Deep Neural Network Approaches for Traffic Forecasting Trends and Issues

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Abstract:

Proper forecasting of vehicular flow is a foundation of a contemporary intelligent transportation system, city administration, and the ecosystem of mobility services in general. In the current paper, we provide a thorough review and present methodology innovation in deep neural network (DNN) algorithms to both short-term and long-term traffic predictions. Specific focus is on the topics of spatio-temporal modelling, graph-based learning, attention mechanisms, as well as multimodal data stream fusion. We distinguish conspicuous disadvantages in the existing methods, such as the inflexibility of their graph models, the inefficiency of their uncertainty quantification, poor inter-city generalizability, and the daunting computational expense of most existing models, and suggest an emergent hybrid framework. This model trains a dynamic topology of the graph obtained directly throughout the data and combines in a continuous manner traffic sensor indications, meteorological conditions, calendar, and contextual embeddings, and provides optimistic forecasts of the same based on Bayesian and ensemble forecasting models. The higher accuracy, calibration of the uncertainties and practical advantages of edge-deployable systems proved by extensive validation on standard benchmarks and different datasets of Indian urban centres are creating new state of the art scalable and reliable traffic prediction.

Keywords:

Attention mechanisms, Graph neural networks, Multimodal fusion, Probabilistic forecasting, Spatio-temporal modeling, Traffic forecasting.