Study on Traffic Multi-Source Data Fusion

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ABSTRACT
In order to alleviate urban traffic congestion, it is necessary to obtain roadway network traffic flow parameters to estimate the traffic conditions. Single-detector data may not be sufficient to obtain a comprehensive, effective, accurate and high-quality traffic flow data. Neural networks and regression analysis data fusion methods are employed to expand data sources as well as for improving data quality. The multi-source detector data can provide fundamental support for traffic management. An empirical analysis was conducted using acquisition technology employed by the Beijing urban expressway to estimate traffic flow parameters. The results show that the proposed data fusion method is feasible and provides reliable data sources.

KEYWORDS
Data Fusion, Multi-Source Data, Neural Networks, Regression Analysis

1. INTRODUCTION
With the increase in car ownership, urban traffic congestions are also critically increasing (Bu et al., 2010). Traffic status can reflect the intersection of cities. Traffic flow speed is the best indicator of traffic flow characteristics and, favorably, this is a traffic flow parameter that is easier to obtain.

Obtaining traffic flow speed can as well reflect the traffic status, thus providing a reliable parameter data for traffic managers. After the data fusion, the multi-source traffic information can be a more reliable traffic information (Foschini et al., 2011), which provides strong support for traffic operation and management. In order to better serve the traffic management, control and guidance, it is necessary for the multi detector to recognize traffic flow speed. Liu and Zhang (2016) proposed an improved K-Nearest Neighbor model, named I-KNN, in a general MapReduce framework of distributed modeling on a Hadoop platform, to enhance the accuracy and efficiency of short-term traffic flow forecasting. Practically, the different methods often give the contradictory outcome. It is difficult to remark the credibility of the traffic data detected by the different methods individually. To solve the issue, the multi-source data fusion algorithm was researched widely.

Dong, Zhou and Chen (2011) reported that the traffic detecting result is always short of accuracy by different kinds of individual sensors in urban China. To solve the issue, a new data fusion approach is raised. The algorithm combines fuzzy and rough set theory based on evidence theory. Ren, Peng, Wu and Zhou (2014) take the Dynamic Traffic Routing System of Nanning City of China as example.
multi-resource heterogeneous data fusion model is proposed. The fusion results provide comprehensive traffic information for Dynamic Traffic Routing System and Traveler. In Chris et al. (2013), seven multi-sensor data fusion-based estimation techniques are investigated. All methods are implemented and compared in terms of their ability to fuse data from loop detectors and probe vehicles to accurately estimate freeway traffic speed. Unfortunately, these kinds of algorithm show poor capacity to figure out the conflict among the traffic flow data to be fused.

From the evidence found in the literature, it is reasonable to consider that the application of control and multi-detectors will lead to positive results on traffic flow detection. By using information fusion technology, the traffic flow velocity data collected by multi-source detectors can be exploited. As a result, more abundant and high-quality traffic information is obtained, so as to improve the mobility, safety and organization of traffic.

The processing object of data fusion is the speed of data from different sources, and the core of data fusion is to coordinate data optimization and comprehensive treatment. Within the scenario of an intelligent transportation system, it is necessary to carry on traffic flow speed acquisition integration in order to fully exploit the advantages of data fusion. Data fusion technology can get more accurate traffic information through comprehensive processing of traffic data from different sources.

In this work, we focus on the Beijing city traffic scenario. At the center of the city, within the scope of the road network, the city fast network system operates without traffic lights. In the city of Beijing, Expressway Development in city traffic plays an important function. Moreover, the quality of its operation directly affects the overall road network in the city. The supply capacity of the expressway is a freeway traffic flow whose characteristics are reflected whether in traffic planning or in the control of the daily traffic management. If correctly analyzed and identified the traffic flow characteristics of the expressway, these will determine the running state of the city traffic network.

2. THE DATA FUSION MODEL

2.1. B-P Model

The B-P algorithm presents multiple advantages, among which: the research theory is mature, it has the rigorous derivation process, the fault-tolerant ability is strong, it is versatile, and at the current time, it is the main algorithm of the forward network learning.

Du, Jiao and Wang (2014) first reviewed the evolution process of the traffic signal control system and analyzed characteristics of real-time traffic counts at intersections. Then a back-propagation neural network (BPN) model was proposed to estimate and forecast the dynamic turning movements, and an algorithm was designed to solve the model. Du, Jiao and Wang (2014) use B-P neural network to do data fusion, to get more realistic traffic flow speed information, to provide a basis for traffic management, control, and induction measures. Nevertheless, the B-P algorithm presents some disadvantages as well: 1) the learning efficiency is low, the training time is long, the convergence speed is slow, and the increase of the sample dimension will make the network performance worse. 2) The greedy algorithm is especially easy to form local minimum, which make it possible for the algorithm to not identify the global optimum. 3) The selection of hidden nodes in the network lacks theoretical support. 4) In the course of training, learning the new samples will forget the trend of the previous samples (Gao et al., 2011; Kaygisiz et al., 2016).

In the application of B-P model to solve practical problems, better data normalization method can be used to avoid non-convergence or slow convergence, which to a large extent improve the performance of the network.

2.2. The Method of Speed Fusion Based on Linear Regression

Regression analysis is a statistical analysis method that determines the degree of influence or interdependence between the changes of one or more variables to another specific variable. In this
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