Queue length and delay estimation at signalized intersections using detector data

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QUEUE LENGTH AND DELAY ESTIMATION
AT SIGNALIZED INTERSECTIONS USING
DETECTOR DATA

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INTRODUCTION

• Measures of Performance for Signalized intersections
  – v/c ratio
  – Control delay
  – Max. queue length
  – Level of service
  – Fuel consumption
  – Number of stops
INTRODUCTION

- Measures of Performance for Signalized Intersections
  - v/c ratio
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METHODOLOGY

• INPUT
  - Stop bar detections
  - Signal timing information

• Development of Queue polygon

• Measure Max. Queue length and delay for each cycle
STUDY SITE

- This method requires signal timing information—difficult to get in India
- Study sites selected are 17 G and 27G Cornhusker in Lincoln, Nebraska, USA
DATA COLLECTION

• Micro loop detectors placed just after stop line
• Digitalized data generated as vehicles arrive and leave
• Signal timing information obtained
• Actual values extracted manually from video
• One hour each from 17G intersection and 27G Cornhusker in peak and off-peak hour
Start

Get Phase Data
- Cycle Start Time (CST)
- End of Red (ER)
- End of Green (EG)

Get Exit Detector Data for a given lane (ExitDetLnA) subject to CST < ExitDetLnA < EG

Get time headway from Exit Detector Data for a given lane (ExthdwayLnA)

ExthdwayLnA < saturation headway and first headway lies in green time of that cycle?

Yes
Queue is not cleared

No

6
Queue clearance time = Time stamp of start of green - time stamp of the first headway greater than saturation headway

Numqueue = Count of number of vehicles leaving before queue clearance time

Generate queue polygon with
  Arrival rate = Numqueue / Red duration
  Departure rate = Numqueue / queue clearance time

Vehicles coming after queue clearance time in that cycle departs in green and so no queue
Delay $t_d$ at a time instant $k+1$ is given as

$$t_d(k+1) = \int_{k}^{k+1} N \, dt = \left( \frac{N(k) + N(k+1)}{2} \right) \times h$$

where $N(k)$ is the number in queue at $k^{th}$ instant of time, $h$ is the duration of analysis period from $k$ to $k+1$. 
## RESULTS

<table>
<thead>
<tr>
<th>Intersection</th>
<th>Queue (veh)</th>
<th>Delay (veh-sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>17G off-peak</td>
<td>1.2</td>
<td>0.12</td>
</tr>
<tr>
<td>17G peak</td>
<td>1.3</td>
<td>0.18</td>
</tr>
<tr>
<td>27 G off-peak</td>
<td>1.5</td>
<td>0.32</td>
</tr>
<tr>
<td>27 G peak</td>
<td>1.3</td>
<td>0.2</td>
</tr>
</tbody>
</table>
CONCLUSION

• Simple and effective scheme to determine performance measures at signalized intersections

• Developed for under-saturated conditions

• Uses minimal data - stop bar detection and signal timing
REFERENCES


REFERENCES (cont.)


THANK YOU