Methods and Technologies for Pedestrian and Bicycle Volume Data Collection

NCHRP 7-19
Presentation Overview

- Introduction
- Testing Approach and Findings
- Guidebook Walkthrough
- Final Remarks
Project Purpose

- Address lack of pedestrian and bicycle volume data
  - Barrier to planning effective facilities
  - Limits ability to assess safety
- Asses variety of existing and new technologies and methods
- Develop guidance for practitioners
Early Findings

- Limited established count programs in the U.S., but lots of interest
- Count technologies
  - Automated count technology is growing rapidly
  - Manufacturers of automated count technologies tend to be from outside of the U.S.

Source: RJ Eldridge, Toole Design Group
Testing Plan

- Focus on testing and evaluating commercially available automated technologies
- Assess type of technology as opposed to a specific product
- Cover a range of facility types, mix of traffic, and geographic locations
- Evaluate accuracy through the use of manual count video data reduction
Technologies and Site Locations

- Technologies
  - Passive infrared
  - Active infrared
  - Pneumatic tubes
  - Inductive loops
  - Piezoelectric
  - Radio beam
  - Combination of technologies

- Site Locations
  - Portland, OR
  - San Francisco, CA
  - Davis, CA
  - Berkeley, CA
  - Minneapolis, MN
  - Washington, D.C.
  - Arlington, VA
  - Montreal, Canada
Example site: Portland, OR

- Eastbank Esplanade
- Multiuse path
- Tested:
  - Passive Infrared
  - Pneumatic Tubes
  - Radio Beam

Source: Karla Kingsley, Kittelson & Associates, Inc.
Graphical Analysis

Pyroelectric sensor data

Automated Count

Manual Count

Overcounting

"perfect accuracy" line

Undercounting
Passive Infrared (IR)

- Detect pedestrians and cyclists by infrared radiation (heat) patterns they emit
- Passive infrared sensor placed on one side of facility
- Widely used and tested

Source: Ciara Schlichting, Toole Design Group
Passive Infrared

- Easy installation
- Mounts to existing pole/surface or in built pole
- Potential false detections from background
- Possible undercounting due to occlusion
- Differences between products
Active Infrared (IR)

- Transmitter and receiver with IR beam
- Counts caused by “breaking the beam”
- Moderately easy installation
- Occlusion effects
- Single device tested – accurate and highly precise

Source: Steve Hankey, University of Minnesota
Pneumatic Tubes

- One or more tubes are stretched across roadway or path
- When a bicycle rides over tube, pulse of air passes through tube to detector

Source: Karla Kingsley, Kittelson & Associates, Inc.
Pneumatic Tubes Findings

- Fairly high accuracy at very high volumes
- Strong site and device specific effects
- Accuracy rates not observed to decline with aging tubes
- Future research in mixed traffic settings
Inductive Loops

- Generate a magnetic field that detect metal parts of bicycle passing over loop
- In-pavement or temporary loops (on surface)
- Higher volumes slightly affect accuracy
- Generally high accuracy and precision

Source: Katie Mencarini, Toole Design Group
Inductive Loops

- Bypass errors
  - Cyclists passing outside bike lane
  - Loops leaving gaps in detection zone
Piezoelectric Sensor

- Emit an electric signal when physically deformed to detect bicyclists
- Typically embedded in pavement across travel way
- Tested one existing device, due to difficulties procuring equipment
- Existing device tested not precise or accurate

Source: MetroCount
Radio Beam

- Transmitter and receiver emit a radio signal that detect a user when the beam is broken
- Not previously tested in literature
- Some devices count bikes and peds separately
- Occlusion errors
- Product differences

Source: Karla Kingsley, Kittelson & Associates, Inc.
Research Conclusions

- **Factors influencing accuracy**
  - Proper calibration and installation
  - Occlusion
  - Vendor differences

- **Factors not found to influence accuracy**
  - Age of inductive loops or pneumatic tubes
  - Temperature
  - Snow/rain (limited data)
## Research Conclusions

### Automated counter accuracy:

<table>
<thead>
<tr>
<th>Device</th>
<th>Undercounting Rate</th>
<th>Total Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passive Infrared (2 products)</td>
<td>8.75%</td>
<td>20.11%</td>
</tr>
<tr>
<td>Active Infrared</td>
<td>9.11%</td>
<td>11.61%</td>
</tr>
<tr>
<td>Pneumatic Tubes</td>
<td>17.89%</td>
<td>18.50%</td>
</tr>
<tr>
<td>Radio Beam</td>
<td>18.18%</td>
<td>48.15%</td>
</tr>
<tr>
<td>Inductive Loops</td>
<td>0.55%</td>
<td>8.87%</td>
</tr>
<tr>
<td>Piezoelectric Strips</td>
<td>11.36%</td>
<td>26.60%</td>
</tr>
</tbody>
</table>
Guidebook Purpose

- Guidebook produced as a resource for practitioners
- Designed to help practitioners:
  - Understand the value of multimodal data
  - Develop a data collection plan
  - Identify and recommend data collection methods
  - Correct raw count data from a particular technology
Guidebook Organization

Quick Start Guide
1. Introduction
2. Non-Motorized Count Data Applications
3. Data Collection Planning and Implementation
4. Adjusting Count Data
5. Sensor Technology Toolbox

Appendices
Case Studies
Manual Pedestrian and Bicyclist Counts: Example Data Collector Instructions
Count Protocol Used for NCHRP Project 07-19
Appendix D. Day-of-Year Factoring Approach
2. Non-Motorized Count Applications

- Measuring facility usage
- Evaluating before-and-after data
- Monitoring travel patterns
- Safety analysis
- Project prioritization
- Multimodal modeling

For each application:
Details
Case Studies


Before-and-After Bicycle Facility Usage – buffered bicycle lanes on Pennsylvania Avenue
3. Data Collection Planning & Implementation

- **Covers:**
  1. Planning the count program
  2. Implementing the count program

- Provides examples, detailed guidance, checklists

*Source: Tony Hull, Toole Design Group.*
4. Adjusting Count Data

- Sources of counter inaccuracy
- Measured counter accuracy
- Counter correction factors
- Expansion factors
- Examples applications

Occlusion error
## 5. Treatment Toolbox

- **Description**
- **Typical application**
- **Level of effort**
- **Strengths**
- **Limitations**
- **Accuracy**
- **Usage**

### Sidebar with quick facts

<table>
<thead>
<tr>
<th>Maximum user volume:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provides consistent results up to 600 users per hour; counts can be corrected at higher volumes.</td>
</tr>
<tr>
<td>Detection zone width:</td>
</tr>
<tr>
<td>&lt;20 feet</td>
</tr>
<tr>
<td>Typical count duration:</td>
</tr>
<tr>
<td>Can be used for both short-term counts and permanent installations</td>
</tr>
<tr>
<td>Typical equipment cost (2013):</td>
</tr>
<tr>
<td>$1,000–3,000</td>
</tr>
<tr>
<td>Relative preparation cost:</td>
</tr>
<tr>
<td>Medium (may require permitting)</td>
</tr>
<tr>
<td>Typical installation time:</td>
</tr>
<tr>
<td>&lt;30 minutes for temporary installations, longer for permanent installations involving installing posts</td>
</tr>
<tr>
<td>Typical data collector training time:</td>
</tr>
<tr>
<td>&lt;30 minutes</td>
</tr>
<tr>
<td>Relative hourly cost:</td>
</tr>
<tr>
<td>Low, equipment costs are spread over a large number of data-collection hours</td>
</tr>
<tr>
<td><strong>Mobility:</strong></td>
</tr>
<tr>
<td>Very good, equipment can be readily removed and taken to a new site</td>
</tr>
</tbody>
</table>
Recommendations

• Practitioners calibrate and conduct their own ground-truth count tests
• Consider approvals and site characteristics when selecting a count site
• Consider potential sources of counter inaccuracies
Suggested Research

- Additional testing of automated technologies
  - Technologies not tested or underrepresented
  - Additional sites and conditions
- Extrapolating short-duration counts to longer-duration counts
- Adjustment factors for environmental factors
Questions?

- Contact Information
  - Kelly Laustsen
  - klaustsen@kittelson.com
  - 503.535.7439