Modeling Left Turn Queue Lengths

Department of Civil Engineering
The University of New Mexico
Presentation Outline

- Definitions
- Study Objectives
- Overview of Traffic Models
- Study Locations
- Data Collection/Analysis
- Model Comparisons
- Summary and Conclusions
What is a Left Turn Queue?

- A count of the number of vehicles waiting to complete a left turn maneuver at an intersection (signalized or unsignalized)
- Different definitions for left turn queues exist
  - Average queue length
  - Maximum queue length
  - Average maximum queue length
  - Maximum back of queue
Queue Length Definitions

Maximum back of queue

Maximum queue at beginning of green
Why Estimate Left Turns?

- Safety
- Optimize intersection design
- Efficient intersection operation
- Minimize delays caused by blockage and overflow
Traffic Models Studied

Macroscopic models
- Synchro
- Highway Capacity Software (HCS+)
- TEAPAC

Microscopic model
- SimTraffic integrated with Synchro
Data Required

- Traffic volumes by approach/movement
- Roadway geometry
- Type of traffic control
- Traffic signal timings
- Signal phasing
Differences in Traffic Models

Actuated signals (detection on approaches):

- Synchro calculates actuated green time internally
- TEAPAC: User must specify average green time
- HCS+: User must specify average green time
- SimTraffic uses Synchro data
Differences in Traffic Models

Vehicle Length

- Synchro, TEAPAC, and HCS+ all assume 25 feet
- SimTraffic assumes 19.5 feet
Differences in Traffic Models

Queue length calculated

Q1 = Maximum queue calculated by TEAPAC
Q2 = Maximum queue calculated by Synchro (vehicles delayed less than 6secs are not considered)
Q3 = Maximum queue calculated by HCS+

Delay = 6secs

Departure rate

Arrival volume

Red phase

Green phase
Study Area
NM528 & Southern
NM528 & Sara
NM528 & Westside
Estimated queue length comparison

- Synchro underestimated queue length for AM and PM
- TEAPAC is comparable to maximum observed queue for AM and PM
- HCS+ overestimated queue length for both AM and PM
- SimTraffic underestimated for AM and is comparable for PM
Estimated queue length comparison

- Synchro underestimated queue length for AM and overestimated for PM
- TEAPAC underestimated queue length for AM and overestimated for PM
- HCS+ underestimated queue length for both AM and overestimated for PM
- SimTraffic overestimated for AM and PM
Estimated queue length comparison

- Synchro underestimated queue length for AM and PM
- TEAPAC is comparable with maximum queue observed for AM and underestimated for PM
- HCS+ is comparable with maximum queue observed for AM and underestimated for PM
- SimTraffic overestimated queue length for AM and PM
Estimated queue length comparison

- Synchro underestimated queue length for AM
- TEAPAC is comparable with maximum observed queue for AM
- HCS+ overestimated queue length for AM
- SimTraffic is comparable with maximum queue observed
- PM queues are not comparable
Estimated queue length comparison

- Synchro underestimated queue length for WB and SB
- TEAPAC underestimated queue length for WB and SB
- HCS+ is comparable with maximum observed queue for WB and underestimated for SB
- SimTraffic is comparable with maximum observed queue for WB and underestimated for SB
Estimated queue length comparison

- Synchro underestimated queue length for WB and NB
- TEAPAC is comparable with maximum observed queue for WB and overestimated for NB
- HCS+ overestimated queue length for WB and NB
- SimTraffic underestimated for WB and SB
Simulating for 10 minutes without volume adjustment gives longer queue lengths compared to the rest of the simulation times.
SimTraffic queue length

- SB queue lengths are overestimated for both AM and PM
- NB AM queue length is overestimated for 2 min, queue length is overestimated for PM
SimTraffic queue length

NM528 & Westside

Queue Length (vh/s)

Simulation Time (minutes)

WB AM  SB AM  WB PM  NB PM

MOQ  2 min  10 min  60 min
## Model Comparison

<table>
<thead>
<tr>
<th></th>
<th>MOQ</th>
<th>Synchro</th>
<th>Teapac</th>
<th>HCS</th>
<th>Simtraffic</th>
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<td>4*↑</td>
<td>12*↑</td>
<td>9*</td>
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<tr>
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<td><strong>Overall performance</strong></td>
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## Summary

<table>
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<tr>
<th>Intersection and Approach</th>
<th>95th Simtraffic queue (vehicles)</th>
<th>90th TEAPAC queue (vehicles)</th>
<th>95th Synchro queue (vehicles)</th>
<th>95th HCS queue (vehicles)</th>
<th>MOQ (vehicles)</th>
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</tbody>
</table>

**Score**
- 4
- 4
- 3
- 4

**Accuracy**
- 76.5%
- 74.3%
- 69.3%
- 67.0%
Conclusions

- Synchro underestimated queue length at all approaches
- HCS+ overestimated queue length at almost all approaches
- TEAPAC and SimTraffic gave comparable values when compared to the maximum observed queue
- SimTraffic seems to perform better under certain volume and simulation time assumptions
- The advantages of SimTraffic also include its animation capabilities
- SimTraffic advantages must be balanced with its additional time requirements
Questions?