A simple procedure to estimate gap-acceptance parameters for calibration and validation of micro-models

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Summary

- Gap-acceptance terms
- Methodology - requirements, previous research
- Methodology - steps
- Use it practice - calibration and validation of micro-models
- What's next
- Demonstration
Gap-acceptance theory | basic terms

- Gap - $\Delta t_i$
- Minimum headway - $\Delta t_m$
- Critical gap - $\Delta t_{cr}$
- Follow-up time - $\Delta t_f$
- Hierarchy of streams
Basic terms in schematic view

Conflict points
Conflict area

Δt

Δt_m

Δt_i

Δt_f

Δt_cr

Δt

Mott MacDonald
Bulgaria
Methodology - requirements

- Simple
- Automated
- Reliable
- Inexpensive
- Applicable
Previous research

USA

- NCRHP 3-65: Data collection and extraction, 2004

Europe

- Estimation of critical gaps and follow-up times at rural unsignalised intersections in Germany, 2000

- Estimation and simulation gap acceptance behaviour at congested roundabouts, 2006
Methodology

- 1st step – Video observations
- 2nd step – Extraction of primary data
- 3rd step – Preparation of data for statistical analysis
- 4th step – Estimation of $\Delta t_{cr}$
- 5th step – Estimation of $\Delta t_m$
- 6th step – Estimation of $\Delta t_f$
STEP 1. Video observations

- Equipment
- Video materials in helicopter view
STEP 2. Extraction of primary data

- **Time events**
  - Minor stream 1,2
  - Major stream 3,4

- **Location marks**
STEP 2. Extraction of primary data continues

- Keystroke register
- Raw data
STEP 3. Preparation of primary data for statistical analysis

Data needed

- For critical gap estimation
  - \( A_i \) - accepted gap
  - \( R_i \) - rejected gap
  - \( F(t_{cr}) = F(A_i) - F(R_i) \)

- For follow-up time

- For minimum headway
STEP 3. Preparation of primary data for statistical analysis - continues

- Input: time events
- Algorithm
  - Accepted and largest rejected gap and follow-up time for each driver
  - Number of rejected gaps
  - Evaluates behaviour and removes inconsistent drivers
- Output file: extracted data
STEP 4. Estimation of critical gap

Maximum Likelihood Procedure

- Advantages
- Statistical analysis

\[ \Delta t_i \text{ (sec)} \]

Cumulative distribution functions

\[ F(x) = f(x) \]
STEP 5. Estimation of minimum headway

Excel spreadsheet using Luttinen formulae

- minimum headway
- proportion of free vehicles
STEP 6. Estimation of follow-up time

- Grouping entering vehicles
- Average follow-up time per group
- Calculate overall average value for observed driver population
Using results in practice — calibration of PTV VISSIM micro-models

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Estimated (sec)</th>
<th>Value to calibrate</th>
<th>Software Menu</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critical gap</td>
<td><strong>5.90</strong></td>
<td>As estimated (default is <strong>3.0s</strong>)</td>
<td>Priority rules/Min. gap time</td>
</tr>
<tr>
<td>Follow-up time</td>
<td><strong>3.40</strong></td>
<td>CC0 (Standstill distance) = <strong>1.5m</strong></td>
<td>Driving behaviour parameters set</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CC8 (Standstill acceleration) = <strong>3.5m/s^2</strong></td>
<td>(Wiedemann 99)</td>
</tr>
<tr>
<td>Minimum headway</td>
<td><strong>1.30</strong></td>
<td>CC1 (Headway time) = <strong>0.90s</strong></td>
<td>Driving behaviour parameters set</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(Wiedemann 99)</td>
</tr>
</tbody>
</table>
Demonstrate reliability of procedure ï validation of VISSIM model

- Observed Qe
- Modelled Qe Default
- Modelled Qe with real values

Time periods (min)
Demonstrate reliability of procedure \( \ddagger \) validation of VISSIM model

<table>
<thead>
<tr>
<th></th>
<th>Critical gap</th>
<th>Headway time</th>
<th>Follow-up time</th>
<th>Average entering traffic from minor road</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Standstill distance CC0</td>
</tr>
<tr>
<td>Observed</td>
<td>5.90</td>
<td>1.30</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Modelled with defaults</td>
<td>3.00</td>
<td>0.90</td>
<td>1.50</td>
<td>3.50</td>
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<tr>
<td>Callibrated model</td>
<td>5.90</td>
<td>1.30</td>
<td>1.00</td>
<td>4.00</td>
</tr>
</tbody>
</table>
What's next?

- Single unit software
- Connection to loop detectors for automatic extraction and calculation, classified by vehicle types
1. Video observations
2. Locate, mark and register time events in text files
3. Extract data using pre-defined program into DBF output file
4. Estimate critical gap - Excel
5. Estimate headway - Excel
6. Estimate follow-up time - Excel
Example ii registering time events