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Title	Evaluation of the Sensitivity of Traffic Flow Characteristics to the Microscopic Driving Behaviour – Impact of Parameter Values
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Abstract

Traffic microsimulation models are increasingly used by transportation professionals as a cost effective way of assessing alternative designs of traffic management and control. Traffic microsimulation models explicitly represent detailed driving behaviour, e.g. in vehicles following and lane-changing behaviour, and employ a large number of parameters to model the behaviour (see a collection of papers on the various microsimulation tools in Barcelo, 2010). Understanding the individual and collective impact of these behavioural parameters on model estimation is important in our confidence in applying these models in practice. Bonsall et al (2005) identify the key parameters of traffic simulation models and show a significant lack of empirical observations of real behaviour in determine the parameter values in these models.

Most of the existing practice in the calibration of traffic microsimulation models has been via either a trial-and-error or mathematicallt formulate the calibration as an optimization problem (see a review in Hollander and Liu, 2008). Either way, the steps involved include collecting the field traffic operating data which will be called test parameter, assuming some sets of behavior parameters, making simulated experiments, obtaining the simulated data with the test parameter, inspecting the consistency of the field data and simulated results. This is a process of solving the multivariate optimization, there may be multiple sets of the optimal solutions and the relationship between the set of the behavior parameters and the test parameter is unclear.

This paper sets out to understand the impacts of some of the behavioural parameters in the VISSIM traffic microsimulation model (see Microscopic Traffic Flow Simulator VISSIM in Barcelo, 2010) on the modelled traffic flow characteristics. This work is a first step in developing a quantitative and optimization-based calibration method for the VISSIM driver behavior parameters.

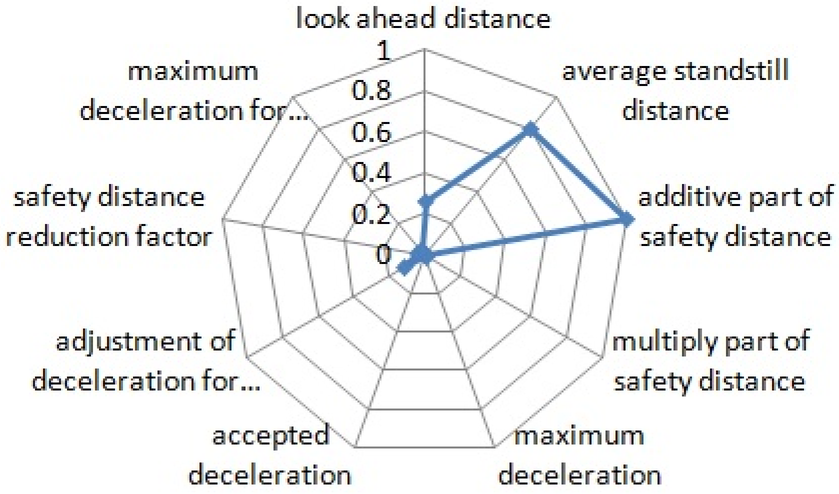
Through a series of traffic simulation experiments, this research presents a sensitivity analysis of VISSIM simulated traffic flow characteristics output under various values of driving behavior parameters. The traffic flow characteristics include: average speed, average volume， travel time, queue length, individual vehicle speed, individual vehicle following distance, individual vehicle acceleration. The driving behavior parameters tested include: look ahead distance, average standstill distance, additive part of safety distance, multiply part of safety distance, maximum deceleration, accepted deceleration, adjustment of deceleration for mandatory lane-changing, safety distance reduction factor, maximum deceleration for cooperative braking.

The analysis is undertaken on 4 groups (200times) of simulated experiments developed for a merging area which contents the car-following and lane-changing driving task. The random seed of each group is different from others, which are 5, 50,100 and 150. In each group, there were 10 parameters with 5 values separately were tested.

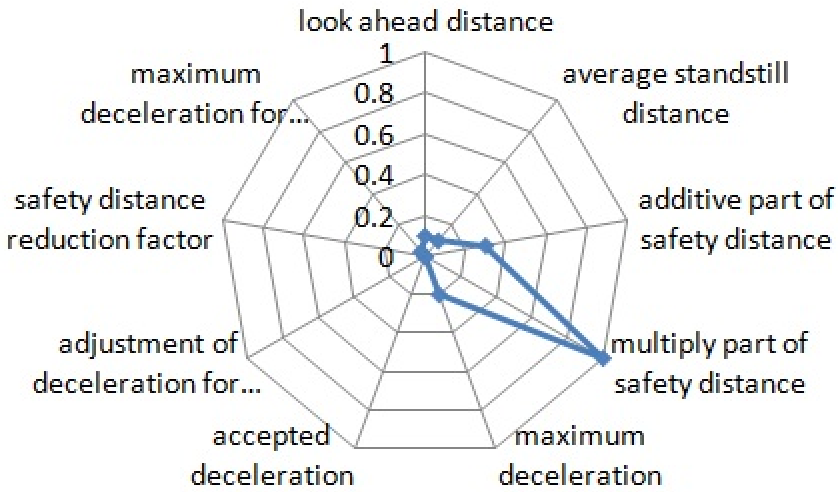
The speed data of the traffic on the main line and merging ramp were surveyed. The acceleration data of the vehicle was also surveyed to set the basal vehicle model.

The simulation experiments yield 200 groups of data for each traffic flow characteristics. The method of analysis of variance (ANOVA) was used to analyze the differences between group means. The variance between groups was used to quantify the sensitivity of the simulated traffic flow characteristics to the driving behavior parameters. ANOVAs are useful in comparing (testing) three or more means (groups or variables) for statistical significance. The between group variable can represent the level of the different between

different groups. Figure 1 presents illustrative results in a radar map. It shows the relative effects of each of the ten behavioural parameters on vehicle speed and acceleration.



(a)



(b)

Figure 1. Radar maps showing the sensitivity of behavioural parameters on: (a) vehicle speed, and (b) acceleration at lane-changing.

The overall sensitivity results are summarised in Table 1, which shows the most sensitive behavioural parameter(s) to each of the traffic flow characteristics examined. For example, the results of the sensitivity analysis suggests that the average speed of the traffic flow is most sensitive to the additive part of safety distance, whilst the individual vehicle following distance is sensitive to look ahead distance and additive part of safety distance. The full paper will present the experimental set-up for the sensitivity tests, the values of the parameters tested, the details ANOVA analysis of individual and between-group variables, as well as the full test results on the sensitivity of the traffic flow characteristics to driving behavior parameters.

The results of the sensitivity test will help understand the relationship between the macroscopic traffic flow characteristics. The results will also be useful for the microscopic simulation model calibration. Giving the potentially very large number of behavioural parameters in traffic microsimulation models, the sensitivity results would help the practitioners to choose the most appropriate parameters to calibrate, given their observed traffic flow data.

Key References:

Barcelo, J. (ed.) (2010). *Fundamentals of Traffic Simulation.* Springer.
Bonsall, P., Liu, R. and Young, W. (2005), Modelling safety-related driving behaviour – impact of parameter values. **Transportation Research**, 39A, 425-444.
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