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
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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 (ExtDetLnA) subject to
CST < ExtDetLnA < 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
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 $k+1$
<table>
<thead>
<tr>
<th>Intersection</th>
<th>RMSE</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Queue (veh)</td>
<td>Delay (veh-sec)</td>
<td></td>
</tr>
<tr>
<td>17G off-peak</td>
<td>1.2</td>
<td>0.12</td>
<td></td>
</tr>
<tr>
<td>17G peak</td>
<td>1.3</td>
<td>0.18</td>
<td></td>
</tr>
<tr>
<td>27 G off-peak</td>
<td>1.5</td>
<td>0.32</td>
<td></td>
</tr>
<tr>
<td>27 G peak</td>
<td>1.3</td>
<td>0.2</td>
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</tbody>
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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