Available online at www.sciencedirect.com

ScienceDirect

Procedia Engineering 7 (2010) 482–489

Procedia Engineering

www.elsevier.com/locate/procedia

2010 Symposium on Security Detection and Information

Highway Traffic Incident Detection Based on BPNN

Xueqing Cheng [a]*, Wenfang Lin [a], Enxiang Liu [a], Dan Gu [b]

a. *College of Traffic & Transportation, Southwest Jiaotong University, Chengdu; Sichuan 610031, China*
b. *Department of Information Engineering, Sichuan Tianyi University, Chengdu; Sichuan 610100, China*

Abstract

Because traffic incident is the main cause of traffic congestion in Highway, traffic incident detection plays an important role in ITS. Based on the professional software VISSIM, we performed an experiment on incident caused by traffic jam to obtain the original simulated data. We offered a way to deal and analyse the traffic prameters, then an updated automatic traffic incident detection method was proposed based on BP neural network. Simulation result shows that the new method has many advantages such as higher detection rate, lower false alarm rate and shorter mean detection time.

Keywords: traffic incident; VISSIM; automatic incident detection; BPNN

1 Introduction of traffic incident detection

1.1 The Importance of traffic incident detection

Traffic incident detection plays a decisive role for being the core and key of the traffic incident management system. The transportation management system which depends largely extent on high efficiency and reliable traffic incident detection technology. Traffic incident detection system can give the fastest and disposal of the incidents on the road, which can reduce casualties and property loss, avoid the second-incident, save energy and shorten the pollution as well as realize the real-time monitoring on traffic incident condition. It also provides data support and real-time control for traffic management department which helps to save time and release traffic jam.

1.2 Category and application of different traffic incident detection method

The highway traffic incident detection method includes manual incident detection (MID) and automatic incident detection (AID). The manual incident detection is the earliest and the most universal method applied to report traffic jam or incident information in diary which. Its main advantages are convenient, direct and efficient, while the disadvantages are follows, such as the need of witness, hard to define the place of congestion and incident, and need the professionals to select and confirm report, therefore the work intensity is high. Taking account of the

* Corresponding author. Tel.: 13880606999.
E-mail address: cxq@swjtu.cn or 6950385@qq.com

1877-7058
doi:10.1016/j.proeng.2010.11.080

manual incident detection is easy to be influenced by time or weather and taking a long time, the experts in different countries try their best to study and exploit the automatic incident detection in order to make it work all the time and get higher detection rate.

Hence, the application of MID and AID is different. MID is often used in city road while AID is applied in highway and urban expressway[1].

1.3 Evaluation indicators of traffic incident detection algorithm

We usually used three performance indicators which are detection rate（DR）, false alarm rate （FAR） and mean time to detect （MTTD） to assess the performance of AID algorithm[2].

(1) Detection rate（DR）

DR is the ratio between the number of incidents and strategy sum .

$$DR = \frac{incident\ number\ of\ \det ecction}{sum\ of\ incident} \times 100\% \quad (1)$$

(2) False alarm rate（FAR）

FAR is the ratio between the times of false alarm and strategy sum .

$$\mathrm{FA}R = \frac{number\ of\ \ false\ alarm}{sum\ of\ \ decision} \times 100\% \quad (2)$$

(3) Mean time to detect（MTTD）

MTTD is the mean time from the incident generation to algorithm detection.

$$MTTD = \frac{1}{n}\sum_{i=1}^{n}\left[\mathrm{TI(i)} - \mathrm{AT(i)}\right] \quad (3)$$

Where $TI(i)$ is the actual time of the incident i, $AT(i)$ is the detection time of the incident i, n is the the number of incident.

DR and FAR reflect the effectiveness of AID, while MTTD reflect efficiency. DR and FAR are correlated, reducing FAR can lead the omission factor rising and correspondingly lead the detection rate lowering. The measure to reduce FAR is persistence test, but this measure would increase MTTD, so DR, FAR and MTTD are correlated, it must be synthetically considered in the assessment.

2 Relization of traffic indent detection with neural network

2.1 Theory of BPNN

Neural networks are widely interconnected by a large number of neurons. Because of its learning , multi-input parallel processing, misalignment mapping and fault-tolerant ability, as well as obtaining the auto-adapted ability via the new knowledge, it has been widely used in the pattern recognition, the control optimization and the failure diagnosis.

There are many kinds of neural network, in which BPNN(Back Propagation Neural Network) is one of the most widely used artificial neural networks.

Seen from the structure, BPNN is a typical forward type network according to the training of multilayer feedforward network. BPNN can learn a lot of input-output model mapping relation, without the prior to reveal the mapping relationship of describing mathematical equations. It uses the rules of learning the steepest descent method, through propagation to constantly adjusting the network weights and threshold, make the minimum error square network. The topology structure of BPNN includes input layer, hidden layer and output layer (Figure 1) .