RESEARCH NOTES

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Caltrans

Real-Time Traffic Information Estimation Through On-line Simulation and Hybrid Data Fusion

Why We Pursued This Research

Task Order (TO) 4143 research project was undertaken to focus on the use of microscopic simulation, i.e. PARAMICS as a tool for on-line simulation and data fusion studies under a traffic system with various Intelligent Transportation System (ITS) components. This project only focuses on studies related to the on-line simulation and data fusion for a better section travel time estimation based on point detector data and probe vehicle data.

What was done?

- Developed the capability-enhanced PARAMICS simulation environment through API programming.
- Proposed a general approach to calibrate and validate microscopic simulation models and provided an example calibration study under PARAMICS environment.
- Enhanced the capabilities of PARAMICS in order to make it fit to the needs of on-line simulation.
- Developed data fusion algorithm that can provide a better estimation of section travel time.

What can be concluded from the Research?

- API can be used to access the core models of a micro-simulator and potentially, researchers can use commercial micro-simulators as a shell for testing their own models and algorithms.
- Provide a general scheme of model calibration and validation for network-level simulation, responding to the extended use of microscopic simulation models.
- To enhance the capabilities of the PARAMICS simulation model through API programming for the on-line simulation application.
- The proposed fusion algorithm is established based on traditional flow theory and Kalman filtering theory. It fuses the single loop detector data (i.e. traffic count data only) with probe vehicle data (i.e. sample section travel time data) appropriately in order to obtain a more accurate section travel time estimate. The proposed fusion algorithm was evaluated through the comparison with other algorithms, including the probe-based method, the density-based method, and the double-loop speed based method, under both recurrent and incident scenarios. The fusion algorithm performed much better.

What do the Researchers recommend?

- This project established an on-line simulation framework that can apply microscopic simulation to on-line applications. Based on the framework, a prototype on-line simulation system was implemented using some simple traffic flow prediction and OD estimation methods. In order to implement the on-line simulation scheme for real-world applications, more research on traffic flow prediction and OD estimation algorithms are warranted since the current methods are not accurate enough.
- Due to the advancements in probe vehicle technologies, such as Global Positioning Systems (GPS), Automated Vehicle Identification (AVI), cellular phone positioning, and wireless networking, probe vehicle will potentially become an alternative or complementary data source of the currently dominant point detection

systems. As a result, the proposed data fusion algorithm fusing both probe vehicle data and loop detector data has its potential to be implemented in the real world. The research on the use of travel time data from probe vehicles for both ATIS and ATMS applications deserves more investigation.

Implementation strategies

- The Paramics plug-ins developed in this research have been used by various Caltrans districts, several consulting companies (Cambridge Systematic and Dowling Associates), and UC researchers at Berkeley, Irvine and Davis. Since the current plug-ins are developed for the research purpose, extra development for the user-friendly graphical user interfaces may be helpful for Caltrans engineers.
- The data fusion algorithm that fuses data from probe vehicles and the loop detector system can be potentially applied to the travel time estimation in the Bay Area because of the availability of probe vehicle data (Metropolitan Transportation Commission (MTC) collects travel time data from vehicles equipping with the FasTrak transceiver).

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