Fernando García Fernández and Zhixiong Li, Editors

EDITOR'S NOTE

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Adaptive Signal Control and Coordination in Connected Vehicle Environment

Jiangchen Li

Abstract

Although various connected vehicle (CV)-based signal control systems have been investigated in the past few years, these approaches still have issues to overcome. These issues include suboptimal results in low market penetration conditions, underperformance in both undersaturated and saturated traffic conditions, a lack of consideration for rapidly changing demand uncertainties, and expensive complex signal control systems architecture. With this in mind, this thesis contributes to current research from three essential perspectives, including data, traffic model, and control strategy. More specifically, the contributions can be defined in the following ways. First, the issue of data quality is addressed with a proposed enhanced dynamic segmentation approach for the low penetration rate to obtain accurate traffic data. Second, the traffic model is addressed by proposing a virtual cycle-based store and forward model in addition to a dynamic parametric dispersion model for intersection and corridor level modeling, respectively. Third, the control strategy is addressed by proposing a model predictive control (MPC)-based framework for adaptive signal control and coordination, as well as a stability method, for a considerable scalable capability and good performance; finally, CV-centric in-the-loop testing prototypes for adaptive signal control and coordination are implemented.

Both field and simulation results from implemented CV-centric in-the-loop testing then validate the efficiency of these proposed methods in the CV environment, in which the proposed methods have shorter travel times for different approaches, different demands, and different penetration rates than typical existing conventional signal control methods. Besides, simulation results of the proposed stable method indicate that high-frequency communication helps the MPC controller be more efficient with a faster convergence speed.

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Visual Analytics of AIS Data and the Application in Bridge Area

Jinyu Lei

Abstract

An automatic identification system (AIS) is the main support for ship safety prevention and the main carrier for ship behavior data acquisition in the bridge area. The increase in AIS data volume and complexity sometimes troubles the decision making of supervisors rather than bringing more insights. Recently, the AIS data analysis issues in the bridge area have been effectively solved by data mining, ship domain, and other theoretical models. Despite their positive impacts on ship safety prevention,

existing approaches neglect the visual thinking and reasoning ability of the human brain. This thesis presents several visual analysis approaches to explore AIS data and ship behavior in bridge waters. First, a visual analysis system was developed to analyze AIS data quality problems. In the system, a novel visualization model of AIS dirty data was proposed to analyze the AIS base station. Second, visual analysis approaches for ship behavior discovering based on AIS data was proposed. Based on the improved space–time cube model, researching anomaly ship identification, ship berth identification, and cornering behavior are carried out. Third, through the visualization of AIS historical data, navigation collision risk can be visible, and the distribution characteristics of the navigation collision risk can be effectively revealed.

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Quantitative Intelligence Test and Evaluation for Automated Vehicle

Kangwei Mou

Abstract

Rapid development of autonomous driving has raised serious safety issues that require accurate comprehensive intelligent quantitative evaluation for autonomous vehicles. This thesis builds a virtual simulation scene based on the simulation software SCANeR in the test field of Tsinghua University Suzhou Automobile Science and Technology Park and analyzes the trajectory information of autonomous vehicles in combination with automatic driving data twin test technology. The main content includes: 1) the Lyapunov index is obtained according to the phase space reconstruction of the time series of the trajectory deviation data of the autonomous vehicles—the chaotic nature of the vehicle trajectory and the use of the Lyapunov index can make the expert experience judgment result more objective; 2) subjective and objective weights are combined in the comprehensive test evaluation system of the intelligence level for the autonomous vehicles, where the order-relation analysis method is used to determine the subjective weights while the entropy is used for the objective weight; and 3) the fuzzy comprehensive evaluation method is proposed to comprehensively and quantitatively evaluate the intelligence level of the autonomous vehicles.

The proposed evaluation system was verified through a comprehensive quantitative analysis on the field performance of the participating vehicle "Tsinghua Suzhou Lions" by the Suzhou Automobile Research Institute of Tsinghua University, and the analysis results demonstrate that the intelligence level of the tested vehicle can be effectively evaluated.

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