Application of Big Data in Management Information System

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Abstract. With the rapid development of social economy and the acceleration of urbanization in China, the scale of urban road network is expanding day by day, and the total mileage of all levels of roads is growing rapidly. As the road with the highest level of technology and service in the urban road network, urban expressway plays the role of the skeleton road network in the urban road system, bearing the traffic demand of high flow and high speed. Once a traffic incident occurs, it is easy to produce traffic congestion. If it is not handled in time, it will also cause secondary accidents, which will have a serious impact on the operation of the whole urban expressway network. In this paper, an algorithm design based on Intelligent Transportation nonlinear dynamic control and automatic accident detection algorithm is proposed to improve the coverage and uncertainty of expressway incident detection.

Keywords: Intelligent transportation · Nonlinear dynamic control · Automatic accident detection

1 Introduction

The anomaly detection method of ad system is to judge whether there are abnormal events by the algorithm according to the collected data information. The performance of automatic traffic incident detection algorithm is the core of traffic incident management system and one of the important evaluation indexes for the successful operation of intelligent transportation system. Common traffic j anomaly detection algorithms include state recognition algorithm, statistical prediction algorithm, catastrophe theory algorithm and high-level event detection technology, It depends on the preset threshold of relevant key parameters, and identifies the abnormal changes of traffic state through the abnormal mutation of key parameters beyond the threshold, so as to finally find the traffic accidents. For example, California algorithm gives an alarm when the three eigenvalues calculated by the upstream and downstream occupancy exceed the threshold at the same time. As a parameter statistical prediction algorithm for comparing and evaluating the new model, California model generally makes a short-term prediction of the future traffic conditions according to the historical data, and then compares the real-time collected data with the predicted value. If there are large changes between the two, it is considered that there

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is an accident. The characterization of traffic parameters to traffic state depends on the speed flow (or occupancy flow) relationship diagram. Such as McMaster algorithm. This paper consists of the following parts. The first part introduces the relevant background and significance of this paper, the second part is the related work of this paper, and the third part is data analysis. The fourth part is example analysis. The fifth part is conclusions.

2 Related Work

The article is devoted to the description of the developed software system of risk management [1]. The subject of Ref [2] was to determine how much the application of the industrial revolution 4.0 management information system influenced innovation. Tarigan et al. examine the impact of information system management implementation on the company performance with the mediating role of process innovation and process innovation [3]. Muslih et al. discuss the effectiveness of marriage services through Marriage Management Information System (SIMKAH) at Palu city religious court [4]. The process of supply chain management information system and the key technology of block chain are analysed, and the collaborative mechanism of supply chain management information system from the perspective of block chain is proposed, including the process and consensus collaborative management mechanism, which optimizes the transaction process management and block chain system consensus, accounting and so on [5]. Maqsudov et al. present the general results obtained during the automation of document management (workflow of documents) in university based on a management information system of Khujand Polytechnic institute of Tajik technical university (KPITTU) [6]. In order to solve the problems of low efficiency of management information systems and low utilization rate of the information resources, Hu et al. propose the designs of an exhibition management information system by using a B/S structure (Browser/Server mode) [7]. The personnel management information system designed and implemented integrates the functions of batch import of information, instant update of personnel information, position transfer, information inquiry and statistical analysis [8]. Other influential work includes [9, 10].

The algorithm mainly includes time series method, standard normal deviation method, double exponential smoothing method, filtering model method and Bayesian catastrophe theory algorithm. It is based on the sudden change of the traffic state represented by the traffic parameters when the traffic accident occurs. At the same time, the accident is finally confirmed by comparing the different traffic States of adjacent sections of the road at the same time.

2.1 Analysis of Big Data Characteristics in Enterprises

(1) Object of enterprise big data analysis

According to the analysis of business activities within the enterprise, the big data formats managed within the enterprise generally include structured data and unstructured data. Structured data generally refers to the data with unified format, fixed fields and can be defined based on relational database. These data have been

well managed in their respective information systems. The other is unstructured data. This kind of data has no fixed format, or its format often changes. It can not be formatted with some fixed methods. These data are generally random and easy to be ignored by enterprises in general. Unstructured data generally has the characteristics of wide distribution, diversified formats and large amount of data, which poses a challenge to the collection, processing and storage of big data.

(2) Significance of unstructured data analysis

Although these unstructured data have no direct relationship with the daily operation and specific business of the enterprise, the analysis of these unstructured data may bring indirect value to the enterprise. For example, we can get some information that reflects the user status, operation and management status or employee behavior of the enterprise. Through this information, we can provide reference for the operation and management decision-making of the enterprise. The value of these data comes from the generation point of the data, which is the key point of the enterprise information system. For example, users access the enterprise's product information by accessing the enterprise portal website, and these access behaviors are recorded in the log file of the enterprise website. The enterprise obtains the information of the user's access behavior by analyzing the above files, so as to obtain the specific data of different product concerns. For example, if an enterprise finds that the attention level of a product suddenly decreases in a certain period, it can analyze and deal with it accordingly, such as reducing the production plan of the product, otherwise it can improve the production plan of the product. This shows that unstructured data has reference value for enterprise production and operation decision-making, but at present, most of the data are ignored or even discarded.

2.2 Overview of Linear Dynamic Control

In the local sense, a. Isidori and others consider the nonlinear regulation problem of nonlinear system under the assumption that the external system is Poisson stable, and the internal system dynamic index can stabilize the assumption of nonlinear regulation. The necessary conditions for the general local tracking of unrestricted external signals are obtained by J w. grizle, It is worth noting that local nonlinear regulation cannot track the unbounded external signals, which is essentially different from linear systems. In order to realize the tracking of unstable (unbounded) external signals, the adjustment problem in the global sense must be considered. In the global sense, the models considered by M. D. dayawansa and a. r.tee are as follows:

$$\begin{cases} x = \varphi(x, y) \\ y_1 = y_2 \\ \cdots \\ y_m = \alpha(x, y) + \beta(x, y)u \end{cases} \tag{1}$$

In recent years, topological Photonics and non Hermite optics have become the two most active emerging research fields of photonics. The concept of topology originally came from mathematics and was used to study the properties of geometric shapes that remain unchanged under continuous deformation. For example, if a doughnut is not

torn, no matter how it expands, rubs or contracts, it cannot be equivalent to a solid ball. The most famous topological invariant in topology is the "Chen number" named after Mr. Chen Shengshi of Nankai University. The development of topological photonics originated from the study of topological states in condensed matter physics. At first, the concept of topology was introduced into physical science to explain the famous quantum Hall effect. Therefore, the 2016 Nobel Prize in physics was also awarded to pioneer scientists in topological materials research.

Subsequently, the concept of topology was extended to the fields of optics, acoustics, metamaterials and cold atomic systems, which greatly promoted the development of topological physics. Especially in the field of optics. Topological photonics has gradually become an important frontier and cross field in optics and related scientific fields from the initial unidirectional transmission electromagnetic wave topological state experiment to the recent topological laser.. On the other hand, the concept of non Hermite comes from quantum mechanics. It is generally believed that non Hermite systems have no physical meaning, and the introduction of parity time Pt symmetry has changed people's traditional understanding of non Ö Mi open systems. When the concept of Pt symmetry in non Hermite quantum mechanics is introduced into the optical field, the carefully designed IPS symmetry with reciprocal loss and easy to control system continues to bring new discoveries. The development of non Hermite optics also brings new prospects for a series of application technologies, such as sensing and detection, wireless transmission energy and single-mode laser.

Due to the difficulties in experiment and theory, most studies of topological Photonics and non Hermite optics in the past were carried out by an Shengye, almost focusing on the on-line effect. However, nonlinear effects can be found everywhere in both the classical world and the quantum world. The diversity of the natural world also promotes the development of Applied Science. For example, nonlinear response is the key to the powerful function of digital electronic technology. It is the fundamental reason why artificial neural network can perform complex operations and the basis for the development of many new photonics technologies. Until recently, it has been found that there are many interesting phenomena when considering nonlinearity in optical topological systems, such as topological optical solitons, topological lasers and nonlinear topological insulators. However, the "marriage" between topology and non Hermite has just begun. For complex systems with topological and non Hermitian characteristics, the research on nonlinear effects is almost blank. Even in the field of optics, it has not found or built an adjustable nonlinear non Hermite topology photonics experimental platform.

2.3 Global Adjustment of Nonlinear Dynamic Control System

Considering that the external dynamic control system $w = r\,(w)$ is free and uncontrolled, if the solution flow of the system is $\varphi_t^r(w)$, $\Omega = \left\{\mathrm{w}|\varphi_{\mathrm{t}}^{\mathrm{r}}(\mathrm{w}_0)\text{is a limit point and w}_0 \in \mathrm{R}^{\mathrm{r}}\right\}$, then q is the invariant manifold of the external dynamic control system, and any bounded solution w (T) of the system has $w\,(t) \to \Omega\ (t \to \infty)$, so the following proposition can be obtained.

The necessary conditions for global adjustment problem to be solvable by state feedback are: existence of maps $c\ (w) \in L$ and $S\ (w) \in C'$, which makes

$$\begin{cases} \frac{\partial S(w)}{\partial w} r(w) = f\left(S(w)\right), w, c(w)) \\ h(S(w), w) = 0 \end{cases} \tag{2}$$

Due to the difficulties in experiment and theory, most studies of topological Photonics and non Hermite optics in the past were carried out by an Shengye, almost focusing on the on-line effect. However, nonlinear effects can be found everywhere in both the classical world and the quantum world. The diversity of the natural world also promotes the development of Applied Science. For example, nonlinear response is the key to the powerful function of digital electronic technology. It is the fundamental reason why artificial neural network can perform complex operations and the basis for the development of many new photonics technologies. Until recently, it has been found that there are many interesting phenomena when considering nonlinearity in optical topological systems, such as topological optical solitons, topological lasers and nonlinear topological insulators. However, the "marriage" between topology and non Hermite has just begun. For complex systems with topological and non Hermitian characteristics, the research on nonlinear effects is almost blank. Even in the field of optics, it has not found or built an adjustable nonlinear non Hermite topology photonics experimental platform.

To address this gap, researchers at Nankai University used the self-developed continuous laser direct writing technology to prepare non Hermite topological photonic lattices in nonlinear crystals for the first time, realizing the regulation of parity time and non Hermite topology. The influence of nonlinear effect and the resistance of sensitivity and robustness between outliers and singular points further reveal the nonlinear effect. The results show that the local nonlinear effect can affect and change the overall Pt symmetry of the system, resulting in the emergence and disappearance of topology and abnormal non Hermitian singularity dynamic control. This result changes people's understanding of the interaction of multiple characteristics in nonlinear complex systems, and provides a new research direction for topological Photonics and non Hermite optics.

3 Data Analysis

3.1 Data Analysis and Selection of Input Parameters

According to the data base of Chapter 3, the microwave detector data on Beijing Expressway can collect the traffic, speed, occupancy and traffic volume of a certain point on the road. Among them, the flow, speed and occupancy can be used to describe the characteristics of traffic flow. The changing law of these parameters can reflect the operation state of traffic flow. When the traffic flow is in the normal and stable state, the change of traffic parameters is relatively stable or not obvious; When traffic events occur and affect the upstream detector, the traffic parameters detected by the upstream detector change obviously, and the traffic parameters detected by the downstream detector are not obvious. Therefore, the event detection can be carried out by considering the change rate of traffic parameters with time and the change rate of upstream and downstream traffic parameters.

3.2 Bayesian Algorithm

In the method of statistical analysis, the method of discriminant analysis is used to establish a better discriminant function according to a batch of samples with clear classification, so that the cases of misjudgment are the least. Then, for a given new sample, it can be judged which population it comes from. The main methods include Fisher, Bayesian, distance and so on. Among them, Bayesian discriminant thought is to calculate the posterior probability according to the prior probability and make statistical inference based on the distribution of posterior probability. The so-called prior probability is to describe the degree of people's understanding of the object studied in advance by probability; The so-called posterior probability is the probability calculated according to the specific data, prior probability and specific discrimination rules. It is the result of the correction of prior probability. Because Bayesian discriminant method considers the loss after misjudgment, it has certain superiority. Here, Bayesian discriminant analysis method is adopted.

$$\begin{aligned} OCCRDF &= \frac{OCC(i,t) - OCC(i+1,t)}{OCC(i,t)} \\ VOLRDF &= \frac{VOL(i+1,t) - VOL(i,t)}{VOL(i,t)} \end{aligned} \tag{3}$$

3.3 Improved Algorithm Based on Multi Parameters

California algorithm is the most classic and practical algorithm based on Discriminant recognition. It has been used as a comparison algorithm of other newly developed algorithms. The only disadvantage of this algorithm is that it only uses one traffic parameter of occupancy rate, and only one parameter is easy to cause high misjudgment rate, In this study, the occupancy rate, the change rate of vehicle speed with time and the change rate of upstream and downstream are used as the judgment conditions. This paper uses the improved California algorithm based on multi parameters to judge the relative difference of the upstream and downstream occupancy rate, the relative difference of the upstream and downstream speed, the change rate of the upstream occupancy rate with time, and whether the change rate of the upstream speed with time is greater than the specified threshold to give an event alarm. The flow chart of the algorithm is shown in Fig. 1.

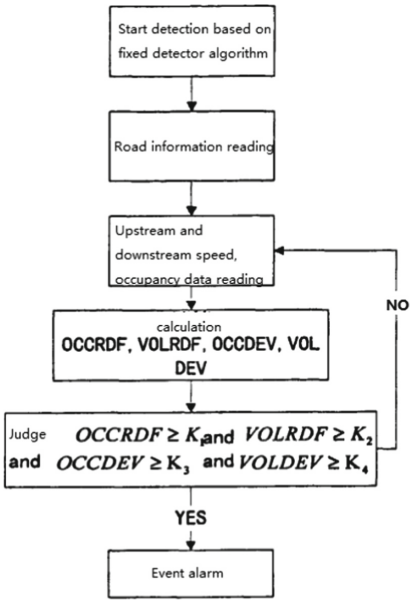

Fig. 1. Flow chart of multi parameter discrimination algorithm based on fixed detector

4 Example Analysis

4.1 Algorithm

This paper first introduces the relatively mature normal deviation method (SND). The normal deviation method uses the arithmetic mean of the traffic parameter values of the N sampling periods before the time t as the prediction value of the traffic parameter at the time t, and then uses the standard normal deviation to measure the change degree of the parameter in time. When it exceeds the corresponding threshold, the alarm will be triggered. Based on the analysis of the travel speed of expressways in the previous section, if only considering the change of traffic parameters in time dimension, it will cause false alarm in morning and evening peak, resulting in a high false alarm rate. Therefore, the space-time two-dimensional discrimination algorithm based on floating car proposed in this paper is as follows:

(1) From the time dimension, we first judge the speed value, then use the arithmetic mean of the driving speed of the N sampling periods before the time t to predict the traffic parameter value at the time t, and then use the standard normal deviation to measure the change degree of the driving speed relative to its previous average value. Algorithm is shown in Fig. 2.

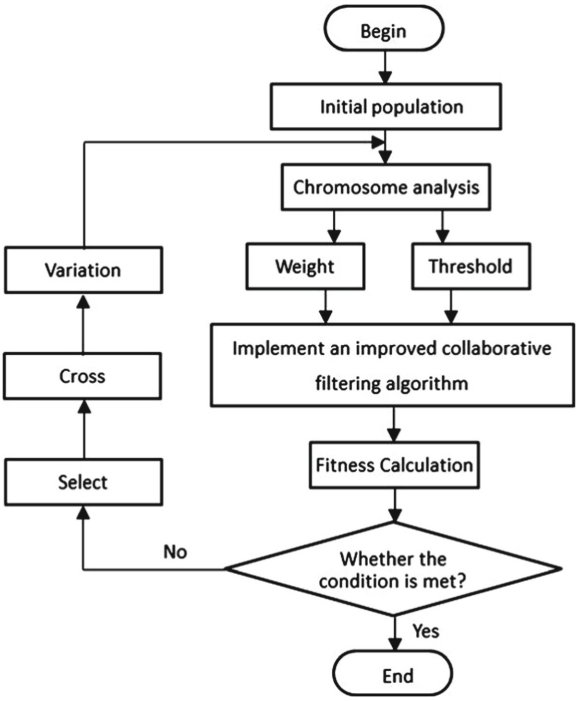

Fig. 2. Algorithm diagram

Let the actual value of the driving speed at time t be $v\ (t)$, and the actual values of the traffic parameters in the n sampling periods before time t are $v(t-n)$, $v(t-n+1)$,… $v\ (t-1)$.

$$\begin{aligned} &v(t) \le K_1 \\ &SND(t) = \tfrac{\bar{v}(t)-v(t)}{S} \ge K_2 \end{aligned} \tag{4}$$

(2) From the spatial dimension, based on the drastic change of the upstream and downstream driving speed when the event occurs, the following formula is used for discrimination;

$$VRDF(t)\frac{V(i+1,t)-V(i,t)}{V(i,t)} \ge K_3 \tag{5}$$

$$\begin{aligned} &E(t)\dot{x}_{d+1}(t) - E(t)\dot{x}_{k+1}(t) = E(t)\Delta\dot{x}_{k+1}(t) = f(t,x_d(t)) + B(t)u_d(t) - \\ &f(t,x_k(t)) - B(t)u_k(t) = f(t,x_d(t)) - f(t,x_{k+1}(t)) + B(t)\Delta u_{k+1}(t) \end{aligned} \tag{6}$$

$$\|\Delta x_{k+1}(t)\| \le \left(pk_f + m_2 + m_3\right)\int_0^t \Delta x_{k+1}(\tau)d\tau + \int_0^t (m_1\|\Delta u_k(\tau)\| + pd)d\tau \tag{7}$$

4.2 Algorithm Effectiveness Analysis

There are two methods to test and verify the event detection algorithm, one is based on simulation data, the other is based on actual data. However, under the simulation condition, the traffic condition is ideal, which is far from the real situation. Therefore, the algorithm verification based on the measured data is carried out, that is, the event detection algorithm is verified by collecting and processing the floating car detection data, fixed detector data and real event information in Beijing, and different threshold combinations are used to detect the algorithm, On the premise of ensuring a certain error rate, improve the detection rate, so as to determine the national value of the algorithm, and obtain the detection effect of the multi parameter discrimination algorithm based on fixed detector and the spatiotemporal two-dimensional discrimination algorithm based on floating car.

In 1996, through a survey of the traffic management center of the United States, abdulhai proposed that the acceptable average indicators of incident detection were Dr Z 88% and far s 1.8%. This index is also called TMC acceptable index. Here, this paper takes this as the index of the effectiveness analysis of the algorithm. If the algorithm meets this requirement, the algorithm can meet the needs of practical application (Fig. 3).

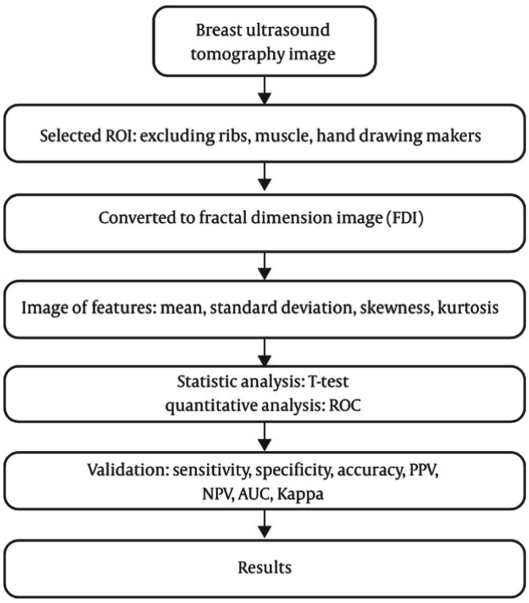

Fig. 3. Algorithm effectiveness analysis

5 Conclusions

Due to the fixed detector spacing, communication failure caused by the serious lack of data and the number of floating cars and other issues, if the simple use of a single data

source for expressway incident detection, the effect is not ideal, often resulting in long-term interruption of detection, can not smoothly carry out detection and other issues. Therefore, in this paper, the fixed detector data and floating car data are effectively combined, and a good detection algorithm is proposed respectively. Finally, the D-S theory is applied to the fusion of algorithm results, which can effectively solve the problems of low coverage and reliability of single data source event detection algorithm. Finally, the effectiveness of the algorithm is analyzed with the data of Beijing Expressway. It is expected that the algorithm proposed in this study can provide some reference for automatic event detection of urban expressway.

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