Assessment of Agricultural Information Service Based on Improved BP Network

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Abstract. According to the specific needs of the agricultural information service assessment, ant colony algorithm was adopted to optimize the traditional neural network to avoid its disadvantages of low convergence speed and being prone to fall into the minimum. Evaluation Index system of agricultural information service was built and the neural network model was designed. Learning and training were carried out using the sample data of agricultural information service system. The final evaluation result was obtained through learning of 56 sample data and training of 24 sample data. The result showed that iterations of the BP model optimized was significantly reduced, learning rate and stability were also improved. The model was able to evaluate scientifically and objectively the service of agriculture intelligence agencies..

Keywords: Agriculture Information Service, BP Network, ant colony algorithm.

1 Introduction

With the development of modern agriculture, scientific management methods are widely used in library. How to conduct scientific, quantitative assessment of the agriculture intelligence service of the library, so that it can better meet the agricultural research and engineering staff requirements for intelligence and information has become a hot research focus. Some researchers have made some achievements: Tan(2009) analyzed the evaluation index of the library service and discussed the five evaluation index system on university library personalized service performance. Qiu(2013) built a evaluation index system of library information service quality based a constructed model. Ran(2013) designed the main models of knowledge service in university libraries using fuzzy synthetic appraising method. Some other researchers(Walters 2003, Liangzhi 2005, Nimsomboon 2003) studied the assessment method of service of libraries. However, current researches do not give a method based on uniform standards and intelligence service evaluation system. Based on existing researches, this paper constructed a reasonable evaluation index using APH method, and combined with neural network algorithm to get an overall assessment result. Traditional neural network has slow learning speed and local optimum over-fitting and other defects, affecting the accuracy of the assessment. In this paper, the neural network was optimized by using genetic algorithms(GA). The right values and the structure of the network were obtained through training and learning. The

algorithm was reliable and the low convergence speed, easy falling into local minima and other defects can be avoided. The algorithm can automatically find the inherent nature of property law of the samples. And finally objective and accurate assessments of the agricultural information service quality of library were calculated.

2 Construction of Evaluation Index System

2.1 Construction of Index System

By combining the features of agricultural information services and users' requirements for information, the evaluation system was divided into three categories: (1) personnel assessment of Information Service (2) Resource assessment of Information Service (3) achievements assessment of Information Service. Indicators were further refined and the index system was got as shown below:

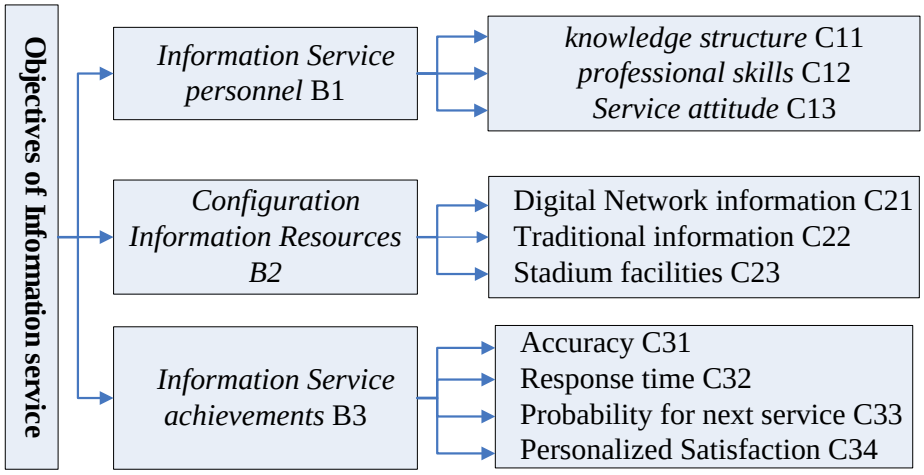

Fig. 1. Index system

From the above, the secondary indicators to assess the information services of the library can be expressed as {B1，B2，…，Bn}(n=3 in this research).

The function of information retrieval Agent is to interact with all kinds of search engine. It retrieved the library of local data information and merged the retrieve information acquired. The information with low correlation degree to user demand was filtered by information filtering agent using certain filtering algorithm. There were two types of filtering algorithms. They were filtering algorithm based on the information content filtering and filtering algorithm based on collaborative filtering respectively. Another algorithm combined the advantages of the above two filter algorithms and realized the combination filtering.

2.2 Consistency test

The weights of the Evaluation indexes were given by the agriculture information specialists. The weights matrices A-B, B1-C, B2-C, B3-C were created after the statistical analysis. Column vectors of the matrices were normalized. The matrices rows were summed and finally the weights of evaluation indexes of the specialist. Consistency test of the evaluation was conducted and the result was shown in the following table:

Table 1: Result of consistency test of evaluation indexes

	A-B	B1-C	B2-C	B3-C
Max characteristic root λ max	3.0020	3.0146	3.0187	4.0533
Consistency index CI	0.0011	0.0013	0.0127	0.0159
Random Consistency RI	0.4400	0.4400	0.4400	0.7800
Consistency ratio CR	0.0025	0.0030	0.0289	0.0204

The above table showed that the consistency ratio CR were all under 0.1. This showed that the consistency of evaluation was within the acceptable range(Liu, 2008). The weight values of the evaluation indexes were shown in the following table:

Table 2: weights of the evaluation indexes

Evaluation index	Weight W	Weight in percentage
C11	0. 0492	4%
C12	0. 1054	11%
C13	0. 0833	8%
C21	0. 1396	14%
C22	0. 0642	7%
C23	0. 1461	15%
C31	0. 1228	12%
C32	0. 0902	9%
C33	0. 0640	7%
C34	0. 1343	13%

The consistency test of weights was conducted and the result was $CR = CI/RI < 0.1$. Therefore, the consistency of the evaluation could be determined in the acceptable range.

3 Evaluation of Information Service

3.1 Optimization of neural networks

The traditional neural network was optimized using genetic Algorithms, so that it can adapt to the assessment of the information services. This optimization algorithm improved the initial weights of the neural network by genetic variation. Essence of the algorithm is designed to train the network by two steps. The first step is the introduction of genetic algorithm and optimization of the BP network weights by GA. The second step is to achieve the goal of network training using the BP network. By encoding the neurons that may be present in neural networks, the initial population

was randomly generated. The neural network was optimized by selection, crossover, mutation and other genetic operators. The specific steps are as follows:

(1) Initial population, the crossover scale and a weight threshold

(2) Calculate the evaluation function of each individual by the following formula:

$$P_i = f_i / \sum_{j=1}^{N} f_j \quad (1)$$

Where f_i was the fitness value of individual i. f_i was measured by error sum squares E , that is

$$f_i = 1/\frac{1}{E(i)} \quad (2)$$

Where $i = 1, 2, ...N$, N is the number of the chromosomes.

(3) Conduct crossover and mutation among the group, thus making it possible to build the next generation of groups.

(4) Place the new population of individuals generated by crossover and mutation in group P and then recalculate the new individual evaluation function. Repeat step 2 to step 4 and a set of thresholds were obtained. And finally training targets complied with the requirements of this study, the algorithm ended.

3.2 Determination of neural network parameters

(1) Selection of the network hidden layers

Increasing the number of hidden layer can improve the nonlinear mapping ability of BP network But if the number of hidden layer exceeded a certain value, it caused performance degradation. of the network. According to the characteristics of neural network and the research needs, this network in this study was designed a three-layer network. The 10 evaluation index values were the input vector of BP neural network. The number of neurons in neural networks was 10. There was only one user evaluation result. Therefore, there was one node in output layer of the neural network.

(2) Determination of the number of neurons in the hidden layer

The number of neurons in the hidden layer had a relatively large impact on nonlinear of the neural networks. It was also related to the complexity of the problems to be solved. The complexity of solving a problem is difficult to quantify. In current time there is no an algorithm for the accurate number of neurons in the hidden layer. If relatively few nodes in the hidden layer were set, the neural network data is difficult to obtain enough information, network training can not be achieved. If more hidden layer nodes were set, the neural network would become over-fitting and the performance would be affected. Assume herein that the number of nodes in the input layer of BP network was I and J in the output layer. The number of hidden layer nodes was determined by the following formula:

$$a = \frac{I + J}{2} < L < (I + J) + 10 = b \quad (3)$$

10 factors were selected in the input layer. The output layer was the evaluation result of the user's. The output layer was in the range of [0,100], 100-90 for excellent, 89-80 for good, 79-70 for medium, 69-60 for acceptable and under 59 for unacceptable. Therefore, in this paper, I=10 and J=1. It can be seen hidden layer node range was between 5 and 21. After several tests, when the hidden layer neural network structure located in the 8-node structure, minimum mean square error (MSE) is obtained as 0.0025113. Therefore, the 10-8-1 three layer neural network was constructed.

(3) Determination of the learning rate

In order to ensure the neural networks without oscillation, a smaller value should be selected as the learning rate. Under normal circumstances the learning rate interval is [0.01,0.9]. To reduce the cost of training, rate based on the adaptive adjustment was selected in this study.

(4) Processing the sample data

Due to the different units between each sample collected, sample sets were normalized to [-1,1] range. Thus BP network training speed was increased.

3.3 Neural network training

Five University Libraries have been selected, namely library of Agricultural University of Hebei, Shanxi Agricultural University Library, Baoding Agricultural Higher Academy Library, Beijing Agricultural College Library, Inner Mongolia Agricultural University Library. 100 users in each University were selected for evaluation, there were 500 evaluation results. 100 samples were randomly selected as the study sample, among which the number of the excellent, the good, the medium, the acceptable, and the unacceptable are 20 respectively. The other 400 samples were for testing. After the training of BP network, the weights obtained when the learning process finished were used as the weights of BP neural network. Neural network model was finally showing convergence. The simulation results showed that the neural network model optimized by genetic algorithm run 184 times when it met the requirement of error（<0.001）. The Training stopped and Network error change leveled off. The neural network optimized by genetic algorithm can achieve rapid optimization. The measured values and the curve fitting values are as follows:

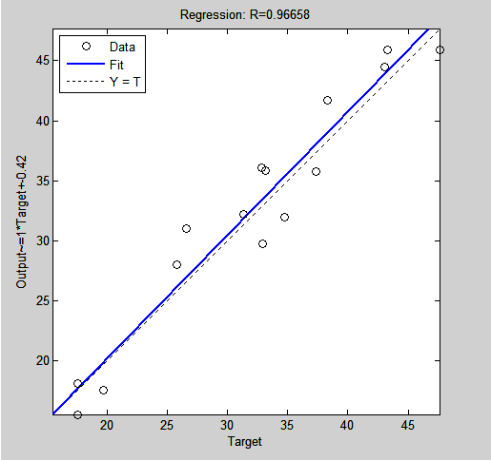

Fig.2. Curves of measured values and the fitting values

The correlation coefficient was close to 1. The algorithm Optimized constructed in this study achieved an ideal result. Learning training error performance curve of basic BP network was shown below:

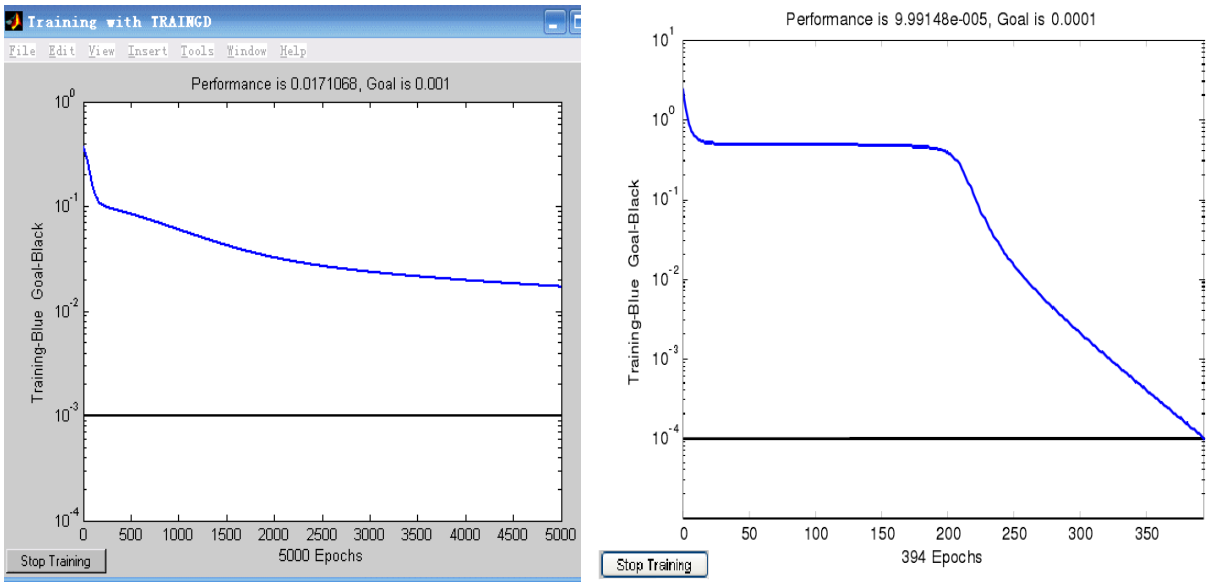

Fig 3. The error performance curve of basic BP network

The horizontal axis represents the number of training and the vertical axis represents the performance of the error, the black line is the training goal line. The blue line is the training error curve. As can be seen from the graph, the basic BP neural network did not meet the target error 0.001 after 5000 times of training, indicating that the basic training of BP network convergence speed was very slow. Learning and training error performance curve of improved adaptive neural network was shown in the following figure:

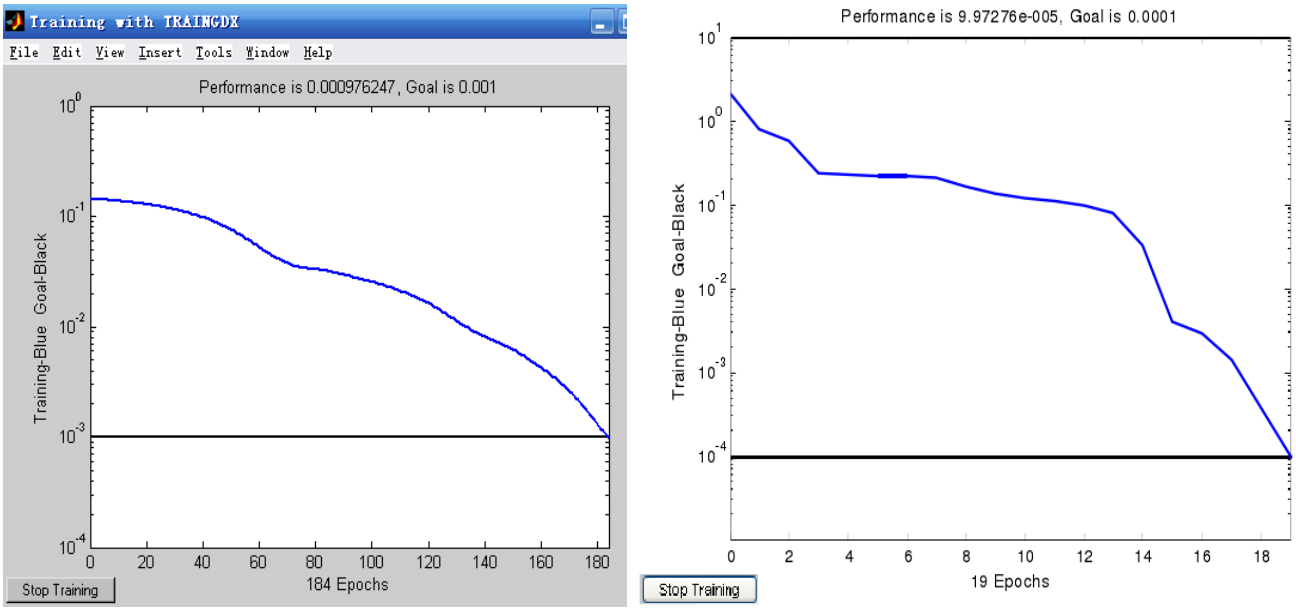

Fig 4. Learning and training error performance curve of improved adaptive neural network

The neural network model optimized by genetic algorithm met the requirement of error（<0.001）after 184 times operation. From the results, the fitting curve was smooth and good simulation performance was got. The remaining data samples 400 were tested. And the test results were compared with the results using by the conventional method. The comparison result was shown below:

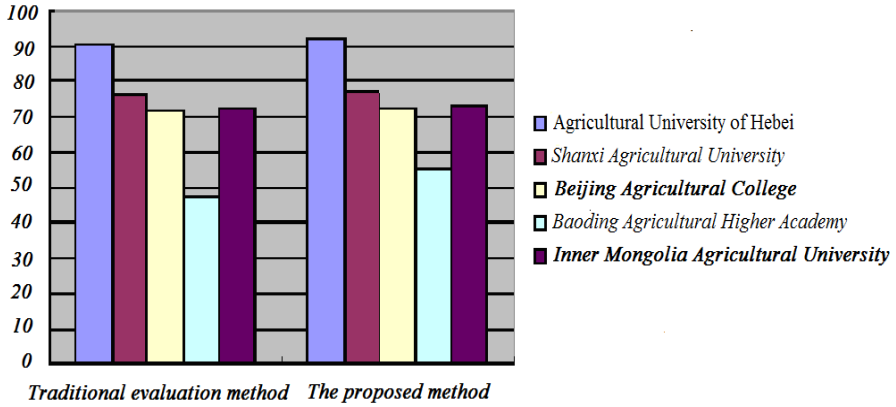

Fig 5. Comparison of proposed method and the traditional method

Two sets of values are as follows, the traditional method test results were 90.5, 76.2, 71.4, 47.9, 71.4. Neural network method test results were 92.5, 77.2, 72.7, 55.6, 73.5. The university library information service quality sorting results were consistent, both are Baoding Agricultural Higher Academy Library, Beijing Agricultural College Library, Inner Mongolia Agricultural University Library, Shanxi Agricultural University Library, library of Agricultural University of Hebei. Figure 5 illustrates the

evaluation scores based on neural network are higher than the original evaluation results.

This is because the neural network was not a simple weighted sum. The neural network gave full consideration to the assessment of uncertainty and diversity of information service, etc. so a little higher or lower evaluation scores on the whole were reasonable. The evaluation model based on neural network is able to reflect the real situation more fully, more reasonable degree， can be applied in the information service quality evaluation. Evaluation based on neural network model can reflect the real situation more fully, more reasonable. It can be applied in the information service quality evaluation.

4 Conclusions

Library is the social information exchange and storage centers. With the development of knowledge economy, the connotation and forms of information service also changed with users' requirements. The library needs to raise their level of information service to meet the user's information needs. This paper constructed the evaluation index system based on AHP and assessment method based on the optimized neural network. This study was helpful to libraries for finding problems and constantly improving their services.

Acknowledgements

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