Bicycle Detection Sensor Technology

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Diamond Traffic Products
<table>
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<th>Technology</th>
<th>Typical Applications</th>
<th>Strengths</th>
<th>Weaknesses</th>
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<tr>
<td>Inductance Loop</td>
<td>Bicyclists only</td>
<td>Capable of counting bicyclists only</td>
<td>May require site modifications and careful setup</td>
</tr>
<tr>
<td>Magnetometer</td>
<td>Bicyclists only</td>
<td>Commercially available, off-the-shelf products for counting bicyclists are limited</td>
<td>Needs specialized installation</td>
</tr>
<tr>
<td>Pressure sensor/pressure mats</td>
<td>Typically used on unpaved trails or paths</td>
<td>Capable of counting pedestrians and bicyclists separately</td>
<td>May pose hazards to trail users</td>
</tr>
<tr>
<td>Seismic sensor</td>
<td>Short-term counts on unpaved trails</td>
<td>Equipment is hidden from view</td>
<td>Limited to temporary use</td>
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<tr>
<td>Radar sensor</td>
<td>Short-term or permanent counts on dedicated bike lanes or bikeways</td>
<td>Capable of counting bicyclists in dedicated bike lanes or bikeways</td>
<td>May have higher error with groups</td>
</tr>
<tr>
<td>Infrared – Active</td>
<td>Relatively portable, unobtrusive appearance</td>
<td>Cannot distinguish between bicyclists and pedestrians unless combined with another bicycle detection technology</td>
<td>Expensive/disruptive for installation under asphalt or concrete pavement</td>
</tr>
<tr>
<td>Infrared – Passive</td>
<td>Very portable with easy setup</td>
<td>Cannot distinguish between bicyclists and pedestrians unless combined with another bicycle detector</td>
<td>Limited visibility to backpacks</td>
</tr>
<tr>
<td>Pneumatic Tube</td>
<td>Short-term counts</td>
<td>Capable of counting bicyclists only</td>
<td>Requires specialized installation and care</td>
</tr>
<tr>
<td>Video Imaging – Manual Reduction</td>
<td>Requires specific mounting configuration for use on unpaved trails or paths</td>
<td>Capable of counting bicyclists only</td>
<td>Requires specialized installation and care</td>
</tr>
<tr>
<td>Manual Observer</td>
<td>Short-term counts</td>
<td>Capable of counting bicyclists only</td>
<td>Requires specialized installation and care</td>
</tr>
</tbody>
</table>

### 1. What Are You Counting?
- **Pedestrians & Bicyclists**
  - Bicyclists and pedestrians separately
  - Bicyclists, Pedestrians, Pedestrians & Bicyclists combined
  - Pedestrians only
  - Bicyclists only
  - Bicyclists and pedestrians combined

### 2. How Long?
- **Permanent**
  - Bicyclists and pedestrians combined
  - Pedestrians & Bicyclists
  - Pedestrians
  - Bicyclists

- **Temporary/Short Term**
  - Bicyclists and pedestrians combined
  - Pedestrians & Bicyclists
  - Pedestrians
  - Bicyclists

- **Inductive Sensors**
  - Magnetic Loop
  - Magnetometer

- **Video Imaging**
  - Automated
  - Manual

- **Seismic Sensor**
  - Video Imaging – Automated
  - Video Imaging – Manual Reduction

- **Pneumatic Tube**
  - Video Imaging – Manual Reduction

- **Radar Sensor**

- **Infrared**
  - Active
  - Passive

- **Gas Sensors**

- **Manual Observers**

### Weaknesses
- **Inductive Sensors**
  - May interfere with motor vehicles.

- **Video Imaging**
  - May be affected by weather conditions.

- **Seismic Sensor**
  - Difficult to use for bike lanes and shared lanes.

- **Pneumatic Tube**
  - Limited visibility to backpacks.

- **Manual Observers**
  - Expensive and possibly inaccurate for longer duration counts.

### Cost
- **Inductive Sensors**
  - $5, $5

- **Video Imaging**
  - $5-$5

- **Seismic Sensor**
  - $5

- **Pneumatic Tube**
  - $5-$5

- **Manual Observers**
  - $5-$5

### Notes
- Indicates what is technologically possible.
- Indicates a common practice.
- Indicates relative cost per data point.
This figure illustrates the detection of a bicycle or motorcycle by an inductive loop. These conveyances can be modeled as a vertical conducting object relative to the plane of the loop. When the cycle travels along the loop wire, eddy currents are induced in the conducting wheel rims and frame. When the cycle is directly over the loop wire, coupling between the inductive loop and the cycle is maximized.

In other words, objects are best detected right above the loop wire itself. The loop “field” created by the loop antenna is disturbed when metal traverses nearby.

All wire conductors carrying an electrical current produce magnetic flux lines, which encircle the current flow that forms them. The magnetic flux induces the electrical property called inductance, measured in henrys (H). The inductance of the wire is called self-inductance. If the flux from current flowing in one wire couples to other wires, the resulting inductance is called mutual inductance.
Loop sensitivity is not linear to the object above the loops antenna. The higher the object the less the amount of change in inductance is observed. This is VERY important in bicycle detection since bicycles typically have a 10 times less magnitude difference than a passenger car.

- **Bicycle:** As low as 0.05 percent!
- **Class 1:** 0.13 percent ($L/L$) or 0.12 H ($L$) inductance change (small motorcycle).
- **Class 2:** 0.32 percent ($L/L$) or 0.3 H ($L$) inductance change (large motorcycle).
- **Class 3:** 3.2 percent ($L/L$) or 3.0 H ($L$) inductance change (automobile).
DATA

DON’T

TRUST

DATA

QA/QC (quality assurance/quality control) is KEY to good data. Good data is achieved by choosing the best technology for the application. But... the #1 rule to follow to get good data is:

LOCATION, LOCATION, LOCATION
Resources:
