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Multivariate Traffic Uncertainty Prediction with a Hybrid Kalman Filter Based Deep Neural Network

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Abstract

Deriving statistical description of uncertainties associated with prediction of traffic states is essential to the development of reliability-based intelligent transportation systems. This paper presents a hybrid model-based and data-driven approach for predicting evolution of both traffic states and the associated variability. The proposed framework ensures the interpretability and stability of the predictions with an underlying recursive regression model, and captures sophisticated dynamics of traffic variability via a data-driven recurrent neural network component. The framework is trained with a multivariate Gaussian negative log-likelihood loss function for quantifying both aleatoric and epistemic errors. It is implemented and tested with actual traffic data collected from a Hong Kong Strategic Route. The case study shows that the proposed prediction framework can simultaneously retain the interpretability of the results while capture the complex dynamics of the evolution of traffic variability with the recurrent neural network component. This study contributes to the development of reliability-based intelligent transportation systems through the use of advanced statistical modelling and deep learning methods.

About the Speaker

Xinyue Wu received the B.S. degree in traffic management from Dalian Maritime University, Dalian, China, in 2017, and the M.S. degree in transport from Imperial College London and University College London, U.K., in 2018. She is currently pursuing her Ph.D. degree at the Department of Systems Engineering, City University of Hong Kong. Her research interests include data fusion and analytics, deep learning, and their applications in intelligent transportation systems.

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