Microscopic Calibration and Validation of Car-Following Models

Motivation

- What is the minimum quantitative data requirement for a given calibration task in terms of minimum number of vehicles, minimum length of time interval, or minimum temporal resolution?
- Is it possible to formulate qualitative data requirements by defining a minimal set of traffic states which must be contained in the data?
- To which degree does data noise or the sampling rate influence the calibration result?
- Is it possible to distinguish noise from intra-driver and inter-driver variations?
- To which degree does the result differ when calibrating a given model on given data with different methods such as least squared errors (LSE) or maximum-likelihood?
- How does the result depend on the objective function?
- Is it necessary to smooth trajectory data before calibration?
- Finally: Why there so little difference when comparing LSE calibration results of the "best" with that of the "worst" models?

Data Preparation

- check for discontinuities, negative speeds, negative gaps
- ensure internal and platoon consistency
- data resampling (if needed) and smoothing (if desired)

Consistency requirements:

- internal consistency:

  \[ q(t) = s(t) - v(t) \]

- platoon consistency:

  \[ q(t) = e(t) - s(t) - \dot{l_i} \quad \dot{v}(t) = v(t) - v(t) \]

Global calibration of the IDM to relative gaps

Influence on Calibration Method and Objective

- Local Calibration
- Global Calibration to log(gaps)
- Global Calibration to gaps

Influence of Data Rate and Smoothing

- Influence of the Car-Following Model
- Influence of Data Rate and Smoothing

Conclusions

- Furthermore, we have found:
  - a global calibration based on the logarithms of the gaps is most distinctive;
  - a data sampling rate of 10 Hz is unnecessarily high and 1 Hz sufficient;
  - in contrast to intuition, data smoothing has no significant influence on the calibration result as long as internal and platoon consistency are fulfilled
  - data completeness, and also a minimum total time interval of the order of 300 s are crucial.

References

- V. Purus, B. Cufla, Transportation Research Record 2124 (2009) 249–256