Calibrating VISSIM's acceleration characteristics for vehicles starting from rest

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1 Introduction

When using microscopic traffic simulation, the calibration of the model is an essential work step. In general the control variables used in the calibration process depend on the research question that is to be answered with help of the simulation. The model has to be calibrated so it reproduces characteristic variables of the study area to be simulated. In the design of roadways macroscopic variables like traffic flow or average travel time are typically used as control variables[1]. Many calibration studies focus on macroscopic variables. When microscopic simulation is used to estimate emissions, the focus is different. Since microscopic emission models typically calculate emissions from the current velocity and acceleration of each vehicle, it is crucial that the acceleration behavior of the microscopic traffic model used is calibrated correctly. The paper shows how VISSIM can be calibrated to reproduce realistic acceleration behavior.

2 Data

The trajectories used in this study are derived from the data collected by [2]. This data has been extracted from images taken at a junction of two-lane roads controlled by traffic lights. The trajectories cover a range of about 150 m, of which 40 m are after the traffic light, and a period of 80 min. The temporal resolution is 1 s, the spatial resolution is 0.01 m. Three types of vehicles are distinguished: cars, vans and trucks.

A comparable scenario consisting of a two-lane road and a traffic signal is modelled in VISSIM. In order to get most accurate simulation results, we set the simulation time step to the smallest possible value of 0.1 s.

There was the need for data cleaning. In this process we identified and removed obviously wrong data like trajectories with large negative changes of position or stopping vehicles that did not start again. The remaining data was divided into two groups based on whether the vehicle had stopped or not. Only the data of vehicles stopping at the traffic light has been considered further. In addition we restricted our investigations to trajectories of cars. As a result we retained roughly 100 trajectories.

We derived velocity and acceleration from the positional data using numerical diffentiatiation by finite differences. In this process we treated the data from both sources in the same way. For the VISSIM data which was sampled at intervals of 0.1 s, this meant that we kept only every tenth sample point to assure comparability with the real world data.

3 Methodology

In VISSIM we identified the *desired speed distribution* and the *desired acceleration distribution* as parameters that had to be adjusted in the calibration process. For the calibration of these parameters we used informed guessing, i. e. we plotted several statistics and observed how these differed for the real world data and simulated data. Then we guessed how these statistics could be made more similiar, adjusted the parameters, rerun the simulation and verified that the new parameters had indeed the desired effect. We used the following statistics to assist the guessing: Histograms of v_{max} and a_{max}, histograms of velocity and acceleration distributions for small time interval up to 5 s after the start of acceleration from rest and a numerical similarity score derived from the histograms.

We started with a simulation using VISSIM's default parameters yielding velocity and acceleration distributions which are quite different from the respective real world distributions. Adjusting the desired speed distribution in VISSIM improved the match of the velocity distributions substantially. The calibration of the acceleration was a bit more complicated. The desired acceleration is given as a function of speed. This function is given as a continuous, piecewise linear curve for the mean of the desired acceleration, which can be adjusted by arbitrary small intervals. In addition there is an upper and a lower band determining the range of 3.333 standard deviations. The width of both bands can be set individually for every interval. Plotting the acceleration as function of velocity helped in the task of adjusting the *desired acceleration function* since it is directly comparable with the representation in VISSIM.

4 Results

We finally reached similarity scores for the acceleration that are in the same range as the scores obtained when comparing the acceleration distributions of different lanes of the real world data. After calibration VISSIM reproduces realistic acceleration behaviour measured by velocity distributions and acceleration distributions. This calibrated VISSIM model can now be used to generate the input for a microscopic emission model for the estimation of emissions at intersections.

References

[1] R. Dowling, A. Skabardonis, J. Halkias, G. McHale, and G. Zammit. Guidelines for calibration of microsimulation models: Framework and applications. *Transportation Research Record: Journal of the Transportation Research Board*, 1876:1–9, 2004.

[2] Francesco Viti, Serge P. Hoogendoorn, Henk J. Zuylen, Isabel R. Wilmink, and Bart Arem. Microscopic data for analyzing driving behavior at traffic signals. In Jaume Barcel and Masao Kuwahara, editors, *Traffic Data Collection and its Standardization*, volume 144 of *International Series in Operations Research & Management Science*, pages 171–191. Springer New York, 2010.