What’s New in Video Bike Detection?
Bicycle Detection for Advanced Traffic Control in California

SF Bay Area ITE Annual Modeling Workshop
Modeling for Sustainable Complete Streets / Multimodal Transportation Planning

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What’s New?

Bicycle Differentiation

After 20+ years of detecting bikes, video detection is taking a technological leap forward.
Bicycle Differentiation

- Vehicle detectors also distinguish bikes from other vehicles in the lane as the bike approaches.
Interface to Controller

• As desired for the traffic control strategy…
  – The detector can output both bike and vehicle detection events by phase or by lane at the stop line, mid-range in the dilemma zone, and in the advance area.

• Detector separates vehicle and bike detection for the traffic controller.
  – Typically, there is room in the detector controller scheme for bike detection by phase and for additional special bike detectors by lane.
There’s Nobody in the Intersection!

An Exercise in frustration and awareness
There’s nobody in the intersection

- Have you ever been frustrated while sitting at an intersection waiting for the light to change...
- Try this next time
- Repeat the phrase...
- 3-seconds – a very long time to wait
  - “There’s nobody in the intersection.” = 3
  - “There’s nobody in the intersection.” = 6
  - “There’s nobody in the intersection.” = 9
  - “There’s nobody in the intersection.” = 12
There’s nobody in the intersection

- 3-seconds – a very long time
  “There’s nobody in the intersection.” “There’s nobody in the intersection.” “There’s nobody in the intersection.”

![Diagram showing traffic lights and time intervals]
There’s nobody in the intersection

- 3-seCONDS – a very, very, very long time

The Details Of Efficiency

Find ways to save time for *more efficient* Intersection Operations
# Gap Time/Veh Ext Precision

## Controller Timing Data

<table>
<thead>
<tr>
<th>Phase...</th>
<th>1...2...3...4...5...6...7...8</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIN GRN.</td>
<td>2 2 2 2 2 2 2 2 2</td>
</tr>
<tr>
<td>BIKE GRN</td>
<td>0 0 0 0 0 0 0 0 0</td>
</tr>
<tr>
<td>CS MGRN.</td>
<td>0 0 0 0 0 0 0 0 0</td>
</tr>
<tr>
<td>WALK....</td>
<td>0 5 0 5 0 5 0 5 0</td>
</tr>
<tr>
<td>PED CLR.</td>
<td>0 7 0 7 0 7 0 7 0</td>
</tr>
<tr>
<td>VEH EXT.</td>
<td>2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0</td>
</tr>
</tbody>
</table>

\[
gap = h - \frac{L_v + L_d}{v}
\]

\[
Flow = \frac{3600}{h}
\]
Traffic Flow & Gap

Flow = \frac{3600}{h}

gap = h - \frac{L_v + L_d}{v}
Where Save Time?

gap = h - \frac{L_v + L_d}{v}

Flow = \frac{3600}{h}
Sensitivity of Flow to Headway

Flow = \frac{3600}{h}

-360 vph
Snappy vs. OK Performance

-360 vph
-900 vph
How Long To Wait?

Flow

Headway
Gap Time Determines When a Phase Terminates

- Min Green
- Bike Min Green
- Vehicle Extension
- Gap > Veh Ext Or Max out

An Econolite Group Company
Min Green / Bike Min Green

- **Min Green**
- **Bike Min Green**
- **Vehicle Extension**
- **Gap**
- **Veh Ext Or Max out**

Time:
- Red
- Green
- Yellow
- Red
Extra Time for Bike to Cross

- Min Green
- Bike Min Green
- Extra Time
- Vehicle Extension
- Gap > Veh Ext Or Max out
- Red
- Green
- Yellow
- Red
What Happens When Min Green = Bike Min Green?

<table>
<thead>
<tr>
<th>Time</th>
<th>Min Green</th>
<th>Red</th>
<th>Yellow</th>
<th>Red</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Gap > Veh Ext Or Max out

Extra Time

Vehicle Extension

Red

Green

Yellow

Red
Extra Time Wasted When Only One Car?!
Intersection Design

How integrate with controller?
Bike Integration To Controller

Traffic Operations Center

Local PC

Communication Backbone

TIP

DPM

TAP

“3-wires-only”

Outputs to Controller

TS2 SDLC

TS1/TEES
Bike Integration Options

A. Combine with vehicle call to controller
   – Can add time in detector

B. Bike Call separately to controller
   – Controller adds time to detection
A. Output With Vehicle Call

Bike Call combined with Vehicle Call

1. Min Green = Bike Min Green

2. Detection adds time for bike call
Davis, CA

- Example Combine Bike Call with Vehicle Call
B. Bike Detector Input to Controller

• Bike Call output separately from Vehicle Call to Bike Detector input on Controller
  – Bike Min Green on demand
  – Bike Extension during green on demand

• Up to 64 detectors possible
  – Many ways to allocate
  – Think about maintenance – give meaning to the order
  – Think about maintenance – give meaning to LED indicators in cabinet

• Not all controllers support Bike Detector (see A.)
### B. Bike Detector Input to Controller

<table>
<thead>
<tr>
<th>Input</th>
<th>Function</th>
<th>Input</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detector 1 *</td>
<td>NB Lane 1 Stop Line - phases 2 &amp; 5</td>
<td>Detector 33</td>
<td>NB Lane 1 Mid-Range/Advance - phases 2 &amp; 5</td>
</tr>
<tr>
<td>Detector 2</td>
<td>NB Lane 2 Stop Line - phases 2 &amp; 5</td>
<td>Detector 34</td>
<td>NB Lane 2 Mid-Range/Advance - phases 2 &amp; 5</td>
</tr>
<tr>
<td>Detector 3</td>
<td>NB Lane 3 Stop Line - phases 2 &amp; 5</td>
<td>Detector 35</td>
<td>NB Lane 3 Mid-Range/Advance - phases 2 &amp; 5</td>
</tr>
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<td>Detector 4</td>
<td>NB Lane 4 Stop Line - phases 2 &amp; 5</td>
<td>Detector 36</td>
<td>NB Lane 4 Mid-Range/Advance - phases 2 &amp; 5</td>
</tr>
<tr>
<td>Detector 5</td>
<td>NB Lane 5 Stop Line - phases 2 &amp; 5</td>
<td>Detector 37</td>
<td>EB Lane 1 Mid-Range/Advance - phases 4 &amp; 7</td>
</tr>
<tr>
<td>Detector 6</td>
<td>NB Lane 6 Stop Line - phases 2 &amp; 5</td>
<td>Detector 38</td>
<td>EB Lane 2 Mid-Range/Advance - phases 4 &amp; 7</td>
</tr>
<tr>
<td>Detector 7 **</td>
<td>NB Left Turn Lanes Bike - phases 5</td>
<td>Detector 39</td>
<td>EB Lane 3 Mid-Range/Advance - phases 4 &amp; 7</td>
</tr>
<tr>
<td>Detector 8 **</td>
<td>NB Thru Lanes Bike - phases 2</td>
<td>Detector 40</td>
<td>EB Lane 4 Mid-Range/Advance - phases 4 &amp; 7</td>
</tr>
<tr>
<td>Detector 9 *</td>
<td>SB Lane 1 Stop Line - phases 6 &amp; 1</td>
<td>Detector 41</td>
<td>SB Lane 1 Mid-Range/Advance - phases 6 &amp; 1</td>
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<tr>
<td>Detector 10</td>
<td>SB Lane 2 Stop Line - phases 6 &amp; 1</td>
<td>Detector 42</td>
<td>SB Lane 2 Mid-Range/Advance - phases 6 &amp; 1</td>
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<tr>
<td>Detector 11</td>
<td>SB Lane 3 Stop Line - phases 6 &amp; 1</td>
<td>Detector 43</td>
<td>SB Lane 3 Mid-Range/Advance - phases 6 &amp; 1</td>
</tr>
<tr>
<td>Detector 12</td>
<td>SB Lane 4 Stop Line - phases 6 &amp; 1</td>
<td>Detector 44</td>
<td>SB Lane 4 Mid-Range/Advance - phases 6 &amp; 1</td>
</tr>
<tr>
<td>Detector 13</td>
<td>SB Lane 5 Stop Line - phases 6 &amp; 1</td>
<td>Detector 45</td>
<td>WB Lane 1 Mid-Range/Advance - phases 8 &amp; 3</td>
</tr>
<tr>
<td>Detector 14</td>
<td>SB Lane 6 Stop Line - phases 6 &amp; 1</td>
<td>Detector 46</td>
<td>WB Lane 2 Mid-Range/Advance - phases 8 &amp; 3</td>
</tr>
<tr>
<td>Detector 15 **</td>
<td>SB Left Turn Lanes Bike - phases 1</td>
<td>Detector 47</td>
<td>WB Lane 3 Mid-Range/Advance - phases 8 &amp; 3</td>
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<td>Detector 16 **</td>
<td>SB Thru Lanes Bike - phases 6</td>
<td>Detector 48</td>
<td>WB Lane 4 Mid-Range/Advance - phases 8 &amp; 3</td>
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<td>Detector 17 *</td>
<td>EB Lane 1 Stop Line - phases 4 &amp; 7</td>
<td>Detector 49</td>
<td>NB Lane 1 Station data collection - phases 2 &amp; 5</td>
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<td>EB Lane 2 Stop Line - phases 4 &amp; 7</td>
<td>Detector 50</td>
<td>NB Lane 2 Station data collection - phases 2 &amp; 5</td>
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<td>Detector 19</td>
<td>EB Lane 3 Stop Line - phases 4 &amp; 7</td>
<td>Detector 51</td>
<td>NB Lane 3 Station data collection - phases 2 &amp; 5</td>
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<td>Detector 20</td>
<td>EB Lane 4 Stop Line - phases 4 &amp; 7</td>
<td>Detector 52</td>
<td>NB Lane 4 Station data collection - phases 2 &amp; 5</td>
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<td>Detector 21</td>
<td>EB Lane 5 Stop Line - phases 4 &amp; 7</td>
<td>Detector 53</td>
<td>EB Lane 1 Station data collection - phases 4 &amp; 7</td>
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<tr>
<td>Detector 22</td>
<td>EB Lane 6 Stop Line - phases 4 &amp; 7</td>
<td>Detector 54</td>
<td>EB Lane 2 Station data collection - phases 4 &amp; 7</td>
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<td>Detector 23 **</td>
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<td>EB Lane 3 Station data collection - phases 4 &amp; 7</td>
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<td>Detector 56</td>
<td>EB Lane 4 Station data collection - phases 4 &amp; 7</td>
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<td>Detector 25 *</td>
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<td>Detector 57</td>
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<td>Detector 26</td>
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<td>Detector 27</td>
<td>WB Lane 3 Stop Line - phases 8 &amp; 3</td>
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<td>WB Lane 4 Stop Line - phases 8 &amp; 3</td>
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<td>SB Lane 4 Station data collection - phases 6 &amp; 1</td>
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<td>Detector 29</td>
<td>WB Lane 5 Stop Line - phases 8 &amp; 3</td>
<td>Detector 61</td>
<td>WB Lane 1 Station data collection - phases 8 &amp; 3</td>
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<td>Detector 30</td>
<td>WB Lane 6 Stop Line - phases 8 &amp; 3</td>
<td>Detector 62</td>
<td>WB Lane 2 Station data collection - phases 8 &amp; 3</td>
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<td>Detector 31 **</td>
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<td>Detector 63</td>
<td>WB Lane 3 Station data collection - phases 8 &amp; 3</td>
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<td>Detector 32 **</td>
<td>WB Thru Lanes Bike - phases 8</td>
<td>Detector 64</td>
<td>WB Lane 4 Station data collection - phases 8 &amp; 3</td>
</tr>
</tbody>
</table>
Pasadena, CA

• Example Output to Controller
Pasadena, CA

• Example Output to Controller
Bicycle Differentiation
## Sacramento County Test Site

<table>
<thead>
<tr>
<th>Site</th>
<th>Bike</th>
<th>Veh</th>
<th>Bike&amp;Veh</th>
<th>No Call</th>
<th>Total Bikes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ø1</td>
<td>NB LT #1</td>
<td>1</td>
<td>1</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>NB LT #2</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Ø6</td>
<td>NB #1</td>
<td>1</td>
<td>1</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>NB #2</td>
<td>2</td>
<td>1</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>NB #3</td>
<td>1</td>
<td>2</td>
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<td>3</td>
</tr>
<tr>
<td></td>
<td>NB Bike</td>
<td>1</td>
<td>7</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>NB RT</td>
<td>1</td>
<td>2</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Ø7</td>
<td>WB LT #1</td>
<td>4</td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>WB LT #2</td>
<td></td>
<td>3</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Ø4</td>
<td>WB #1</td>
<td></td>
<td></td>
<td></td>
<td>5</td>
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<td></td>
<td>WB #2</td>
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<td></td>
<td>WB Bike</td>
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<tr>
<td>Total</td>
<td></td>
<td>7</td>
<td>3</td>
<td>35</td>
<td>45</td>
</tr>
</tbody>
</table>
Video: Bad Weather Example
Video: Slow Approach in Snow
Video: Heavy Snow
Bicycle Differentiation & the Traffic Controller

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- As desired for the traffic control strategy…
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Thank You For Your Time!

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