A sensitivity-analysis-based approach for the calibration of traffic simulation models

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**Introduction**

The calibration and validation of traffic simulation models is a key step in any simulation application. Sensitivity analysis is crucial for a true comprehension of these models behavior, but the main obstacle towards an extensive use of the most sophisticated techniques is jeopardized by the high number of model runs usually required, especially in case of high number of model parameters.

We propose a multi-step approach in which a preliminary analysis is carried out on groups of model parameters owning common features (e.g. same sub-model). The sensitivity analysis of parameters in the most influential groups can be performed. The proposed methodology has been applied to the MITSIM model (101 model parameters) and has allowed uncovering the role played by the different parameters and by the model stochasticity with 80% fewer model evaluations.

**The Case study**

**The network**: the A44 urban motorway is located in the region of greater Porto, Portugal. It is a dual-carriageway motorway with two 3,50m width lanes, and 2,00m width shoulders in each direction.

**Available aggregated data**: Fixed loop sensor counts and average speeds by 5 min periods at the 8 detection locations resulted in two measures of performance (MoP) were used in the computation of 3 goodness of fit (GoF) measures (RMSE, RMSPE, and U) during the SA.

**Available trajectory data**: Trajectories for the entire A44 network collected for a specific weekday morning using aerial remote sensing resulted in 7 different MoP describing the trajectories (accelerations, headways, gaps, etc). For each MoP 11 distribution statistics (percentiles, max, min) were used. The same 3 GoF were computing during the SA.

**The traffic simulator**: MITSIM integrates four levels of decision-making: target lane, gap acceptance, target gap and acceleration, in a latent decision framework based on the concepts of short-term goal and short-term plan.

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**Multi-step global SA**

1. Group model parameters on the basis of their similarities;
2. Create a map between a number in the range [0,1] and a combination of the parameters within the group;
3. Apply variance-based SA to the groups to distinguish those accounting for the highest share of model variance;
4. Consider only the parameters in the influential groups.
   1. If the number is sufficiently small, apply variance-based techniques to the new set of parameters;
   2. If the number is still too high, go back to step 1 applying steps 1 to 4 to the new parameter sub-set.
5. Define the final set of parameters for subsequent analyses.

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**Results**

**Conclusions**

A multi-step approach for the sensitivity analysis of computationally expensive and high-dimensional traffic simulation models is presented and applied to the MITSIMLab model.

It was possible to save as much as the 80% of model evaluations without necessarily paying in terms of result accuracy. Many aspects of this novel view needs further research, such as different grouping structures or its application to other simulation model formulations. Yet, the results presented throughout the present work might aim at slightly modifying how the reliability of traffic simulation is perceived.

**Main references**


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