GUI of Prediction of Gas Emission with Artificial Neural Network

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Abstract. This paper predicted the GUI of gas emission in mining face with the back propagation neural network (BPNN), the radial basis function neural network (RBFNN) and the general regression neural network (GRNN). By comparing the measured values and the prediction values, the results indicated that the BPNN, GRNN and RBFNN were capable of predicting the gas emission, and the prediction value by using the RBFNN is better than the other methods.

1. Introduction
China is one of the few countries in the world that uses coal as the main primary energy source. For a long time, the energy provided by coal has accounted for about 70% of China's energy structure. According to the prediction of the Chinese Academy of Engineering, coal consumption will still account for more than 60% by at least 2020. In the coal mining process, gas is a common by-product. Gas is the product of coalification process, with methane as the main component. If the coal mine gas in the coal gap escapes quickly during the mining process, it is easy to cause geological disasters, which may cause casualties and roadway damage. Coal mine geological disasters generally refer to gas outbursts and coal and gas gushing, and also include gas secondary disasters such as gas explosion, gas suffocation, and coal dust explosion. Gas emission refers to the actual amount of gas that enters the mine from the coal seam during the mining process. The problem of gas emission has always been one of the important factors affecting coal mine safety production, and gas accidents are also a major problem that has always plagued coal mine safety production. According to the statistics of the former State Administration of Work Safety, in the past ten years, the death toll due to gas accidents accounted for 57.4% of the death toll from serious accidents in coal mines [1]. Therefore, if effective methods can be used to predict the amount of gas emission in the production process of coal mines, it will be of great significance to the safe production of coal mines; especially for the production of first-line coal mining face, if the gas emission can be predicted The output can be predicted more accurately, so that timely and effective measures can be taken to prevent the occurrence of gas accidents, which has important practical significance for reducing the loss of life and property and maintaining social stability.

Since the 1950s, various methods for predicting gas emission have been proposed one after another. These methods include mine statistics method, gas content method, source calculation method, analogy method, etc. [2]. Although these traditional gas emission forecasting methods can predict the gas emission to a certain extent, the method itself has certain limitations. They are all realized by a fixed linear relationship and set the influence of various factors on the gas emission. The mapping of results. However, there are many factors that affect the amount of gas emission, and there is a complex nonlinear relationship between factors, which makes it difficult to describe with a single linear relationship.
Therefore, the amount of gas emission needs to find a way to describe the nonlinear relationship for prediction. With the development of computer technology and artificial intelligence technology, artificial neural network (ANN) has been applied in the prediction of gas emission. Artificial neural network has the characteristics of highly parallel processing, highly nonlinear mapping, and self-organizing structure. It does not need to know the exact relationship between input and output, and does not need a large number of parameters. It only needs to know the non-constant factors that cause output changes, that is, non-constant parameters. Therefore, compared with traditional data processing methods, artificial neural network technology has obvious advantages in processing fuzzy data, random data, and non-linear data. It is especially suitable for systems with large scale, complex structure and unclear information. Using artificial neural network to predict gas emission can overcome the shortcomings of the aforementioned linear method; at the same time, compared with other traditional prediction methods, artificial neural network does not need to know the relationship between various factors and gas emission, and can combine various gases non-linearly Gushing factor, thereby outputting the predicted value of gas.

The more common artificial neural networks for predicting gas emission include BP neural network (BPNN) and radial basis function neural network (RBFNN) [3-4]. However, using BP neural network to predict the amount of gas emission requires a large number of training samples. In actual application of BP neural network, because the training samples are often limited and uneven, the parameters are not easy to determine, which affects the prediction results of gas emission and reduces Improved forecast accuracy. The basic idea of the radial basis function neural network is to use the radial basis function as the "base" of the unit to form the hidden layer space. The hidden layer transforms the input vector and transforms the low-dimensional pattern input data into the high-dimensional space. Make the linearly inseparable problem in low-dimensional space linearly separable in high-dimensional space. The characteristics of the radial basis function neural network determine that it can approximate any non-linear function with arbitrary precision, and has the global approximation ability, thereby solving the local optimal problem of the BP neural network; and the radial function neural network has a compact topology. The structural parameters can be learned separately, and the convergence speed is fast. The Generalized Regression Neural Network (GRNN) has the advantages of stable structure, faster convergence speed, higher prediction accuracy, etc., and is suitable for dealing with non-linear problems such as gas emission prediction. At present, there are few predictions of gas emission using generalized regression neural network. Therefore, this article will predict the amount of gas emission by using three artificial neural networks of BPNN, RBFNN, and GRNN. Through the comparison of the predicted value and the measured value, the above-mentioned three common artificial neural networks will be analyzed and compared, and the result can be The artificial neural network that predicts the amount of gas emission more accurately establishes a method that can accurately predict the amount of gas emission.

2. Methodology

BP neural network is currently the most widely used and successful artificial neural network. A typical BP neural network includes a three-layer structure, which is an input layer, a hidden layer, and an output layer. Each layer is fully connected.

Different from the BP neural network, the hidden layer in the radial basis function neural network is a single layer, and the activation function of the neurons in it is the radial basis function. The most common radial basis function is Gaussian function.

Generalized regression neural network is an improvement based on radial basis function neural network. Unlike the radial basis function output which uses the least square method superposition of the radial basis function weights, the generalized regression neural network uses the density function to output.

Matlab was used to design the GUI for predicting the gas emission. The Matlab version is 2014b.
3. Results
The GUI was showed in Figure 1 and 2. The prediction values of gas emission was showed in Table 1.

Figure1. The GUI for predicting the gas emission with artificial neural networks.

Figure2. The prediction of gas emission with radial basis function.

Table1. The prediction of gas emission by using artificial neural networks

| No | Gas Emission Measurement | BPNN Prediction Value | GRNN Prediction Value | RBFF Prediction Value |
|----|--------------------------|-----------------------|-----------------------|-----------------------|
|    |                          | Relative Error        | Relative Error        | Relative Error        |
| 1  | 8.51                     | 8.02                  | 6.99                  | 8.04                  |
|    |                          | -5.78%                | -17.83%               | -5.52%                |
| 2  | 7.95                     | 7.15                  | 6.64                  | 8.04                  |
|    |                          | -10.05%               | -16.54%               | 1.13%                 |
| 3  | 4.06                     | 3.38                  | 5.71                  | 4.92                  |
|    |                          | -16.80%               | 40.52%                | 21.18%                |
| 4  | 4.92                     | 5.22                  | 5.15                  | 4.60                  |
|    |                          | 6.06%                 | 4.68%                 | -6.50%                |
| 5  | 8.04                     | 7.66                  | 6.72                  | 7.95                  |
|    |                          | -4.78%                | -16.46%               | -1.12%                |

4. Conclusion
In this study, we designed a GUI to predict the gas emission with three artificial neural networks. Our results showed the prediction accuracy by using RBF is the best of three artificial neural networks.

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