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EDITOR'S NOTE

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Intelligent Platoon Operating Environment Driving Behavior Cognition and Collaborative Control Optimization Method

Junjie Chen

Abstract

This thesis focuses on the optimization method of the platoon operation control strategy based on the operation features of the intelligent platoon by establishing a cognitive model that can obtain the driver's continuity, sporadic, and stressful driving behavior characteristics and optimize the platoon formation mode in scenarios such as road segments and signalized intersections.

A platoon vehicle separation approach with unsupervised learning is proposed to learn the driving patterns of human-driven vehicles at intersections with safety, efficiency, and energy consumption requirements to select the optimized separation strategy. Bayesian nonparametric learning was employed to segment the drivers' raw data into driving primitives and select the separated vehicle by considering safety, efficiency, and energy consumption. The problem that vehicles have to cross an intersection at the next green light or separate from the platoon because of limited green light duration was solved.

A multivehicle motion pattern acquisition algorithm is proposed based on the Dirichlet process–mixed Gaussian process. By considering the multivehicle motion pattern around the platoon as the mixed Gaussian process and considering the Dirichlet process as the prior distribution of Gaussian mixture weights, this method establishes the multivehicle motion pattern velocity field around the platoon. By comparing the operation efficiency of vehicles in different multivehicle motion pattern, the platoon's perception of the driving environment could be realized. The problem of how to select the optimal parameters for the macroscopic traffic flow from the optimal microscopic traffic behavior is solved.

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Active Control Method for Mixed Traffic Flow on Highways and Urban Roads by Leveraging the Controllability of Connected and Autonomous Vehicles

Xia Wu

Abstract

Mixed traffic flows composed of connected and autonomous vehicles (CAVs) and human-driven vehicles (HDVs) will become an inevitable trend during the process of the development of technologies for autonomous driving and the vehicle–infrastructure cooperative system. Controlling CAVs can physically affect the surrounding traffic status, thus changing the situation of the traditional control methods for traffic flows that rely heavily on the compliance rates of human drivers and a lack of precise control. In this way, the deficiency of low traffic control efficiency caused by the stochastic nature and uncertainty of human drivers' behaviors can be avoided. Traffic problems, such as the capacity drop phenomenon and low discharge rates near bottlenecks or congestion areas, can be addressed, and traffic efficiency and capacity can be effectively improved. Thus, a trajectory optimization method under low or medium

Digital Object Identifier 10.1109/MITS.2021.3124593
Date of current version: 12 January 2022

penetration rates of CAVs at urban multiple-signal intersections is proposed.

Aiming at the traffic scene of multiple vehicles passing through signalized intersections, considering the traffic efficiency of the intersections, two kinds of trajectory optimization methods from the view of centralized control and decentralized control are proposed, respectively. The centralized control method cooperatively considers the fuel consumption of multiple vehicles to construct a trajectory cooperative optimization model under different queue modes. Simulation results verify that the proposed trajectory cooperative optimization model can improve fuel economy. The decentralized control method takes differences in the driving behaviors between HDVs and CAVs into account and analyzes the influence of queues at intersections on trajectory optimization, and then a trajectory optimization model that considers traffic efficiency is constructed. Some simulations are conducted to verify the effectiveness of the proposed method by comparing fuel consumption, delays, and the number of passing vehicles with different penetration rates of CAVs under two kinds of traffic scenarios with/without queues at intersections. The results show that the proposed method can effectively improve fuel economy, reduce delays, and increase traffic mobility.

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Control Methodology of Reducing Congestion at the Freeway Merging Area Under the Environment of Intelligent Connected Vehicles

Yao Xiao

Abstract

The definition of intelligent connected vehicles and its connection with related concepts, such as intelligent transportation and the Internet of Vehicles, are clarified. Intelligent connected vehicle technology is summarized, including three fields: vehicles, information interaction, and basic support. The development status and future development trends and challenges of intelligent connected vehicles at home and abroad are analyzed, the principles of the three-stage division method are put forward, and the development stages are divided into three sections, including the nonconnected environment, the primary connected environment, and the advanced connected environment. The strategy of reducing congestion in the merging area under the condition of primary connected vehicles is proposed. The traffic flow environment is analyzed, and the necessary and sufficient conditions for traffic congestion on freeways are deduced.

The adaptability of jam absorption driving in the merging area is analyzed, and three start-up discrimination conditions for the strategy are proposed. The calculation methods of key parameters, such as the speed reduction value, and the location where the strategy should begin is proposed. A complete jam absorption driving strategy for the merging areas of freeways is formed. Simulation of Urban Mobility software is used to verify the effect of the strategy. The simulation results show that the strategy can be used to reduce congestion in the merging area of freeways in a primary connected environment, and the effect of the strategy is obvious.

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