



Committee on Traffic Flow Theory and Characteristics (ACP50)

# TFTC General Webinar Series : 2023

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## Bayesian Calibration of the Intelligent Driver Model

**Feb 17th (Fri) @ 11 AM EST**

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### Abstract

Modeling car-following behavior is critical to understanding traffic flow dynamics and developing high-fidelity microscopic simulation models. For computational efficiency and interpretability, most existing impulse-response car-following models pursue a parsimonious nonlinear function that only takes the immediately preceding state observations. However, the parsimonious structure overlooks historical information, having a limited capacity to explain and reproduce real-world driving data. In other words, when calibrating car-following models with real-world trajectory data, it becomes inevitable that we observe serially correlated residuals. As a result, these simple car-following models often fail to characterize complex and stochastic phenomena. This talk will introduce a Bayesian calibration approach, which leverages the Bayesian inference and time-series modeling techniques to calibrate an unbiased car-following model while extracting the serial correlations of the residuals. Calibration with this approach is statistically more rigorous than employing a simple independent error assumption. This calibration approach is applied to the intelligent driver model (IDM) and tested using high-resolution highway trajectory data. Experiments demonstrate that the proposed calibration approach can identify the unbiased IDM parameters while estimating the noise level of unrelated errors by decoupling the serial correlation of residuals. Furthermore, a stochastic simulation method is developed based on the generative processes of the calibration approach, which can obtain unbiased posterior motion states and generate anthropomorphic driving behaviors. Overall, this framework inherits the parsimonious feature of traditional car-following models and provides better probabilistic simulations.

### Biography

Chengyuan Zhang is a Ph.D. student in the Department of Civil Engineering at McGill University. He is also a visiting researcher at the Robotics Institute, Carnegie Mellon University. His research interests are Bayesian learning, macro/micro driving behavior analysis, and multi-agent interaction modeling in intelligent transportation systems. <https://chengyuan-zhang.github.io/>