Building a WIM Data Archive for Improved Modeling, Design, and Rating

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Outline

- Data Almanac
- PORTAL
- WIM Archive Quality Control
- Sample Uses of the WIM Archive
  - Sensor Health and Calibration
  - Bridge and Pavement Design
  - System Performance and Planning
DATA ALMANAC
Data Almanac

- 22 reporting WIM sites
  - All upstream of weigh stations
  - All are CVISN sites
  - April 2005 - March 2008
    - 30,026,606 trucks
  - Intermittent data outages and problems
  - Data quality and accuracy?
Data Almanac

- These WIM sites provide
  - Axle weights
  - Gross vehicle weight
  - Axle spacing
  - Vehicle class
  - Bumper-to-bumper length
  - Speed
  - Unique transponder numbers
RFID Tags - Transponders

- Three types of tags
  - Heavy Vehicle Electronic License Plate (HELP)’s PrePass program
  - North American Pre-clearance and Safety System (NORPASS)
  - Oregon Green Light Program

J. Lane, Briefing to American Association of State Highway and Transportation Officials (AASHTO), 22 February 2008
freight.transportation.org/doc/hwy/dc08/scoht_cvisn.ppt
Axle Weight Sensors

- Single load cells
- Sensors weigh vehicles traveling at normal highway speeds
- Weight measurement affected by many factors
  - Site characteristics
  - Environmental factors
  - Truck dynamics
Primary Users

- ODOT Motor Carrier
  - Weight enforcement
    - Workload and screening
  - Weight-mile tax enforcement
- Others want to use but
  - Not sure of quality / accuracy
  - Not equipped to deal with large data sets
PORTAL
Welcome to the Portland Transportation Archive Listing (PORTAL). The purpose of this project is to implement the U.S. National ITS Architecture’s Archived Data User Service for the Portland metropolitan region. This system is being developed at Portland State University by students and faculty in the Intelligent Transportation Systems Laboratory under the direction of Dr. Robert Bertini. We are working in close cooperation with the Oregon Department of Transportation, Metro, the City of Portland, TriMet and other regional partners. This work is supported by the National Science Foundation.*

*We welcome your participation in our project. The current PORTAL system archives the Portland metropolitan region’s freeway loop detector data at its most detailed level and also archives area weather data. We plan to expand the capabilities of our system and to include multimodal data sources from both Oregon and Washington. We provide access to the system by password. To request access to the system click on the Request Account link to the left.

Legend
- 0-25 MPH
- 25-50 MPH
- 50 + MPH
- No Data

PORTLAND: Portland Oregon Regional Transportation Archive Listing

updated: 3/11/2007 14:43 pm

Portland State University - Maseeh CECS - ITS Lab - Oregon DOT
Federal Highway Administration - National Science Foundation

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What’s in the PORTAL Database?

Loop Detector Data
20 s count, lane occupancy, speed from 500 detectors (1.2 mi spacing)

Incident Data
140,000 since 1999

Bus Data
1 year stop level data
140,000,000 rows

Weather Data
Every day since 2004

VMS Data
19 VMS since 1999

WIM Data
22 stations since 2005
30,026,606 trucks

Crash Data
All state-reported crashes since 1999 - ~580,000

Days
Since July 2004
About 300 GB
4.2 Million
Detector Intervals

001497

About 300 GB
4.2 Million
Detector Intervals
What’s Behind the Scenes?

Database Server
PostgreSQL Relational Database Management System (RDBMS)

Storage
2 Terabyte Redundant Array of Independent Disks (RAID)

Web Interface
QUALITY CONTROL
WIM Archive Quality Control

- Upload all per-vehicle records to database
  - Only records with invalid data excluded
  - Include “error” records
- Want records with inaccurate data
- Plan to incorporate
  - Filters to exclude inaccurate data
  - Ability to adjust data
Uses of the WIM Archive

- Sensor Health and Calibration
- Bridge and Pavement Design
- System Performance and Planning Data
SENSOR HEALTH AND CALIBRATION
Sensor Health and Calibration

- Current ODOT Practice:
  - Calibrate every 6 months
  - or when scale operators notice “error”
  - Use ~10 trucks (~consecutive)
  - Not really monitoring WIM data, kept for weight-mile tax purposes

- Why not use the data to monitor sensor health and calibration?
Class 9 Steer Axle Weight

Lane 1

Mean = 9.75

Lane 2

Mean = 9.07

OTREC
Oregon Transportation Research
And Education Consortium
Class 9 Steer Axle Weight (March)

Lane 1

Mean = 10.44

Density

Steering Axle (kips)

Lane 2

Mean = 7.4

Density

Steering Axle (kips)

Steering Axle (kips)

Mar 03  Mar 08  Mar 13  Mar 18  Mar 23  Mar 28  Apr 02
Class 9 Gross Vehicle Weight

**January**
- Station 10 WDS
- Mean = 47.36
- n = 78082

**February**
- Station 10 WDS
- Mean = 48.03
- n = 71592

**March**
- Station 10 WDS
- Mean = 52.67
- n = 84902

GVW (kips) vs. Density
Class 9 Axle 2-3 Spacing

Lane 1

Mean = 4.41

Axle 2-3 spacing (ft)

Density

Mean = 4.6

Axle 2-3 spacing (ft)

Lane 1

Jan Mar May Jul Sep Nov Jan

Axle 2-3 spacing (ft)

Lane 1

Lane 2

Jan Mar May Jul Sep Nov Jan

Axle 2-3 spacing (ft)
Issues

- How to automate “visual” assessment?
- WIM GVW calibration
  - With other WIM sites via matched tags
  - With static scale via sampling
- WIM axle weight/spacing calibration
  - With other WIM sites via matched tags
BRIDGE AND PAVEMENT DESIGN
Oregon-specific Uses

- **Bridge Design**
  - First state-specific live-load rating factors (LFRs)
  - Side-by-side loading criteria
  - Need ~2 weeks of CLEAN accurate data
  - Promised update every 2 to 5 years

- **Pavement Design**
  - Facility specific factors for MEPDG
SYSTEM PERFORMANCE AND PLANNING DATA
System Performance and Planning

- Transponder data allows unique matches
- Travel times on long-distance corridors
  - ~1 million upstream-downstream pairs in 2007
- Routing
- Planning metrics
  - Ton-miles on each corridor by various temporal considerations
  - Seasonal variability in loading, routes, and volumes
### Freight performance metrics

<table>
<thead>
<tr>
<th><strong>Goal 1: Improve Travel Safety in Oregon</strong></th>
<th><strong>Goal 2: Move People and Goods Efficiently</strong></th>
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<tr>
<td>Traffic Fatalities (#1)</td>
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<td>Traffic Injuries (#2)</td>
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<th><strong>Goal 4: Provide Excellent Customer Services</strong></th>
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<td>Intercity Passenger Service (#18)</td>
<td>DMV Customer Services (#26) -- DMV Field Office Wait Time (#26a), DMV Phone Wait Time (#26b), and DMV Title Wait Time (#26c)</td>
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<td>Timeliness of Projects Going to Construction Phase (#21)</td>
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<td>Construction Projects On Budget (#23)</td>
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<td>Certified Businesses (DMWESB) (#24)</td>
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</table>
Freight performance metrics

Using Federal Highway Administration (FHWA) / American Transportation Research Institute (ATRI) proprietary truck satellite data.
Travel Time, Oct 1 2007

- FWB to EMH
- EMH to WYT
- EMH to JBS
- WYT to WDS
- CSL to LGR
- CSL to JBS
- LGR to ODF
- ASP to BOR
- BOR to WDN
Conclusions

- Oregon’s extensive deployment useful
  - Transponders unique in data
- Building on experience with archiving other data (i.e. freeway loops)
  - Data improvement follows use
  - Various users requirements
- Let the data tell the story
  - Quality control helps all users
Acknowledgements

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  - UTCs: Oregon Transportation Research Education and Consortium & Rahall Transportation Institute
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  - National Science Foundation (PORTAL)

- Dave McKane and Dave Fifer, ODOT
- Kristin Tufte and Heba Alawakiel, PSU
Thank You!
www.otrec.us
WIM Classification Algorithm

- Portion related to 5-axle vehicles shown
- Works like a sieve
- Min/Max thresholds for
  - # of axles
  - axle spacing
  - axle weight
  - gvw
- Primarily configured for axle spacing

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