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Research Article

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The research of computer network safety based on neural network

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ABSTRACT

This paper use the Self-Organizing Feature Map neural network and BP neural network to diagnosis the network fault, use the cluster in training sample, add the result to the sample and put some weights, it can increase the qualities. Parallel computing is used in the neural network compute. The computer network fault diagnosis is used as a example to analysis. the work has been emulated and analyzed by computers, and a computer network fault diagnosis system has been excogitated. The whole works have been summed up and the future researching directions have been discussed at the end of this paper.

Key words: Network Safety; Neural Network; Self-Organizing

INTRODUCTION

Computer network is an most important facility in 21 century. With the development of its shapes, the management work of computer network become more and more complex. Computer network fault diagnosis became the focus of people attention. A good computer network connects to good network management. Any fault of network, even though the fault which happens in a short time, may bring to the huge loss in economy, society and construction of national defences.In the draught of fact demands, the application of fault diagnosis become more and more abroad, has filted into the Mechanics and Electronics system, Industry Automatization system, computer system, and all kinds of dynamic system in abroad way, including abjection identify system, combination navigation system and so on from traditional machine system and electron system. As the development of Physics, Mathematics and basic science, and the development of Control Theory, Information Science and application science, it provided many kinds of technology ways for faults diagnosis, became the impetus of the development of faults diagnosis technology.

As the factor of faults is too much, information is too much, it makes the manager of network difficult to use the tools which exist today to resolve the user's service demands of faults diagnosis. How to use the intelligence technology import to network fault diagnosis area, using self-study, auto-adapted technology to create and maintenance the fault diagnosis repository, increase the efficiency of network management is a problem which is worth to lucubrate.

Outline of PNN

Probabilistic neural network (PNN) is a common network model, which is based on Bayesian classifier and probabilistic function [6]. PNN has a wide range of applications in model identification, time series prediction, signal processing, as well as fault diagnosis and other fields [7–10]. The PNN is a pattern classifier that combines the widely used Bayes decision strategy with the Parzen nonparametric estimator for estimation of probability density functions of different classes. Unlike other neural network architectures, PNN is easy to implement and the network is easily interpretable [11].

Generally, the probabilistic density function is the normal probabilistic density function as follows.

$$f_A(X)=\frac{1}{(2\pi)^{\frac{m}{2}}\sigma^m}(\frac{1}{n_A})\sum_{p=1}^{n_A}\exp(-\frac{(X-X_{Ap})^{'}(X-X_{Ap})}{2\sigma^2})$$

where $f_A(X)$ represents the value of probabilistic density function of Category A at point X; m represents the number of input variables; σ represents smooth parameter; n_A represents the number of training vectors in Category A; X represents the testing data vectors; X_{Ap} represents the p-th training data in Category A.

Because

$$\frac{1}{(2\pi)^{\frac{m}{2}}\sigma^m}(\frac{1}{n_A})=\text{constant}=h$$

$$(\mathbf{X}-\mathbf{X}_{Ap})^{'}(\mathbf{X}-\mathbf{X}_{Ap})=\sum_{i=1}^{m}(x_i-x_i^{Ap})^2$$

the probabilistic density function can be simplified as follows

$$f_A(X)=h\sum_{p=1}^{n_A}f_{Ap}$$

where

$$f_{Ap}=\exp(-\frac{\sum_{i=1}^{m}(x_i-x_i^{Ap})^2}{2\sigma^2})$$

where x_i represents the value of i-th input variable in the testing sample; x_i^{Ap} represents the i-th input variable of the p-th sample of Category A in the sample base.

The PNN network is simply a parallel 4-layer structure: input, pattern, summation, and decision layers (Fig. 1). The input layer receives and normalizes input vector; each unit in pattern layer represents a training vector with response function $\exp[(\mathbf{X}^{'}\mathbf{X}_{Ap}-1)/\sigma^2]$. Summation layer computes the summation of each pattern and multiplies the loss factor. Decision layer selects the largest one in summation layer as the classification result.

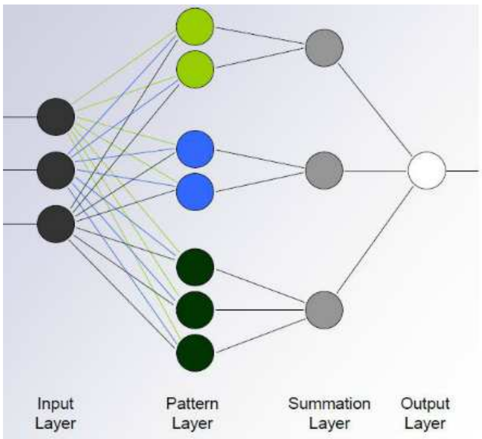

Fig. 1 The structure of PNN

PNN Use of a PNN to evaluate the reliability of computer network

Model building. To prove the efficiency and validity of the proposed PNN-based evaluation method, a real-world engineering application about the reliability evaluation of computer network is given in the following.

According to the degree of influence of the various factors upon the ventilation system reliability of coal mines and in agreement with past studies [4, 12], the following 12 main factors were chosen as the features for the evaluation of ventilation system reliability. These features of input patterns would be most useful for recognition. These features included: 1. ventilation network complexity, 2. the rationality of mine wind pressure, 3. running stability of mine main fan , 4. comprehensive efficiency of mine main fan, 5. qualification rate of mine ventilation equipments, 6. supply-requirement ratio of mine air quantity, 7. qualification rate of air quantity of using wind place , 8.

qualification rate of the air quality of using wind place, 9. qualification rate of the temperature of using wind place, 10. qualification rate of disaster prevention facilities, 11. the flexibility of reversed ventilation system in mine and 12. electricity fee per ton coal. So the feature vector of ventilation system reliability status contains 12 feature values. According to the engineering practice, past studies [4] and the opinion of relevant experts, the ventilation system reliability status is classified into 3 level patterns, i.e. pattern 1: safe; pattern 2: moderately safe and pattern 3: unsafe. Based on above discussion, the structure of PNN for application of computer network reliability evaluation comprised 4 layers and the number of input neuron nodes and output neuron nodes was 12 and 3, respectively.

Working process. The detailed PNN-based evaluation algorithm can be described as following:
Step 1. Read exemplar vectors and class numbers.
Step 2. Sort these into 3 sets where each set contains one class of vectors.
Step 3. For each $k, (k = 1, 2, 3)$, define a Gaussian function centered on each exemplar vector in set k and define the summed Gaussian output function.
Once the PNN is defined, then we feed vectors into it and classify them as follows:
Step 1. Read input vector and feed it to each Gaussian function in each class.
Step 2. For each group of hidden nodes, compute all Gaussian functional values at the hidden nodes.
Step 3. For each group of hidden nodes, feed all its Gaussian functional values to the single output node for that group.
Step 4. At each class output node, sum all of the inputs and multiply by constant.
Step 5. Find maximum value of all summed functional values at the output nodes.
We use training data set to train the PNN and use test data set to verify the trained PNN. The simulation results are shown in Fig. 2. It can be seen from the Fig.2 that there no error sample when we input the training samples into the trained PNN. Hence, the PNN has a good learning performance. In fact, the trained PNN could be used to evaluate additional unknown samples and the results are basically consistent with the engineering practice.

CONCLUSION

(1) A novel evaluation method based on the PNN for computer network reliability is proposed in this paper. The structure design of network and the evaluation algorithm are presented in detail. Compared with other traditional ANN-based methods, PNN is easy to implement and the network is easily interpretable

(2) This paper is the first application of ENN on coal mines safety status pattern recognition. The tested results indicate that this method is feasible and reasonable and this evaluation method is easier and more practical in engineering application.

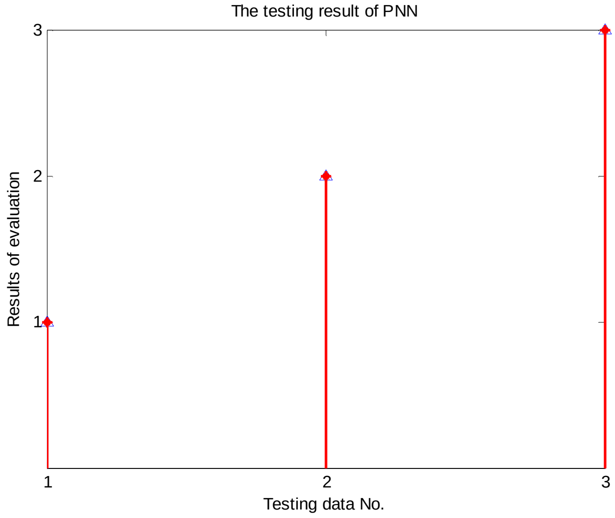

Fig. 2 The results of training

The imitating result indicated that it is easy and feasible of using the model established in this dissertation to evaluate network security. It can eliminate the interference of artificial factors and quickly get the correct evaluating results. This research work provides new thoughts and methods to make comprehensive evaluation to the computer network security, and especially will be worthy referring for future network security problem forecast and control.

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