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Calibration of Microscopic and Mesoscopic Traffic Simulation Model of a Large-scale Network Based on the Real-world Speed Data

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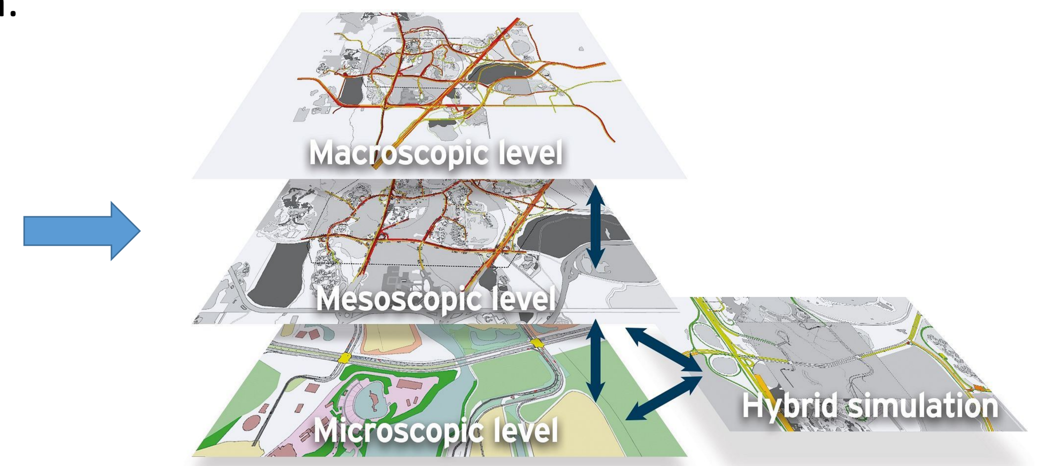
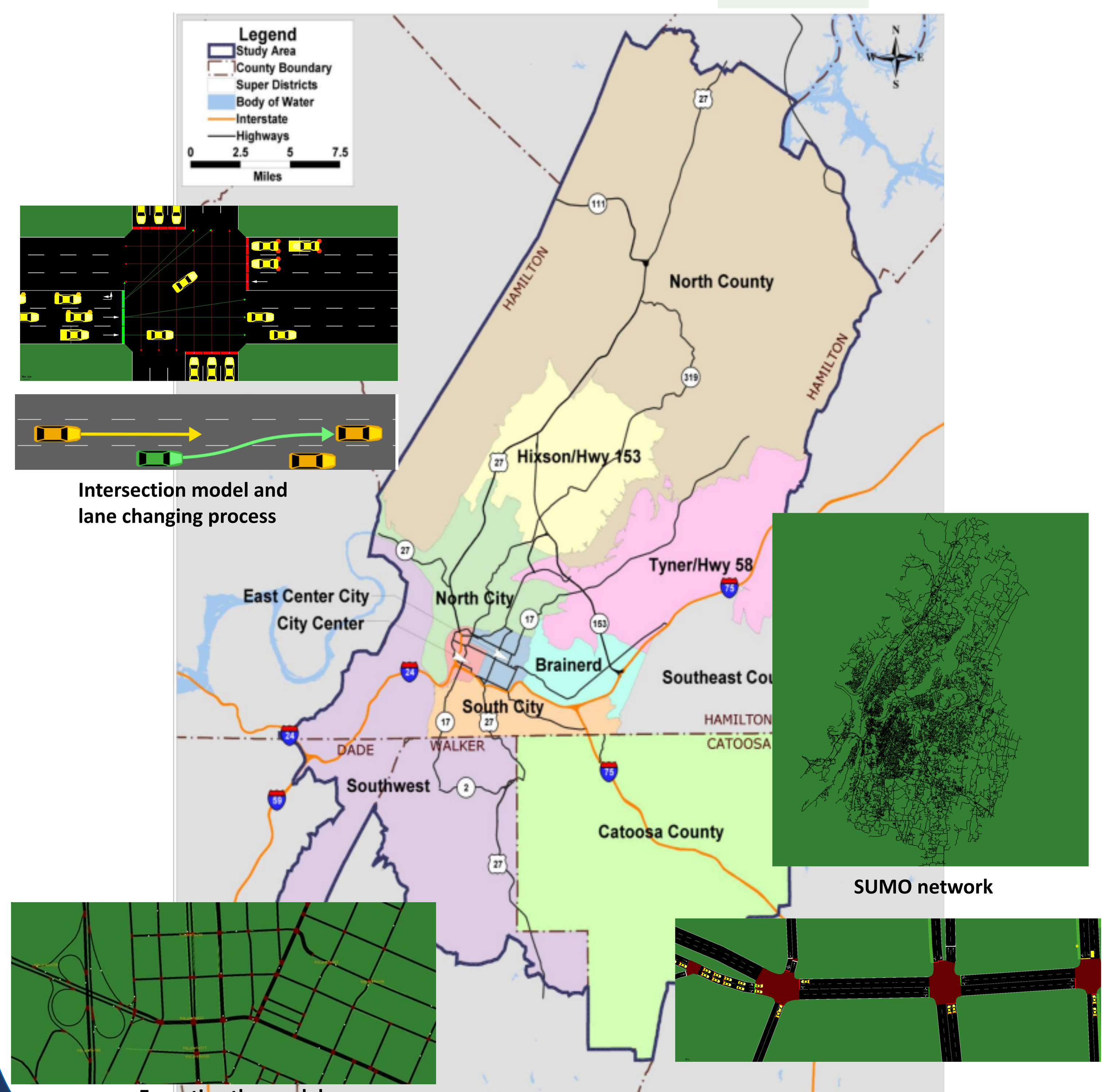
Introduction

This study presents a novel calibration approach for a city-scale traffic simulation model based on limited real-world speed data (RSD). The simulation model runs a microscopic and mesoscopic realistic traffic simulation from Chattanooga, TN (US) for a 24-hour period and includes various transport modes such as transit buses, passenger cars, single-unit trucks, and multi-unit trucks. The experiment results presented demonstrate the effectiveness of our approach for calibrating large-scale traffic networks using only real-world speed data. This paper presents our proposed calibration approach that utilizes 2160 real-world speed data points, performs sensitivity analysis of simulation model to input parameters, and develops a novel genetic algorithm for optimizing the model for calibration.

Different traffic modelling levels



SUMO Simulation Model



Methodology

The calibration process is conducted to determine the best parameters for the car-following, lane-changing, and intersection model so that our simulation model represents realistic field measurements. To calibrate the microscopic and mesoscopic model, we focus on parameters that directly and significantly affect the longitudinal (car-following), and lateral (lane-changing) movement.

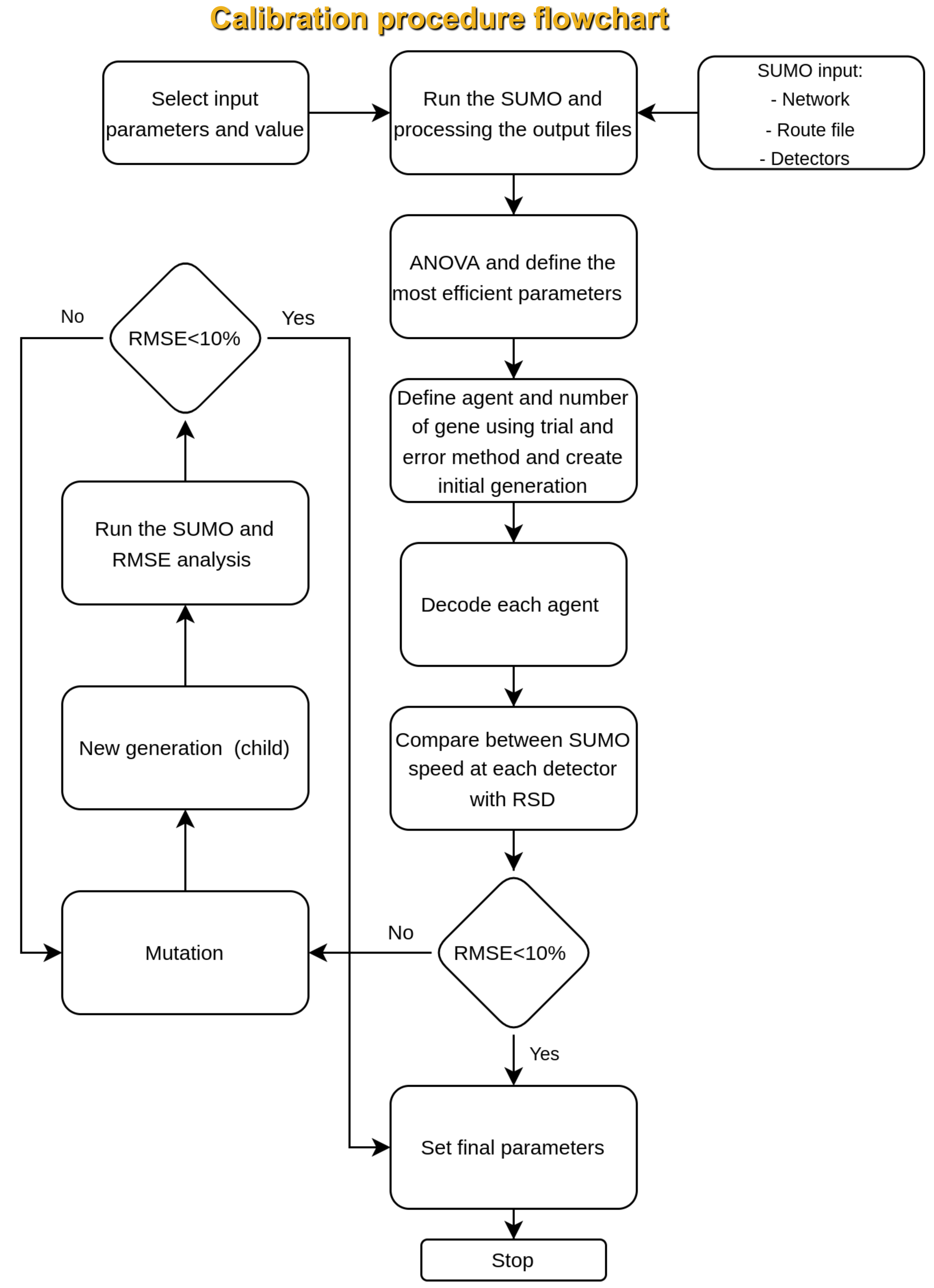
Set of parameters for microscopic simulation

MinGap	1.5	2	2.5						
Tau	1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9
Sigma	0 ~ 0.2	0.2 ~ 0.4	0.4 ~ 0.6	0.6 ~ 0.8	0.8 ~ 1.00	0.2 ~ 0.8	0.2 ~ 0.9	2 ~ 1.00	0.2 ~ 0.11
Speed Deviation	0.1	0.11	0.12	0.13	0.14	0.15	0.16	0.17	0.18
acceleration	3	3.2	3.5						
deceleration	5	5.5							
lcCooperative	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9

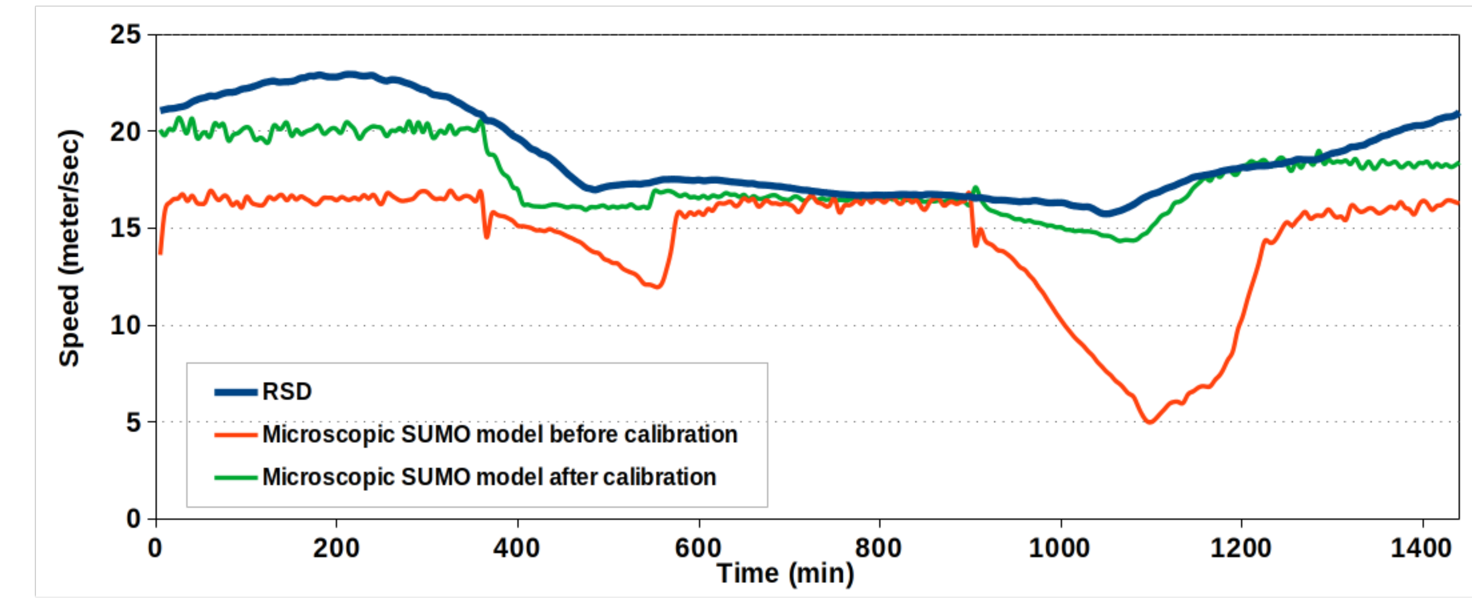
Set of parameters for mesoscopic simulation

Speed Deviation	0.1	0.11	0.12	0.13	0.14	0.15	0.16	0.17	0.18	0.19
Tls-penalty	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.00

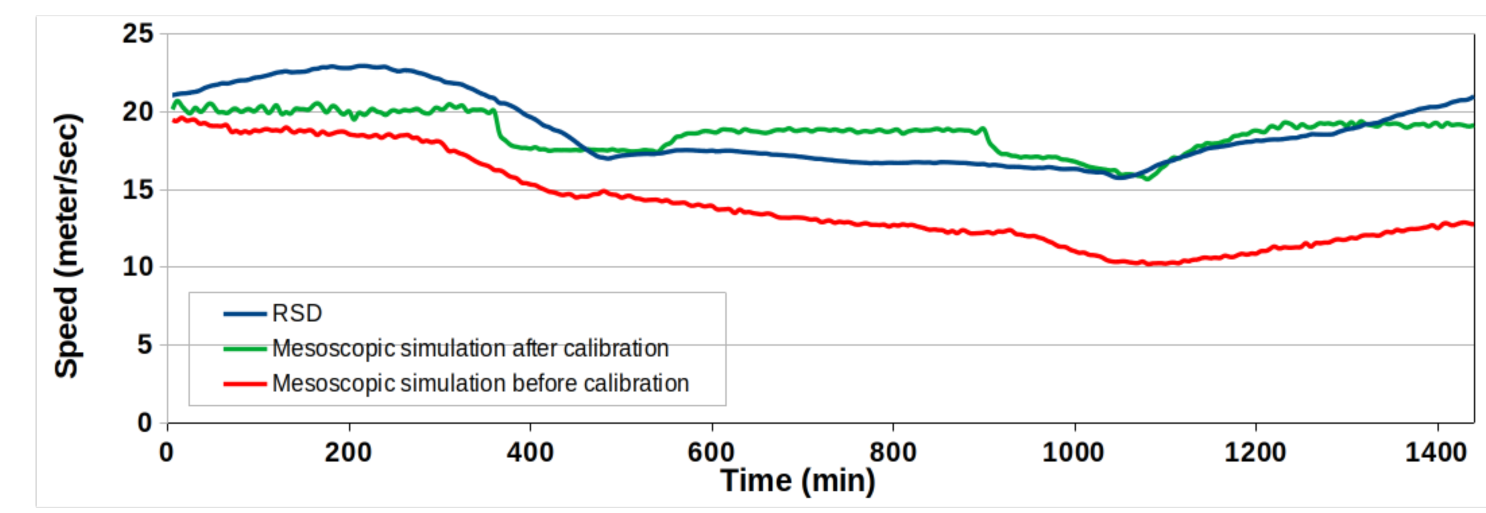
Calibration procedure flowchart



Results



Comparison of speeds obtained from microscopic SUMO before and after calibration vs RSD



Comparison of speeds obtained from mesoscopic SUMO before and after calibration vs RSD

Conclusions

We generated a microscopic and mesoscopic simulation models of the greater Chattanooga region in SUMO by leveraging its tools for developing and evaluating large-scale traffic scenarios. In our calibration approach, we applied ANOVA test method for performing a sensitivity analysis on model parameters in affecting the simulation model outputs, designed a novel modified genetic algorithm for optimal value selection of chosen parameters, utilized RMSE analysis to compare the average speed resulting from the microscopic and mesoscopic simulation with the reference real-world speed data derived from the INRIX dataset.

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