Research on the Evaluation Methods of Bid of Construction Project Based on Improved BP Neural Network

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Abstract: - Bid and tender is the core stage in construction project, however, many evaluation factors can be handled easily by qualitative analysis, which is hard to avoid subjectivity. In this paper, a new evaluation index system is proposed to use quantitative analysis in order to avoid error which is induced by subjectivity, firstly. Secondly, an improved BP neural network is proposed as an evaluation method. The results indicated that the process of evaluation is simple and practical, and the accuracy can satisfy the actual requirement based on this new evaluation index system and the improved BP neural network.

Key-Words: - decision processes, construction project, BP neural network, Bid, tender, evaluation index system

1 Introduction

With the development of the economy in china, the real estate sector has become a pillar in modern macro-economy, which is a very important industry described as weatherglass in national economy. The sound development of real estate is intertwined with macro-economy. Therefore, on of the basic sector in the real estate: the implementation of construction works has attracted more and more attentions. In order to ensure a scientific and reasonable construction works, and high effective and low cost operation, there is a mechanism in real estate, which is the mechanism of bid and tender in engineering construction project. Nowadays, more and more construction project begin to use bid and tender to make sure the contract. We may say so, evaluation of bid has a close bearing on judge which contract is superior in the implementation of construction works. From that point, how to improve the judge process in bid and tender of construction works has been widely studied.

The problem of bid and tender is firstly studied by Friedman in 1956, he proposed a "Friedman closed inviting tender" model in journal "Operations Research". Later many scholars begun to propose other different models based on Friedman's, such as "Gate" model, "Hanssman-Rivett" model, "Case-Shaffer" model and so on. In china, the research on bid and tender in construction works are late beginning, Xiao Weipin et al proposed a model about decision making on the bid price in 1987, then, Xiao Weipin improved his model and propounded an evaluation method of risk in 2000 [1].

At the same time, Long Aixiang proposed a bid model for a new engineering project [2], which was a dynamic bid decision model and presented a new view of the plan selection based on the owner utility.

Yang lanrong proposed a method of risk analysis for project bidding at a later time [3], In her paper, Yang lanrong used a new method of determining attributes weight and fuzzy method. These theories are mainly focus on bid and tender decision theory and their application, which research on how to use fitting decision-making, skill, tactic for the constructing enterprise to obtain construction project. However, the actual situation is construction project is been relatively few, and at the same time, there are more bid enterprises. So how to select a correct enterprise to ensure the quality of

construction project, construction schedule, and reduce construction cost become very important problems for the owners. It is to be regretted that these researches are only limited to law level, business level, the procedure for public bidding and so on both in china and abroad [4]. In recent years, the relevant studies in China are always discussing in appraisal bid of engineering project and how to build its corresponding model [5].

However, the evaluation of bid for large construction project has exceptional complexity, which leads to the evaluation methods and results be more complex than traditional project [6].

The methods of current evaluation of large project focus on experts assess, fuzzy comprehensive evaluation, AHP and so on. Both of these methods evaluate the bid with expertise and their knowledge. It is hard to avoid subjectivity for these above methods, and the object of evaluation is lack in lateral objective comparisons. It is easy to produce error, which makes public bidding be hard and impossible. In this paper, we propose an improve BP neural network, and take in its superior characters, for example, it can be self-studying, self-adjustment and so on, which can eliminate the subjectivity of individual experts. Therefore, these can improve the final evaluation result and actual effect of the competitive bidding directly.

2 the introduction of traditional neural network

Artificial neural network(ANN) was proposed in the turn of 19th-20th century. In 1943, American psychologist W.S. Mcculloch and mathematician W.A.pitts built a very simple neural element model in their paper, which is M-P model. The new model taken neural element as logical function device, which pioneered the field to research on the theory of neural network.

ANN is researched by the ways of several subjects such as physics, psychology, physiology and so on. Neural network consists of lots of neuron (processing units). Neural network is based on the mechanism of human brain; it can reflect the basic character of human brain, and it can be said as abstract and imitation of human brain. Neural network is a mathematical model, and can use electronic circuits or computer to simulate the intelligence of human resource. At the same time, neural network is a non-linear dynamic and self-adaptive system, which is the basis for parallel processing of massive information and large-scale parallel computing.

Neural network can describe the cognitive decision making and intelligence behavior of control, it has lots of capacities to store knowledge and apply experience knowledge. There usually have some common characteristics between neural network and human brain, which can be summarized as following:

① it can obtain knowledge from outside by studying;

② these neuron which is inside neural network can be used to store knowledge.

Generally speaking, neural network has the non-linear reflection ability and association learning ability. It can adjust the network parameters when it is stimulated by outside environment, then it respond to the external environment in a new way. Studying form outer environment and improving itself at the same time are the most rewarding characteristics of neural network. ANN has various applications in many domains at present. For example, Yumin Wang et al [7] had explored the potential of using ANN for modeling the event based suspended sediments concentration for continuous monitoring of the river water quality. They had proved that using the ANN models are more reliable than classical regression method for estimating the suspended sediments concentration. At a later time, Yumin Wang et al [8] had pointed out that the ANN model employed in their study was the feed forward backpropagation (BP) type using maximum and minimum air temperature collected from 1996 to 2006. The result of BP was compared to the RMBF, and the feed forward backpropagation algorithm colud be potentially employed successfully to estimate ETO in semiarid zone. Besides, Liang Zhou [9] et al. proposed new artificial neural network models: PCNN model, then this new model was used for image processing, and the experiment results showed that the good effect of the new model. Generally speaking, Main application domains of ANN are as follows: voice recognition, image processing, Fault check technology, industry economic forecasting and so on.

The whole processing of neural network is consists of two stages:

① the learning phase: The connecting weight between neurons can be adjusted according to some studying rules;

② the working phase: Meanwhile, the connecting weights keep unchanged. The neural network has input so that it can gain corresponding output.

Neural network has different classified method. According to different work flow, there are 4 kinds of

neural network [10]: Forward feedback network model, feedback network model, self-organizing network model, and stochastic network model.

3 the introduction of BP neural network

3.1 the description of BP neural network

BP neural network is belonging to forward feedback network, the most commonly used BP neural network's structure is like the figure 1 as below, it consists of 3 layer network: input layer, hidden layer, and output layer. Its operating mechanism is as follows:

(l) To initialize the structure of neural network, make all the weights be random arbitrarily small and use stochastic distribution in order to select threshold. This stochastic distribution is equally distributed, its normal mean equals to 0 [11], and its variance should be selected carefully in order to make the output of neural change in the proper linear part of activation function.

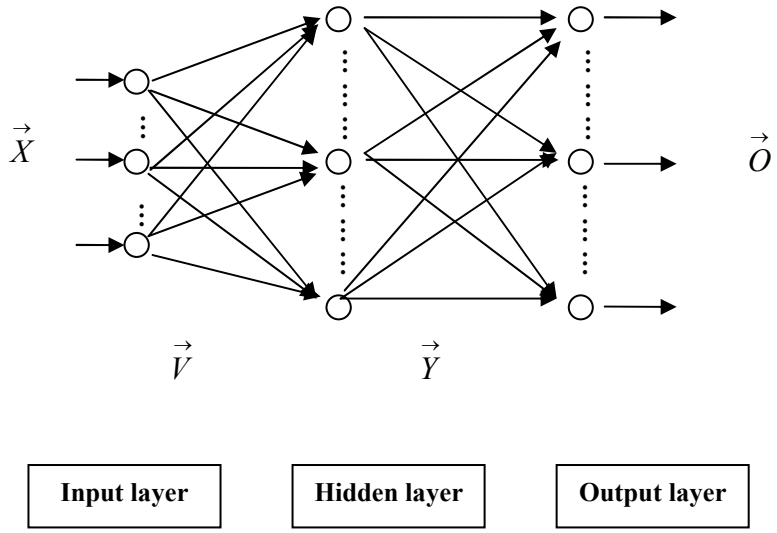

Fig. 1 the structure of BP neural network

(2) To ensure the learning set as input:

$$\vec{X} = \{x_1, x_2, \cdots, x_n\}^T ;$$

the expected output is:

$$\vec{D} = \{d_1, d_2, \cdots, d_l\}^T ;$$

there is a weight matrix between input layer and hidden layer:

$$\vec{V} = \{\vec{v}_1, \vec{v}_2, \cdots, \vec{v}_m\} ;$$

where column $\vec{v}_i$ is the weight vector of i th neuron in hidden layer;

there is a weight matrix between hidden layer and output layer:

$$\vec{W} = \{\vec{w}_1, \vec{w}_2, \cdots, \vec{w}_l\} ;$$

where column $\vec{w}_j$ is the weight vector of j th neuron in the output layer.

According to figure 1, suppose:

$\vec{Y} = \{y_1, y_2, \cdots, y_m\}^T$ as output vector in hidden layer;

Suppose:

$\vec{O} = \{o_1, o_2, \cdots, o_l\}^T$ as output vector in output layer;

(3) To make all the neurons in hidden layer and output layer use non-linear activation function throw feed-forward neural network. Generally, this activation function is single-polarity Sigmoid function:

$$f(x) = \frac{1}{1+e^{-x}}$$

Calculate output values, and the neuron in input layer will not make function transformation to inputs, so this function acted as a cushion. There exists mathematical relation between all of the signals in each layer as follows:

For the hidden layer, there are following formulas:

$$y_j = f(net_j)$$

$$net_j = \sum_{i=0}^{n} v_{ij} x_i$$

For the output layer, there are following formulas:

$$o_k = f(net_k)$$

$$net_k = \sum_{j=0}^{m} w_{jk} y_j$$

(4) BP neural network can use dynamic error feedback to adjust weight with the recursion method from the output node to hidden layer, and then adjust weight according to following formulas:

Firstly, to calculate error E between the output value of neural network and expected output value:

$$E = \frac{1}{2}(\vec{D} - \vec{O}) = \frac{1}{2}\sum_{k=1}^{l}(d_k - o_k)^2 \qquad (1)$$

Then expand this formula to hidden layer:

$$E = \frac{1}{2}\sum_{k=1}^{l}[d_k - f(net_k)]^2 = \frac{1}{2}\sum_{k=1}^{l}[d_k - f(\sum_{j=0}^{m} w_{jk} y_j)]^2 \qquad (2)$$

Lastly, expend this formula to input layer:

$$E = \frac{1}{2}\sum_{k=1}^{l}\{d_k - f[\sum_{j=0}^{m} w_{jk} f(\sum_{i=0}^{n} v_{ij} x_i)]\}^2$$

From above formulas, we can see that this neural network can adjust weight: w_{jk} and v_{ij} to change error E.

Therefore, in order to make error E diminish to satisfy the actual requirement, we can get following adjust value:

For output layer:

$$\Delta w_{jk} = -\eta \frac{\partial E}{\partial w_{jk}} = -\eta \frac{\partial E}{\partial net_k}\frac{\partial net_k}{\partial w_{jk}}$$

Define an error signal:

$$\delta_k^o = -\frac{\partial E}{\partial net_k} = -\frac{\partial E}{\partial o_k}\frac{\partial o_k}{\partial net_k} = -\frac{\partial E}{\partial o_k} f'(net_k)$$

According to formula (1):

$$\frac{\partial E}{\partial o_k} = -(d_k - o_k)$$

Then

$$\Delta w_{jk} = \eta \delta_k^o y_j = \eta (d_k - o_k) o_k (1 - o_k) y_j$$

For the hidden layer:

$$\Delta v_{ij} = -\eta \frac{\partial E}{\partial v_{ij}} = -\eta \frac{\partial E}{\partial net_j}\frac{\partial net_j}{\partial v_{ij}}$$

Define an error signal too:

$$\delta_j^y = -\frac{\partial E}{\partial net_j} = -\frac{\partial E}{\partial y_j}\frac{\partial y_j}{\partial net_j} = -\frac{\partial E}{\partial y_j} f'(net_j)$$

According to formula (2):

$$\frac{\partial E}{\partial y_j} = -\sum_{k=1}^{l}(d_k - o_k) f'(net_k) w_{jk}$$

Then:

$$\Delta v_{ij} = \eta \delta_j^k x_i = \eta (\sum_{k=1}^{l} \delta_k^o w_{jk}) y_j (1 - y_j) x_i$$

(5) Iteration method. Firstly, make a judgment. If the error after learning can meet predetermined requirement, then the learning processing stop; if the error can not meet predetermined requirement, return to step (2) and input new learning set.

3.2 the shortcomings of BP neural network and its related reasons analysis

Generally, the layers and the nodes of BP neural network have a great influence for the convergence, convergence speed, and global optimization of the whole network. Therefore, when the BP neural network is in foreseeable use, it is a critical factor to ensure the optimal structure of neural network. So how to confirm the layers and the number of nodes in each layer is very important. Currently, the most common method to confirm the layers of neural network is achieved by experiences. So there does not exist a fixed principle, and there becomes a new obstacle to the application of BP neural network.

BP neural network uses Widrow-Hoff learning algorithms and adopts non-linear differentiable transfer function in order to build a multi-layer network. Generally, a typical BP neural network uses the algorithm of gradient descent. This algorithm has small computation, and it is easy to realize. However,

the error function is surface in multi-dimensional space for the functions in multi-dimensional. Surface is uneven, and has some local minima and flat surface, so the algorithm of gradient descent is easily trapped into local minima in the training stage of BP neural network. So this will make the training stage be at a standstill, and the neural network can get global optimal solution. At the same time, the convergence rate of BP neural network will be very slow in the later training stage, it will need a hundred or a thousand more iteration time to process, there are two main reasons as follow [12]:

(1) A fixed learning rate η and inertial factor α

According to above formulas, the nature of BP neural network is the algorithm of gradient descent which belongs to optimal computing. BP neural network uses the first order derivative spectrophotometry of error on weight and threshold in order to guide the direction of weight adjustment, which will achieve the goal to make error be the smallest one within the preset of range. To ensure the convergence, learning rate η should be less than one upper limit, which shows that the speed of convergence of BP neural network is unlikely fast. As a general rule, learning rate η and inertial factor α in BP neural network is decided by experience, and they will be unchanged in the training stage. When this neural network is close to local minima, target function can approximately equal a quadratic function; its equipotent surface is close to ellipsoidal surface. Because the direction of neighboring two iterations in gradient method is on the orthogonal condition, therefore, if the concentric elliptical surfaces are very flat, they will induce saw tooth phenomenon in the process of iteration. All of these mean that if we can not use a correct learning rate η, which will make the speed of convergence be very slow.

In the course of implementation of BP neural network, the range of weight and threshold for each adjustment will accompany a phenomenon: when the error curve is too uneven, the range of weight and threshold in this adjustment is very big too, a bias will occur in the surrounding area of minima of error function. Therefore, the neural network can not be convergence to global optima.

(2) "Fake saturation" phenomena in learning stage

"Fake saturation" phenomena means that error which is produced in learning stage will not decrease as the number of studying increasing during a definite period of time, then the error will drop markedly after this definite period of time. Therefore, once the learning of BP neural network get into "fake saturation" phenomena, this network will take longer to be detached from this phenomenon, even this network can not reach the global optima.

4 the design of evaluation index system of construction project and BP neural network

4.1 the design of evaluation index system of construction project

The evaluation of bid should adhere to the following rules in construction industry:

①principle of systematization: the evaluation of construction project enterprise should be effected by its own capabilities, experience, credit and so on. Therefore, the evaluation of construction project enterprise should not only consider one individual factor, but also consider a package factors based on the principle of systematization. Therefore, the evaluation will be completely and objectively.

② fair and transparent way: the quality control between success and failure consists in adhere to this principle.

③ insist on high performance-price ration, appropriate engineering measures, and a advanced and feasible construction scheme.

④combine normalization with flexibility.

Taking all factors into consideration in different construction project based on above principles and reference [13], so the evaluation index system can be set as follows:

(1)the qualifications of constructors X_1:

Testing for this index can assist and support the implementation of construction project;

(2)the quote of construction project X_2:

When the quote is evaluated, the bid price can be selected as a usual value, then corresponding adjustment is permitted;

(3)the quality of construction project X_3:

The aim and measure of quality control in construction project should meet exacting requirement.

(4)the time of construction project X_4:

Bidders shall determine the construction time X_{41}, and a scientific and reasonable construction schedule X_{42};

(5)construction scheme X_5:

Including a reasonable construction plan X_{51}; the qualifications and quantities of principal managers, engineer and technician X_{52}; physical capital, financial capital and resources which is invested in construction project X_{53}; safe and reliable technical measure X_{54}.

(6)all types of soft factors X_6:

The construction experience of contractors X_{61}; the flows of finance of contractors X_{62}.

4.2 The improvement of BP neural network

Theoretically, BP neural network as a multi-layer feed forward neural network can approach any continuous non-linear function with pinpoint accuracy, but for this result, the premise is that the network is very complex. As for actual application, how to design an appropriate BP neural network is very difficult. At the same time, because BP neural network has inherent limitations, so a new BP neural network is proposed in this paper in order to improve its performance.

4.2.1. on the determination of number of hidden layer

There are two kinds of BP neural network, first is multi-layers neural network with multi-hidden-layers, the other is three-layer neural network with mono-layer. Generally, if BP neural network increases its number of hidden layer, it can improve the processing ability of network. However, it needs more operation and feedback adjustment, which increase the operation enormously. At the same time, the solution space is divided carefully, which induces worse generalization ability and global optimization.

So the first thing to build BP neural network is to decide the structure of hidden layer. Hecht-Nielsen had proved when each node in this neural network has different threshold; then a neural network with one hidden layer can approach any continuous function in finite closed interval. So a three level BP neural network can complete analytic geometry from n dimensionality to m dimensionality. Cybenko also said that if each node had adopted Sigmoid function, one hidden layer can achieve any discriminant classify problems. Chen yufang [14] had proposed in her paper that if the BP neural network was with two hidden layers, its number of training would be more than the BP neural network with one hidden layer, which would made the BP neural network inefficient. At the same time, when the BP neural network with one hidden layer is approximation to the functions; it can get a more precise result. As a general rule, when a BP neural network is built, it consists with one hidden layer firstly, if this BP neural network can accomplish its assignment with prescribed requirements, then the final structure of BP neural network is with one hidden layer, otherwise it can add more hidden layers to solve the function.

These conclusions are directive to the determination of number of hidden layer. The new BP neural network in this paper is only one hidden layer.

4.2.2 on the determination of number of nodes in the hidden layer

There is no fixed laws when to decide the number of nodes in the hidden layer. However, because hidden layer can distill character from inputs, it is very important to choose right number of nodes. As a general rule, the more the number of nodes in hidden layer are, the more accurate the recognizing ability of the whole neural network, and the longer the network be in training. At the same time, there is a critical point for the number of nodes in hidden layer. When the number of nodes exceeds this critical point, it will induce recognition rate of the whole neural network falling rapidly. At present, widely used methods to decide the number of nodes in hidden layer are as follows:

(1) The theorem Kolmogorov: as for a neural network with one hidden layer and N input nodes, its number of nodes in hidden layer is $2N+1$

(2) R. P. Lippmann proposed a practical estimation formula in order to ensure the structure of hidden layers as follows:

If T is the number of training, then the number of hidden layer nodes is $\log_2 T$;

(3)

$$n_1 = \sqrt{0.43mn + 0.12n^2 + 2.54m + 0.77n + 0.35} + 0.51$$

Where n_1 is the number of nodes in hidden layer, n is the number of nodes in output layer, m is the number of nodes in input layer.

(4) $n_1 = \sqrt{m \times (n+1)} + 1$

Where, n_1 is the number of nodes in hidden layer, n is the number of nodes in output layer, m is the number of nodes in input layer.

As for the different application problems, the

structure of neural network will be very different. In this paper, the determination of the number is based on this fact: when the network is trained, the network which output is closest with the actual result is the final neural network. In this paper, the number of nodes in hidden layer is decided by above theory, and its determination is a searching process.

4.2.3 The selection of activation function

Generally, function $f(x)$ should be in calculating the successive derivatives. So input $\vec{X}$ should be controlled in a range with fast convergence velocity. In this paper, activation function is selected as follows:

$$f(x) = -\frac{1}{5} + \frac{1}{1+\exp(-x)}$$

The following tests show that: compared with standard S function, the convergence time of this new activation function can cut by half

4.2.4 The selection of initial weight

The selection of initial weight has strong relationship with the convergence of network and the convergence velocity in the training stage. Generally, if initial weight is too large, these inputs after weighting may fall in saturated zone of standard S function, which will make the adjustment of setting weight is close to zero, then the adjustment process will stop. In order to make sure the weight of every neuron is adjusted in the most sensitive zone of the standard S function, the value of initial weight will be selected as a random number between -1 and 1.

4.2.5 Additional momentum parameter

When BP neural network is in the back propagation processing, its corresponding weight will adjust as follows:

$$\Delta w_{jk} = \eta \delta_k^o y_j$$
$$\Delta v_{ij} = \eta \delta_j^k x_i$$

The change in weight of neural network can not only reflect the local gradient information of error curve, but also reflect the changing trend of error curve. In this paper, a new value which is proportion to the last changing value of weight will be added to every weight in order to create a new weight, and thus a new additional momentum parameter will be added to every weight. So the adjustment process of weight with additional momentum parameter is as follows:

$$w_{jk}^{(n+1)} = m w_{jk}^n + (1-m)\eta \delta_k^o y_j$$
$$v_{ij}^{(n+1)} = m v_{ij}^n + (1-m)\eta \delta_j^k x_i$$

Where m is an additional momentum parameter which range is from 0 to 1.

The analytical relationships expressed in above formulas show that effect of the n th weight adjustment can be transferred by additional momentum parameter. When we get the additional momentum parameter, it can induce the changing of weight into mean direction of the bottom of error curve. When the weight of neural network get into the flat zone of the bottom of error curve, δ is very small, and $w_{jk}^{(n+1)} \approx w_{jk}^n$, so this will not make $w_{jk}^{(n+1)} = 0$, which can help neural network jumps out from the local minima of error curve.

4.2.6Adaptive learning rate

If BP neural network can not choose a correct learning rate, it convergence velocity will be very slow. However, the optimal learning rate is very difficult to decide in actual application. Learning rate η will decide the value of the change of weight after each iteration of training. Generally, if learning rate is too large, the whole network will be unstability; if learning rate is too small, the training time will be protracted, so the neural network have the problem of slow convergence. In this paper, an adaptive learning rate is selected. This learning rate can be adjusted automatically according to actual necessaries, which can improve the efficiency of the whole BP neural network. Learning rate η is designed as follows:

To initialize a learning rate, if the total errors increase after an initial adjustment of weight, this adjustment shall be considered null and void. Then:

$\eta = \beta\eta$, ($\beta < 0$) ;

If the total errors decrease after an initial adjustment of weight, this adjustment shall be considered effective. Then:

$\eta = \gamma\eta$, ($\gamma > 0$)

As a general rule, a relatively minor learning rate can minimizes the errors. So a small η can ensure stability of BP neural network. Therefore, η is between 0.01~0.8 in this paper.

The experiments show that this learning rate can ensure BP neural network rapidly converge.

4.2.7 on the determination of number of nodes in the input layer

In this paper, the number of nodes in the input layer should be decided according to the above evaluation index system of construction project in section 4.1.

4.2.8 on the determination of number of nodes in the output layer

The input data will be treated by input layer and hidden layer, then we will get a result in output layer to represent the level of evaluation. We combine the binary numeration system in order to define a specified standard output. So a new vector with four elements is built to represent the evaluation class. There are 9 ranks which suggest the possibility that the evaluation result is from good to bad. For example, the best evaluation result is 9, and its binary numeration is (1 0 0 1), which expresses the corresponding output vector in output layer. Correspondingly, the worst evaluation result is 0, and its binary numeration is (0 0 0 0), which expresses the output vector etc. that is to say, a standard binary coded decimal digits with 4 bits can satisfy the demand of recognition of relevant output vector. So there are 6 nodes in output layer in this paper.

There might also be noted in this paper when activation function is trending towards 0 or 1, which corresponding derivative is trending towards 0 as well. At the same time, the phenomena such as slow astringency and easy torpidity will occur, and the single BP neural network would not be convergent. Therefore, the output vector should be adjusted as follows:

This paper revises the binary code as modified binary code. Then the output vector is composed of 0.01 or 0.99 as modified code. So the best evaluation result is (0.99 0.01 0.01 0.99); Correspondingly, the worst evaluation result is (0.01 0.01 0.01 0.01).

5 Experiments and Results

5.1 quantitative specifications for above indexes

All the data in this paper is from one construction engineering tender agency institution in Nanjing, China, and four evaluation data from corresponding construction project are selected as the learning sample for the improved BP neural network.

As for the bidders, X_1 , X_3 are prestige indexes, and the better the X_1 , X_3 are, the bigger the effect; X_2 , X_4 are benefit indexes, and the less the X_2 , X_4 are, the bigger the effect; X_5 , X_6 are subjective indexes, and inviting tender will mark these indexes with the help of the judgment of experts; in order to make convenience for the following processing, X_5 , X_6 need be set by quantitative methods, in this paper, $X_5 \in \{5,4,3,2,1\}$ and $X_6 \in \{5,4,3,2,1\}$, the higher the level of indexes, the more excellent the indexes.

5.2 The results with improved BP neural network

The parameters of the improved BP neural network should be set as stated above, and the structure of improved BP neural network should be as follows:

According to the actual needs, the number of nodes in input layer is corresponding to the number of evaluation indexes; it is 11 in this paper; at the same time, refer to above principle on the determination of number of nodes in the hidden layer, it is 11 nodes in hidden layer through test. The number of nodes in output layer is 4 as a result vector based on section 4.2.8.

The design for the improved BP neural network can decrease the complexity of the scale of network, and improve its accurate rate of processing.

In this paper, the simulation tool is MATLAB 7.0. And the result of test sample is as the following figure:

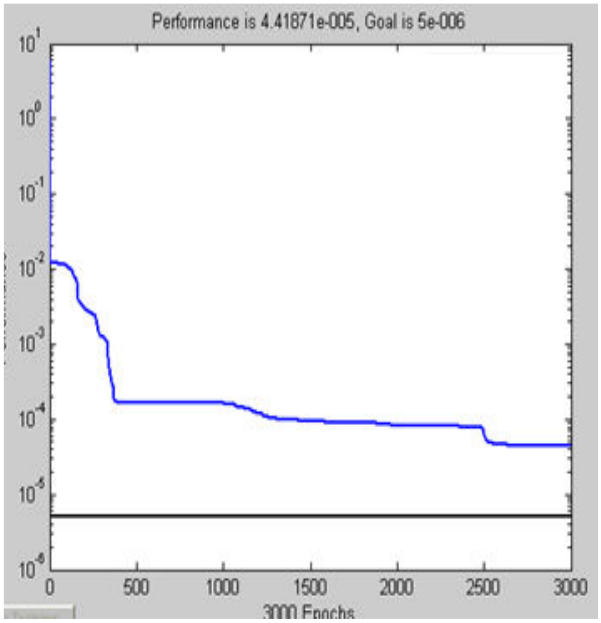

Fig. 2 the result of test sample by improved BP neural network

From the figure 2, it shows that the accuracy of BP neural network after training will be 10^{-5}, and

for the complex test sample, the iteration times of network can be control in 3000, which improve the speed of the improved BP neural network.

5.3 empirical analyses

In this paper, the improved BP neural network is compared with traditional BP neural network, which is used by the toolbox in MATLAB. By way of computing actual test data in order to verify their performance, the results are as follows:

Detected sample	1#	2#	3#	4#
Original evaluation results	0.754	0.552	0.823	0.937
The evaluation results with traditional BP neural network(a)	0.756	0.563	0.872	0.944
The evaluation results with improved BP neural network(b)	0.782	0.569	0.831	0.956
The error rate (divide (a) by (b) /%)	3.439	1.066	-4.702	1.271

Table 1. The results of evaluation on construction project by improved BP neural network and traditional BP neural network

From the table 1, the results of evaluation on construction projects which tested by BP neural network are in substantial agreement in compared with original evaluation results. However, these neural networks improve the accuracy of evaluation results. At the same time, the improved BP neural network has more advanced performance than traditional BP neural network.

6 Conclusions

With economic development in china, more and more major modern construction project will be occur, and the project bid as a standardized preferred transaction method has been seeing more and more applications. However, how to choose a scientific and rational evaluation method is very important to ensure correct and accuracy result. In this paper, according to characters of construction projects, we use the experience of home and abroad as reference, and propose an improved BP neural network based on a new evaluation index system of construction project. It is concluded that the process of evaluation is simple and practical, at the same time, the accuracy can satisfy the actual requirement, which ensure the rationality of the evaluation results.

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