Extracting Freight Corridor Performance from Weigh-in-Motion Data

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Objectives

• Retrospectively study truck transponder data in key corridors to determine the feasibility of producing freight corridor performance measures.

• Demonstrate other freight performance measures
Motivation

Using Federal Highway Administration (FHWA) / American Transportation Research Institute (ATRI) proprietary truck satellite data.
Data Almanac

• 22 reporting WIM sites in Oregon
  – All upstream of fixed weigh stations
  – All are CVISN sites

• PSU WIM Data Archive
  – Part of our PORTAL project
  – April 2005 – February 2009
    • 41,534,800 + trucks
  – Data quality
    • Intermittent data outages and problems
    • Focus of other research project
Weigh-in-Motion

• Single load cells
• Sensors weigh vehicles traveling at normal highway speeds
• Weight measurement affected by many factors
  – Site characteristics
  – Environmental factors
  – Truck dynamics
Weigh-in-Motion

• These WIM sites provide
  – Axle weights
  – Gross vehicle weight
  – Axle spacing
  – Vehicle class
  – Bumper-to-bumper length
  – Speed
  – Unique transponder numbers
Estimating Corridor Performance

- 2007-2008 WIM data
- Matching transponders
- Filtering through trucks
- Results

All trucks: 21.5 M
Trucks with tags: 8.4 M
Trucks between stations: 2.4M
Through Trucks: 1.3 M
Defining Links

• At each station, find all possible downstream stations
• Calculate shortest path between stations
• Three categories
  – Primary
    • Route certain, one highway
  – Secondary
    • Route certain, more than 1 highway
  – Tertiary
    • Route uncertain
Primary – I-5NB, ASP to BOR
Secondary – US-97 NB, KFP to LWL
Tertiary – ?, ASP to BND
Tertiary – ?, ASP to BND
I-84 WB, FWB to EMH

Free flow travel time = 
Distance / 55 mph = 
126.4 mi / 55 mph = 2.3 hrs

Search window = 
2.3 * .75 = 1.7 hrs (74 mph) 
2.3 * 2 = 4.6 hrs (27 mph)
All Matched Trucks in Time Window

[Graph showing time window with data points]

Jan 17  Jan 22  Jan 27  Feb 01  Feb 06  Feb 11  Feb 16

Time Diff. hrs

FF
Filter Algorithm

- For each truck $j$ traveling on link $i$ determine the estimated travel time, $t_{j,i}$.
  - If the travel time $t_{j,i}$ is less than the free-flow time $ff_{j,i}$ denote this truck as a through truck.
  - If the travel time $t_{j,i}$ is less than the upper travel time $ut_{j,i}$ (defined as an average travel time of 50 mph).
  - Find the median travel time $mt_{j,i}$ in the sample of $X$ previous truck observations and compare that to $t_{j,i}$. If $t_{j,i}$ does not exceed $mt_{j,i}$ by a threshold of $Y$, truck $j$ is assumed to be a through vehicle.

- If none of the above criteria are met, the $t_{j,i}$ is excluded (i.e., $j$ is not a through truck).
Filtered Trucks (Green)
Through Trucks Only
I-84 WB, FWB to EMH

Pendleton NOAA
El 1493 ft

Ladd Summit RWIS
El 3619 ft
Through Trucks and Temperature
Through Trucks and Weather Type
I-84 WB, FWB to EMH, August 07
I-84 WB, FWB to EMH, Aug 07
I-84WB, Average Link Speed, by Day
Average Link Speed, by month
Results

min 1000 obs
US-97 NB, KFP to LWL
Other Freight Performance Measures

• Using the matched trucks
  – Estimated Freight Activity on Corridor
  – Freight Patterns
  – Ton Miles
  – Emissions

• Assume trucks with transponders are the same as those without
About 1600 more truckloads consumed
Freight Activity

217: WDN to CSL
Five-Axle Trucks, 2007 Reported Data

- Trucks Increasing Wt
- Trucks Decreasing Wt
- Difference

Cumulative Weight (kips, thousands)

Month

About 3200 more truckloads produced

Production

Consumption
Conclusions

- Procedure developed to obtain, process, load data in archive, match, and filter
  - Need to develop automated method to address data quality

- Performance monitoring
  - Average speed and other measures promising
  - Method established
  - Expandable
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Questions?

Thank You!

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