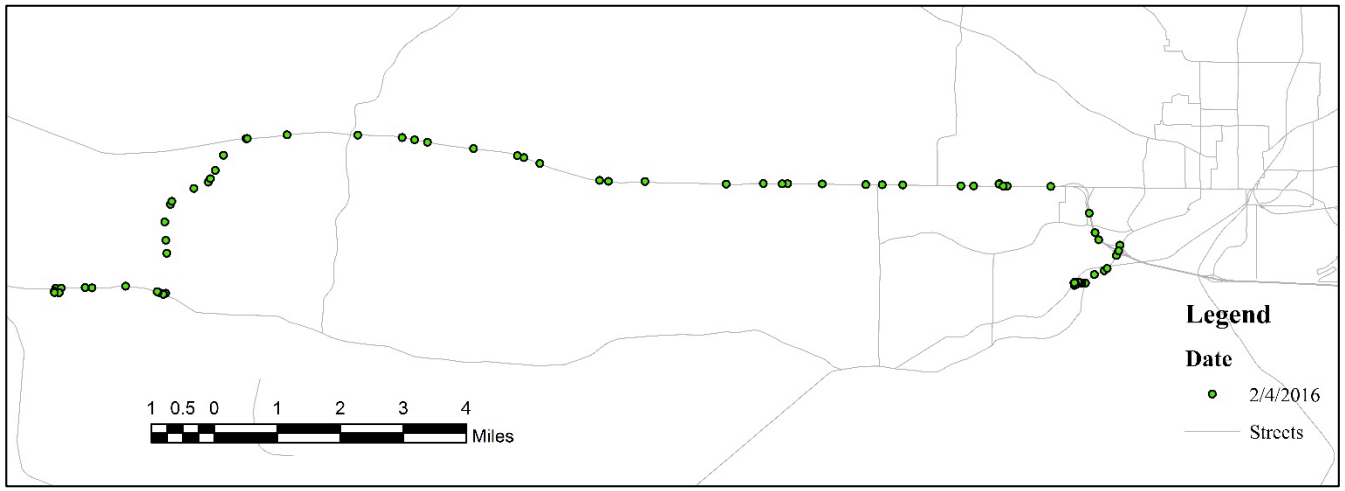
- GPS data were mainly used for developing the truck model.
- Effective data visualization is the key to transform complex GPS data into meaningful insights about freight activities.

Application to Arkansas Truck GPS Data

1. Heavy cross-border traffic with only partial data sample.

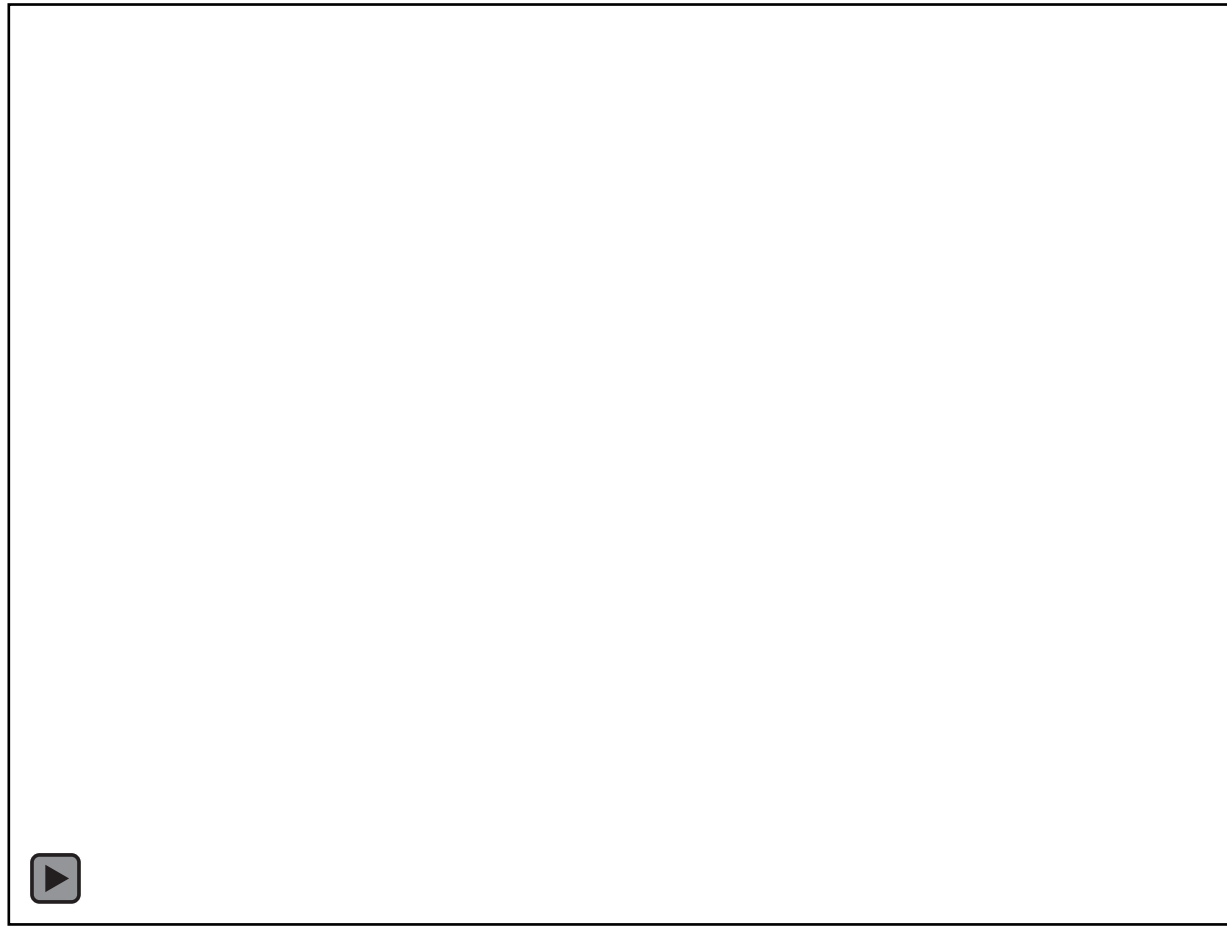


2. Use of statewide planning model network.



Final Thoughts

1. Conventional desktop tools are enough to use the open-source tool.
2. Open-source = better dissemination to other agencies.
3. Identification of routes allows us to perform:
   - Select link analysis
   - Time of day analysis
   - Route choice set formation
   - Advanced visualization



Questions?

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