Leveraging Signal Infrastructure for Non-Motorized Counts in a Statewide Program: A Pilot Study

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Leveraging Signal Infrastructure for Non-Motorized Counts in a Statewide Program: A Pilot Study

Paper #15-5168

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Presentation Outline

▪ Research project goals
▪ Pilot study
  ▪ Pedestrian results
  ▪ Bicycle results
  ▪ Overall Performance of 2070 controllers and inductive loops
▪ Lessons learned and recommendations
Research Project Goals

- SPR # 754: Design and Implementation of Pedestrian and Bicycle Specific Data Collection Methods in Oregon
  - Review best practices regarding statewide non-motorized data collection programs and data collection technologies
  - Provide guidelines regarding location and data collection procedures
  - Perform a pilot study
Pilot Study

- Evaluate 2070 traffic signal controllers and inductive loops as methods for pedestrian and bicycle counting on a typical ODOT facility.
- Apply factors to estimate bicycle and pedestrian Average Annual Daily Traffic (AADT).
Site Selection Criteria

- Adequate volume of pedestrians and bicyclists
- On ODOT facilities
- 2070 signal controller
- Pedestrian push-button to request a pedestrian phase *(for counting pedestrians)*
- Bicycle lane inductive loops *(for counting bicycles)*
- Staff support/recommendation
Pilot Study Site

OR-99W & Hall Boulevard, Tigard

99W AADT ≈ 41,000
Hall AADT ≈ 16,000
Pedestrian Data
Preliminary Site Prep

• PSU Data Collection

• Counting Cars Video Recorder
  • 3 cameras
  • 24 hours
  • 8/29 9 AM – 8/30 9 AM, 2013
Pedestrian volumes – video counts

9AM August 29 - 9AM August 30, 2013

Pedestrian Volume

<table>
<thead>
<tr>
<th>Time</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:00 AM</td>
<td>10</td>
</tr>
<tr>
<td>12:00 PM</td>
<td>30</td>
</tr>
<tr>
<td>3:00 PM</td>
<td>40</td>
</tr>
<tr>
<td>6:00 PM</td>
<td>45</td>
</tr>
<tr>
<td>9:00 PM</td>
<td>35</td>
</tr>
<tr>
<td>12:00 AM</td>
<td>20</td>
</tr>
<tr>
<td>3:00 AM</td>
<td>5</td>
</tr>
<tr>
<td>6:00 AM</td>
<td>10</td>
</tr>
</tbody>
</table>
Pedestrian volumes – video counts

Peak hours: 12 PM to 6 PM
43% of all volume
Pedestrian Activity by Crosswalk and Group Size

Total observations: 440 groups (1 or more per group)
Total: 596 pedestrians
Actual vs. Logged Volumes by Crosswalk

North Crosswalk \( R^2 = 0.74 \)

South Crosswalk \( R^2 = 0.87 \)

East Crosswalk \( R^2 = 0.75 \)

West Crosswalk \( R^2 = 0.70 \)
Potential sources of error

- Pedestrian groups: phases vs. actual number of pedestrians
- Some pedestrians push buttons in both directions
  - Confusion/error
  - Pedestrians have a long wait time
Potential sources of error

- Some pedestrian phases are called by bicyclists (6%)
  - Bicycles on the sidewalk
  - Perceived safety
  - Confusion or lack of understanding
  - Long wait time
Overall Accuracy

- 482 pedestrian phases vs. 440 groups
  - 91% accuracy (for groups of pedestrians)
- 482 Pedestrian phases vs. 596 people using the intersection
  - 81% accuracy (for pedestrians)
  - Factor: 1.24 people per pedestrian phase
- Strong correlations ($R^2 > 0.70$) when broken down by crosswalk and hour
Overall Analysis: Pedestrians

- Importance of video analysis
  - Demographic info and bike/pedestrian behavior
- Counting pedestrian phases is a promising and cost-effective method for AADT estimation!
  - ...but it is necessary to increase the number of sites/analyses before generalizing results
    - Different sites, land use, traffic impacts, etc.
Bicycle Data
Preliminary Site Prep

- **PSU Data Collection**
  - Counting Cars Video Recorder
  - 3 cameras
  - 24 hours
  - 8/29 9 AM – 8/30 9 AM, 2013
Bicycle Volumes: video data

August 29, 9AM - August 30 9AM, 2013

Bicycle Volume

0 5 10 15 20 25

9:00 AM 12:00 PM 3:00 PM 6:00 PM 9:00 PM 12:00 AM 3:00 AM 6:00 AM
Bicycle Volumes: 51% in bike line

August 29, 9AM - August 30 9AM, 2013

Bicycle Volume

- Sidewalk Bike Volume
- Bike Lane Volume
Video Data Summary

- Total bicycle volume: 190
- Bicycles in bike lane: 97 (51%)
- Bicyclists using pedestrian push buttons: 30 (16%)
Bike Loop Locations
Pilot Study

Southbound Hall Boulevard to Tigard Library

- Loop at stop bar
- Second loop approximately 50 feet from stop bar
- Loops in series, counted twice in 2070 data
- Note worn bike lane stripe !!!
Pilot Study

Eastbound- 99W to Portland

• Right turn pocket
• Single Loop before turn pocket
Loop Accuracy: Overcounting

\[
\% \text{ Error} = \frac{\#\text{loop} - \#\text{video}}{\#\text{video}}
\]

NB to Beaverton: 1474 %
SB to Tigard: 1169 %
EB to Portland: 5413 %
WB to Sherwood: 2180 %
• Getting the right inductive loop sensitivity is important to obtain accurate counts

• Sensitivity was subsequently lowered: only switches 2 and 8 set to ON (1 and 4 off)

• We recorded another 24 hour video session from 9 AM 10/24 to 9 AM 10/25
### Loop Accuracy

\[
% \text{ Error} = \frac{\text{#loop} - \text{#video}}{\text{#video}}
\]

<table>
<thead>
<tr>
<th>Sensitivity Change:</th>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>NB to Beaverton:</td>
<td>1474 %</td>
<td>7 %</td>
</tr>
<tr>
<td>SB to Tigard:</td>
<td>1169 %</td>
<td>89%</td>
</tr>
<tr>
<td>EB to Portland:</td>
<td>5413 %</td>
<td>2430 %</td>
</tr>
<tr>
<td>WB to Sherwood:</td>
<td>2180 %</td>
<td>61 %</td>
</tr>
</tbody>
</table>

Accuracy did improve, but there may be a high correlation between vehicle traffic and bicycle detections – especially with high right turning volumes

* Based on 32 and 66 detections (see previous slide, the sum of two loops), the actual number of vehicles or bicycles that were detected at each bicycle loop on Hall is not known
Summary: Bicycle Loops

- Optimizing sensitivity is important to obtain accurate counts. Testing is necessary.
- The location of loops in relation to right turn movements is very important (EB to Portland very inaccurate)
- Right turn volume higher for Hall NB approach (less accuracy in counting bikes than Hall SB approach)
- Loops wired in series added difficulties in determining whether a bicycle was detected
Overall Analysis: Bicycles

- Importance of **video analysis**
  - Demographic/purpose info and bicycle behavior
- Overall **low accuracy** in this study
  - Test other loop configurations
  - Analyze other intersections with better loop location
Overall Conclusions

- Promising results: pedestrian counts utilizing pedestrian phases and simple factors
- Not so good: counting bicycles utilizing inductive loops (many problems as explained)
- Many more pedestrians than expected!
- More research is needed to generalize the results
  - Another ODOT sponsored project is underway
Acknowledgements

• Technical Advisory Committee
• Tiffany Slauter, ODOT Region 1 Signal Manager
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  • Don Crownover
  • Steve Chance, ODOT Traffic Data Analyst
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  • Raymond Herrera (tubes installation)
• PSU Graduate Students
  • Sam Thompson
  • Adam Moore
• Bruce Moody: video documenting and interviewing
Questions?

https://pbs.twimg.com/media/BVGwDQLCEAAASMI.jpg
Pilot Study Land Use
Pilot Study

Northbound Hall Boulevard to Beaverton

- Loop at stop bar
- Second loop approximately 50 feet from stop bar
- Loops in Series, counted twice in 2070 data
Pilot Study

Westbound - 99W to Sherwood

• Single Bicycle Loop
# Loop Accuracy

10 hours with highest volumes:
6 AM to 11 AM and 2 PM to 7 PM

<table>
<thead>
<tr>
<th>Video Counts</th>
<th>Loop Detections</th>
</tr>
</thead>
<tbody>
<tr>
<td>NB to Beaverton :</td>
<td>30</td>
</tr>
<tr>
<td>SB to Tigard:</td>
<td>35</td>
</tr>
<tr>
<td>EB to Portland:</td>
<td>10</td>
</tr>
<tr>
<td>WB to Sherwood:</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td>32*</td>
</tr>
<tr>
<td></td>
<td>66*</td>
</tr>
<tr>
<td></td>
<td>253</td>
</tr>
<tr>
<td></td>
<td>45</td>
</tr>
</tbody>
</table>

*32 and 66 are the sum of two loops; the actual number of vehicles or bicycles that were detected at each loop on Hall is not known*
Acknowledgements

Technical Advisory Committee

• Lyn Cornell, ODOT Research Coordinator
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