Research on Machine Identification and Feature Extraction Technology for Traffic Congestion in the City

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Abstract: With the continuous development of urban intelligence, science and technology continue to deepen, car ownership continues to increase, and urban road traffic congestion continues to increase. In order to effectively solve the current traffic congestion problem in the city, it is necessary to analyze the urban working conditions such as traffic congestion in the massive traffic flow information data, traffic, speed, occupancy rate, etc., relying on machine identification technology and parameter feature extraction technology. Exploring and providing important data support for the implementation of traffic management measures and the release of traffic information is of great scientific significance for mitigating traffic congestion in the city and improving traffic management and service quality.

1. Introduction

Traffic congestion is a concrete manifestation of urban traffic conditions. More suiTable for the actual driving conditions of the city, it can well reflect the current state of the city, a traffic state. As far as the overall traffic state of the city is concerned, the key factor is the driving condition of the vehicle, that is, the driving state of the vehicle on the road. However, in terms of vehicle road driving conditions, China's related research started late, but it is concentrated, mainly in universities and research institutes [1]. At present, China's urban transportation structure is complex, bicycles, motor vehicles, and pedestrians often mix, increasing the energy consumption of urban road transportation systems, which has a negative impact on the urban environment. Therefore, it is necessary to develop a research on machine identification and feature extraction technology for traffic congestion in cities, and based on the actual situation of urban traffic in China, develop more realistic urban traffic driving conditions to alleviate traffic congestion in the city.

2. Domestic urban traffic driving conditions discriminating steps

Under the traffic congestion situation in the city, the rational application of the driving condition discrimination technology is very important. The driving condition discriminating technique is used for identifying the actual working conditions, matching the characteristic values of the current vehicle operating conditions and comparing the pre-specified driving condition characteristic values, and then judging the driving condition of the current vehicle. The main steps for the development and implementation of the urban traffic driving condition discrimination technology are shown in Figure 1 below.

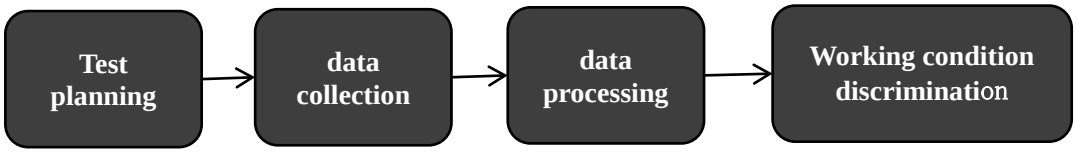

Figure 1 Routine development and implementation steps for the identification of technical conditions of urban traffic

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2.1 Test planning

For test planning, it is necessary to first determine the analysis method, route selection, etc., including data acquisition methods, test time, determination of test roads, and determination of test vehicles and drivers. Among them, the data acquisition methods can be divided into two categories. First, the test vehicles are driven according to the established route and practice. Such situations are not very good. Second, they are conducted by private random driving. The uncertain route is not provided. Any traffic information. In view of the different grades of urban roads, the traffic flow has different performances at different time periods, so the sample can be enriched and the vehicle kinematics data can be counted, but a lot of manpower and material resources are needed. At this time, the traffic flow theory can use less vehicles to achieve the purpose of acquiring vehicle kinematics data, which is scientific and reasonable and easy to operate.

2.2 Data collection

Data collection, in urban transportation, is the basic work for analyzing the driving conditions of automobiles. In the actual data collection, factors such as the number of parameters, the amount of data, and the time interval of sampling should be taken into consideration. The set parameters are not too thin, and should be moderately reasonable to make them statistically specific. In theory, the richer the data collected, the more accurate the test results will be. However, the amount of data is too large, which increases the workload and the accuracy is not large, so the number of data collection should be moderate. In the actual test of speed, speed sensors and GPS speed measurement systems are often used.

2.3 Data Processing

Based on the collected data, it is analyzed and processed. The analysis methods are diverse, including classification, short-stroke method, V-A matrix analysis method, wavelet transform method, and fuzzy neural network. After analyzing the driving conditions of the city, it is necessary to classify the urban traffic driving conditions based on the characteristics and needs of the city. Different types of driving conditions reflect different urban traffic characteristics. The combination of these characteristics results in the current driving conditions of urban traffic. In order to make the judgment more accurate, it is necessary not only to analyze the characteristic parameters of various driving conditions, but also to analyze the correlation and find out the maximum characteristic parameters that can distinguish the driving conditions.

2.4 Working condition discrimination

The method of judging the driving condition is similar to the driving condition analysis method. The main principle is to analyze the current driving state of the vehicle, match and compare the predetermined driving condition categories, and find the working condition most similar to the current working condition from the standard working condition category, thereby identifying the current driving state of the vehicle. . The discriminative methods of driving conditions mainly include neural network, principal component analysis, clustering, etc. Among them, neural network method is the most widely used, and the discriminant result is relatively accurate. The method grasps the neural network to deal with the linear inseparable problem feature. Firstly, the neural network is trained by using the classified characteristic parameter values, so that the network can make accurate judgments on the driving conditions, and then input the characteristic parameter values of the conditions to be determined, and finally obtain the The result of the judgment is the category of the condition.

3. Analysis of machine identification technology for traffic congestion in the city

Multi-sensor information fusion technology is often used for machine identification of traffic congestion in cities. The technology comprehensively processes the multi-source information collected by the sensor under certain criteria to estimate the information processing process of the required task. Because of its robustness and reliability, high detection performance, strong

credibility, and low system cost, it is widely used in target tracking and identification, data fusion and other application fields. Therefore, multi-sensor information technology is used to identify the machine and extract the characteristic parameters of the driving conditions, so as to facilitate the identification of urban traffic conditions [2].

3.1 Information Processing System for Machine Identification

There are three main methods for multi-sensor data fusion technology: first, the sensor data is directly fused; second, the data collected by the sensor is represented in the form of a feature vector, and then based on the feature vector for fusion; third, the sensor The obtained data are analyzed and processed separately, and each decision is made, and then the decision results are combined to obtain the final decision result.

In the information fusion process, if the sensor information matches each other, that is, the sensor output values are the same, then the fusion can be directly merged. Conversely, the sensor information data is extracted and the fusion is performed at the decision layer or the feature layer. Because the information acquired by the sensor is not matched in the traffic driving situation in the city, and the feature attribute is uncertain, the second fusion method is selected, as shown in FIG. 2, and the fusion is performed in the feature layer.

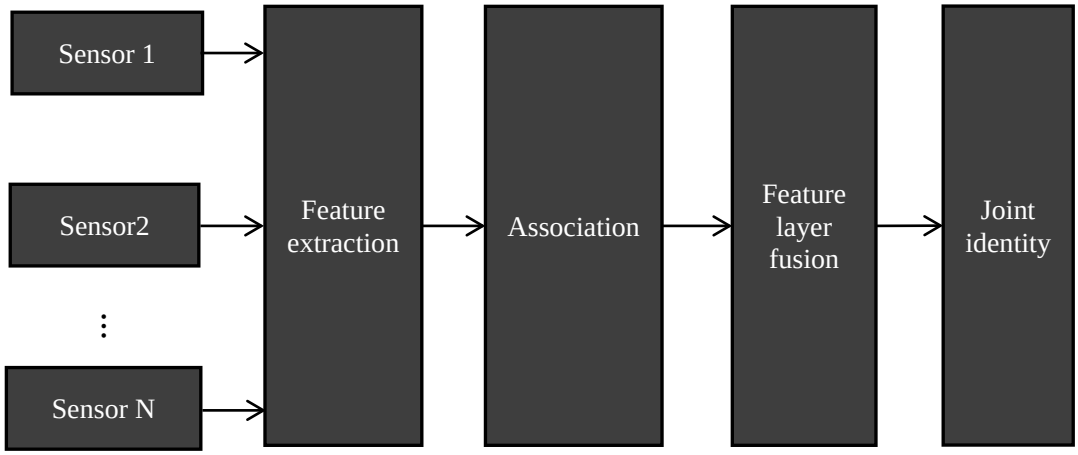

Figure 2 Multi-sensor information processing system

3.2 Information fusion method for machine identification

There are many methods for multi-sensor information fusion, including weight coefficient method, Kalman filter method, neural network method, etc. However, considering the complexity of information data fusion in urban traffic congestion conditions, the neural network method is selected for the collected Driving condition information, using SOM organization mapping, BP neural network method to determine the driving conditions. The neural network uses mathematical models to simulate human brain thinking and process information data. It can effectively deal with and solve complex data fusion and nonlinear problems. The neural network has strong comprehensive processing capability, fault tolerance and robustness, and is widely used in information fusion technology.

3.3 Machine identification characteristic parameters

In the actual urban traffic driving conditions, the driving conditions of the vehicle are complex, the uncertainty and randomness are strong, and the characteristic parameters of the working conditions are also expressed. The driving condition of the car is reflected by the speed curve. Most of the parameters are related to speed and acceleration, and the similarity is high. In order to simplify the calculation, it is not necessary to take all the characteristic parameters into consideration during the development and discrimination of urban traffic driving conditions. By analyzing the characteristics of the preset sensors, some representative characteristic parameters are selected: average running speed V_{mr} , average negative acceleration a_{e-} , average positive

acceleration a_{e+} , acceleration variance f_a , speed variance f_v , deceleration time ratio p_{a-} , acceleration time ratio p_{a+} , idle time Proportion p_i , minimum acceleration $a_{\min}$, maximum acceleration $a_{\max}$, maximum travel speed $V_{\max}$, accelerator pedal opening $\overline{O}$, average gear position $\overline{T}$.

4. Analysis of feature extraction techniques for traffic congestion in the city

4.1 Distinguishing characteristic parameters of driving conditions

In order to discriminate the urban traffic conditions, it is necessary to find such characteristic parameters to distinguish the various working conditions. The main methods are parametric test and nonparametric test analysis, which are used for the known and unknown case distribution of the sample [3]. Because the overall sample condition of urban road traffic is complicated and unknown, the non-parametric test analysis method-Kruskal-Wallis one-way ANOVA is selected to analyze the characteristic parameters of driving conditions and find out the characteristic parameters that can distinguish driving conditions. In the single factor analysis, the characteristic parameters with significant differences are found out. The larger the difference, the more obvious the discrimination of each working condition, and the better the discrimination. After analysis, the degree of distinguishing feature parameters is sorted from big to smal: V_{mr} , p_i , $V_{\max}$, $\overline{O}$, $\overline{T}$, f_v , $a_{\max}$, $a_{\min}$, f_a , a_{e+} , a_{e-} , p_{a+} , p_{a-} .

4.2 Characteristic parameter correlation of driving conditions

Correlation analysis is to analyze the characteristics of two or more characteristic parameters to evaluate the closeness of the characteristic parameters. To correlate the feature parameters, it is necessary to find the correlation between the feature parameters. According to the analysis of the characteristic parameters of the driving conditions, the characteristic parameters of the driving conditions are defined based on the characteristic speed and acceleration, and the correlation is very strong. Correlation analysis removes data redundancy and improves the discrimination efficiency of working conditions. In the Kruskal-Wallis one-way ANOVA analysis, four basic driving conditions were selected as the analysis parameters, and the 0.8 limit commonly used at home and abroad was used as a reference to make a correlation judgment. It was concluded that: V_{mr} , p_i , $V_{\max}$, $\overline{O}$, $\overline{T}$, f_v , $a_{\max}$, $a_{\min}$, f_a , a_{e+} , a_{e-} , p_{a+} , p_{a-} , Strong correlation. Taking this as a reference, V_{mr} , $\overline{O}$, $\overline{T}$, a_{e+} four variables can be selected as the input of the characteristic parameters to discriminate the urban traffic congestion driving workers.

5. Conclusion

The problem of traffic congestion in the city can not be underestimated. The research on its machine identification and feature extraction technology can quickly identify and respond to urban traffic conditions, so that it can be timely adjusted and reduced. Its internal consumption of the urban transportation system, thus achieving environmental protection purposes.

Acknowledgement

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