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Network Method for Engineering Geological Disaster Risk Assessment and Prediction of Railway

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Abstract. The regional engineering geological conditions and geological hazard evaluation is the important part of realizing the railway geological selection, However, the accuracy of the evaluation largely depends on the reliability of basic information and reasonable mathematical model. Remote sensing provides reliable geological information and accurately reflects the geological conditions along the railway line. The artificial neural network has a self-learning ability, even with the noise data lack of items or lack of awareness still can get a satisfactory conclusion. Therefore, the paper uses the improved BP neural network-LM neural network established evaluation and prediction model, Achieved the effective assessment and prediction of engineering geological conditions and geological hazard align the railway. Theoretical analysis and case study shows, the Levenberg-Marquard neural network based on the adaptive adjustment learning step has high accuracy and speed advantages, Is an ideal geological hazard assessment methods.

Keywords: railway engineering geological; Levenberg-Marquardt neural network; geological evaluation; Virtual reality environment.

1 Introduction

The area of the railway line engineering geological conditions and geological hazard evaluation is one of the important contents of railway geological route selection; however, the accuracy of the evaluation rationality depends on the reliability of the underlying data and mathematical models. Remote sensing geological information provides a reliable basis for the information, reflects the geology along the railway accurately. The Artificial neural network has a self-learning ability, even the data contained noise, missing items and lack of awareness also can get a satisfactory conclusion .In particular, it can learn from the accumulated knowledge engineering examples, the variety of qualitative and quantitative factors to be used as input variables as much as possible, Established the highly nonlinear mapping between influencing factors and conclusions. The Artificial neural network completed forecasting by adaptive pattern recognition method, it can avoid excessive human subjectivity, uncertainties on the evaluation results effectively. However, the isolated

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artificial neural network method due to difficulties and deviation data obtained will be greatly limited in practical applications. How to combine remote sensing and neural networks to establish comprehensive evaluation of engineering geology prediction model, evaluated the engineering geological conditions and geological hazard, provide decision help for engineers in railway comparison and selection become the core issue that we should study. Therefore, the paper used Levenberg-Marquard Neural Network establish evaluation prediction model on the basis of remote sensing geological information, Achieved the engineering geological conditions and geological hazard assessment and evaluation results visualization.

2 Overview of the BP neural network

Artificial neural network is a highly nonlinear mapping processing system, with a strong self-learning, self-organization, adaptive and classification of computing power. There are several types of neural networks of current application, the Back-Propagation Neural Network is the most widely used neural network [1, 2], usually consists of input layer, hidden layer and output layer. BP neural network formed by a non-linear transfer function neurons, it's a non-feedback to the network and neurons are arranged in a hierarchical style.

BP neural network usually consist an input layer, hidden layer (one layer or multi-layer) and output layer, Fig. 1 is a typical three-layer BP neural network, only one hidden layer.

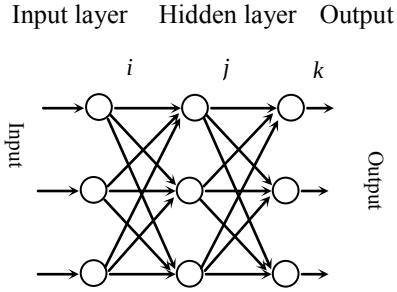

Fig. 1. A typical Three-layer BP neural network

Set the input: $x = (x_1, x_2, ..., x_n)$, hidden layer neurons number is r, The output layer neurons number is m, Output: $y = (y_1, y_2, ..., y_m)$, from input layer to the hidden layer weight is w_{ij} threshold is θ_i, from hidden layer to the output layer weight is w_{jk}, threshold is θ_k, and then the output of each hidden layer neuron:

$$x_j^{'} = f(\sum_{i=1} w_{ij} x_i - \theta_j), \qquad j = 1,2,..., r$$

The output of each output layer neuron:

$$y_k = f(\sum_{j=1}^{r} w_{jk} x_j^{'} - \theta_k), \qquad k = 1,2,..., m$$

4 LM-neural Network Computing

Selects the neural network and simulation data to meet the training requirements, you can use neural network method to evaluate each unit level. According to LM neural network model established to evaluate the entire evaluation unit, Fig. 2 shows the regional geological evaluation of alignment zoning map.

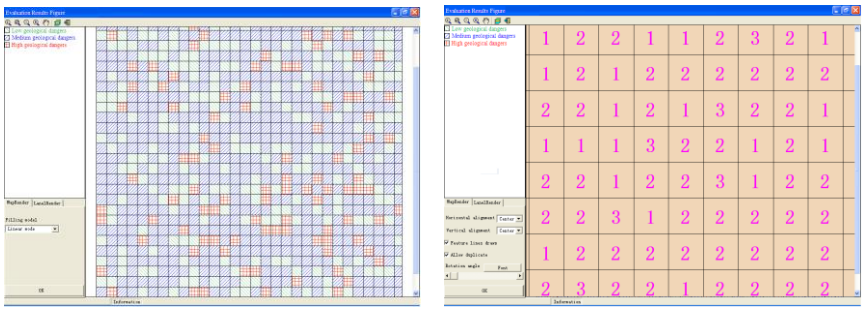

Fig. 2. Comprehensive evaluation of the results (Sign pattern and Sign pattern)

Levenberg-Marquard algorithm has many advantages than improved BP algorithm, its fast convergence and avoid local minimum points, total system error can quickly reach the required system accuracy, the training time is short and the data accurate more predictions. Levenberg-Marquard algorithm has fault-tolerant capability and high reliability, the Network algorithm created with Levenberg-Marquard can get a high prediction accuracy and speed. It's suitable for high demand for relatively real-time applications extremely. The geological hazard assessment usually involved more factors, so it's applicable for applying Levenberg-Marquard neural network algorithm.

5 Three-dimensional visualization of the evaluation results

Evaluation results will be integrated into three-dimensional geographical environment of alignment system, so that alignment engineers are very intuitive to view and understand geological hazard assessment results through areas of the routes, the realized method as follows:

The evaluation results were stored in database, divided three-dimensional environment evaluation unit automatically according to the digital elevation model and evaluation unit size. Through read the unit corresponding evaluation rank from the database and set fill color to different levels, achieved the evaluation result three-dimensional visualization in virtual environment. The color fill and frame fill display mode were pride, shown in Fig.3.

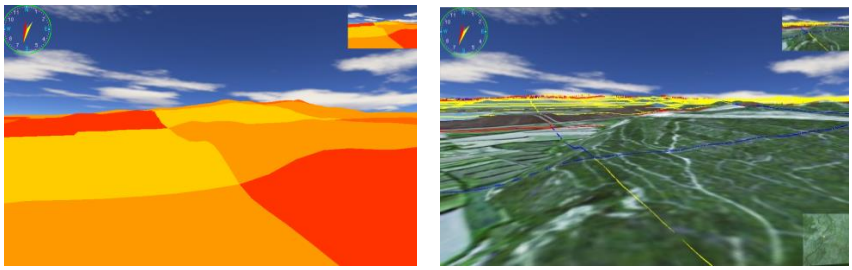

Fig. 3. 3D visualization of geological evaluation results (Color fill and Texture fill mode)

6 Results and discussion

Network method for engineering geological disaster risk assessment and prediction of railway. Gave the prediction and evaluation model of artificial neural network and introduced the modeling process in detail. The model structured learning sample set based on remote sensing geological information data and Geological hazard classification criteria, through self-learning function of neural networks, Establish a complex nonlinear relationship between regional geological hazard grade and influence factors. Achieved an effective evaluation and prediction of engineering geological conditions and geological hazard for railway location. Obtain a zoning map of geological disaster risk assessment, assessment results consistent with the actual situation. Levenberg-Marquardt neural network algorithm has fault tolerance capability and high reliability. The Paper used the step adaptive LM artificial neural network method has a strong versatility. For different degree of regional geological hazard classification criteria and more evaluation indicators, it can establish the appropriate Levenberg-Marquardt neural network prediction model easily according to the paper proposed method. It overcomes some shortcomings effectively of current risk prediction methods in multi-index evaluation of geological disasters, so the step adaptive Levenberg-Marquardt artificial neural network method has a good prospect and promotional value for engineering geological disaster risk assessment and prediction.

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