



Committee on Traffic Flow Theory and Characteristics (ACP50)

TFTC General Webinar Series : 2023

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Joint freeway traffic state and queue profile estimation using heterogeneous data sources :

Differentiable programming reformulation on a layered computational graph

Feb 3rd (Fri) @ 11 AM EST

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Abstract

This talk presents an integrated framework for joint traffic state and queue profile estimation (JSQE) on freeway corridors using heterogeneous data sources. The integrated modeling framework helps to fully utilize information from different components and take advantage of joint estimation spaces. On the other hand, potential inconsistencies between different modeling components should be recognized and carefully handled to ensure model feasibility. To minimize such inconsistencies, a nonlinear programming model is developed to formulate the JSQE problem by considering traffic flow models and observations from both corridor and local segment levels. At the corridor level, we use a fluid queue approximation to model queuing dynamics. Based on the assumption of polynomial arrival and departure rates, critical system variables such as time-dependent delay, travel time, and queue length are analytically derived. To maintain the differentiability of traffic state variables, we introduce continuous space-time distribution functions to model traffic flow variables and partial differential equations. A computational graph is constructed to represent the nonlinear programming model in a layered structure, which is then solved using a forward-backward method. Extensive numerical experiments based on real-world and hypothetical datasets were designed to demonstrate the effectiveness of the proposed framework.

Biography

Jiawei Lu is Postdoctoral Scholar at the School of Sustainable Engineering and the Built Environment, Arizona State University. His research interests include traffic simulation, combinatorial optimization, and the adoption of machine techniques in solving real-life transportation problems. He is leading some open-source projects, including `osm2gmns`, a Python library for creating multimodal transportation networks from OpenStreetMap.