Automatic Control of Electronic Information Transmission Integrity Considering Gabp Neural Algorithm

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Abstract. With the rapid development of the economy and society, information has become an essential social resource and creates wealth continuously. However, open electronic information can be easily lost during transmission control. In this paper, the state of the information network is determined through a series of indexes based on the GABP neural algorithm. At the same time, the rate of information transmission is adjusted based on the state of the information network through self-adaptation, and the integrity of information transmission is controlled by the genetic particle swarm algorithm. Based on reasonable control of the integrity of information transmission, the research on the automatic control technology of open electronic information transmission integrity is accomplished under the condition that the bandwidth and response delay indexes are meeting. The study results indicate that the neural algorithm based on the GABP network can automatically control the electronic information transmission integrity and improve the reliability of information transmission effectively.

Keywords: GABP Network Neural Algorithm; Electronic Information; Transmission Integrity; Automatic Control

1. Introduction
With the rapid development of informatization, the level of science and technology in China is getting higher and higher. The degree of development and research on electronic information technology has been increasingly deepened. In the transmission of open electronic information, information intercommunication is a prerequisite for realizing different business applications [1-3]. Due to the limitation of the environment of electronic information communication transmission, the objects of current electronic information exchange and the means of communication are relatively single [4-5].

In the electronic information operation, the congestion of the information network can easily cause the reduction of performance indexes such as throughput and delay, which will affect the stability of the operation of the electronic information network and the quality of services. It also affects the bandwidth of the information network and the information network such as caching. The key factor of resource utilization [6-7]. To better meet the development need of the information society, we should pay attention to the research and improvement of the current electronic information system, develop new technologies, and improve its application effects continuously [8-10].
Based on the GABP network neural algorithm, this paper attempts to explore the automatic control of electronic information transmission integrity. The information transmission rate can be adjusted adaptively based on the state of the information network by improving the AIMD congestion control algorithm, and the information can be adjusted to meet the bandwidth and delay indexes. Transmission integrity control is to implement the automatic control of electronic information transmission integrity.

2. Research on key technologies

2.1. BP neural network structure determination

The GABP neural network prediction model can be divided into three parts: BP neural network structure determination, genetic algorithm optimization, and BP neural network prediction. Figure 1 is a schematic diagram of the GABP algorithm flow.

Statistical analysis shows the factors with a significant influence on the working hours of employees. The neural network structure includes n input layers, and the output layer is m=1, which is the operating time.

![Figure 1. GABP algorithm flow](image)

The number of hidden layers is first determined based on equation (1), and then the convergence and error of different hidden layers on the entire learning process are repeatedly verified through data, and the number of layers is finally determined.

\[ h = \sqrt{n + 2 + a} \]  

(1)

where \( a \) is the adjustment constant, which is usually selected in \([1, 10]\).

Assuming there are a total of Q samples, the input of the q-th sample is \( X_q = (x_{q1}, x_{q2}, x_{q3}, x_{q4}) \), the output is \( R_q \), and the input of the jth neuron in the hidden layer is

\[ I_{jq} = \sum_{i=1}^{n} w_{ij} \times x_{qi} - \theta_j \]  

(2)

where \( w_{ij} \) is the weight value of the i-th input of \( X_q \) to the j-th neuron in the hidden layer, and \( P_s \) is the threshold.

The output of the jth neuron in the hidden layer is

\[ O_q = f(I_{jq}) = \tan \frac{\pi}{2} \left( \frac{2}{e^{2I_{jq}} - 1} \right) \]  

(3)

The input of the output layer neuron is
\[
I_q = \sum_{j=1}^{k} w_j \times O_{qj} - \theta
\]

where \(w_j\) is the weight value of the \(j\)-th neuron in the hidden layer to the output layer neuron, and \(\theta\) is the bias.

The output of the \(q\)-th neuron in the output layer is

\[
O_q = f(I_q) = \tan \text{sig}(I_q) = \frac{2}{1 - e^{-2I_q}} - 1
\]

The momentum reversal gradient descent function Traingdm is used in the training function. The network learning function adopts the BP learning rule Learnngdm of momentum term.

2.2. Genetic algorithm optimization

The genetic algorithms are mainly used in the GABP neural network prediction method to optimize the initial weights and thresholds of the BP neural network so that the optimized BP neural network can predict the function output more effectively. The process mainly includes population initialization, fitness function determination, selection, and crossover operations.

Determination of chromosome length: In the genetic optimization algorithm, chromosomes are divided into a weight part and a threshold part. The length of the soft body of the weight part is \(n \times h + m \times h\), and the length of the chromosome of the threshold part is \(n + m\).

Determination of fitness function: The fitness value in the genetic optimization algorithm is a quadratic error between the output value of the BP neural network training and the expected value

\[
\text{fit} = \frac{1}{2} \sum_{q=1}^{Q} (O_q - R_q)^2
\]

Selection: Evolutionary individuals are selected by roulette.

Crossover: As the individual chromosomes are coded by real numbers, the real number crossover method is used in the crossover operation. The \(r\)-th chromosome pt and the \(r\)-th chromosome pr cross at the \(j\)-th position, and the pt and pr after crossover are

\[
\begin{align*}
\hat{p}_{qj} & = p_q (1-z) + p_r z \\
\hat{p}_{rq} & = p_q (1-z) + p_r z
\end{align*}
\]

Conditions met: The number of iterations meets the specified requirements.

2.3. Information transmission control

The quantification of the feedback electronics mainly uses the field value of the packet loss rate of the RTCP message to calculate. In this paper, the information packet loss rate is obtained from the field value of the loss rate in the RTCP-controlled message fed back by the receiving end. If the message information has multiple identifiers and the same time information report block, the highest loss rate is used as a parameter to quantify the required loss rate. The information data are smoothed through the smoother for the acquisition loss rate. The result of information smoothing is quantized and used as the basis for judging the information state. The information smoothing equation is expressed as

\[
P_n = P_{n-1} (1-b) + bP_{\text{back}}
\]
In equation (1), $P_n$ represents waiting to obtain the predicted value, which is the quantized value of the information packet loss rate, $P_{n-1}$ represents the quantized value of the packet loss rate at $Tn$, $P_{back}$ is the loss rate of the information message at $Tn$, and $b$ represents the smooth operator.

From the equation, it can be concluded that when the electronic information network is congested, the value of the loss rate of information data packets $P_{back}$ will be relatively large, and $P_{back}$ will gradually increase and get closer to $P_{back}$ . When the electronic network information changes from congestion to a light load state, the value of X1 will be converted to a smaller value. If the duration is relatively long, $P_{back}$ will decrease and get closer to $P_{back}$.

The implementation of the quantization and adaptation process of the information network through the smoother is closely related to the smoothing operator $b$ because $b$ can filter out random fluctuations. If the value of $b$ is excessively small, the response to the information packet loss rate will be slower; if the value of $b$ is excessively large, the response to the information packet loss rate will be overly sensitive and prone to causing the adjustment of the oscillation of the information transmission. Hence, a reasonable value of $b$ is critical. By changing the value of $b$ continuously, multiple groups of $P_n$ values can be obtained, and the $P_n$ and $b$ values of each group are corresponding. After each group of $P_n$ is close to the $P_{back}$ smoothing effect, the value of $b$ is 0.3. When the information is smooth, the effect is optimal.

2.4. Automatic control of the integrity of information transmission

Combined with the above adjustment of the information transmission rate, automatic control is optimized using the automatic control algorithm of the information transmission congestion of the genetic particle swarm. This method leverages the advantage of the early speed of the particle swarm to generate a relatively large initial population. After optimization based on particle swarm algorithm, it is easier to converge than the initial population, thereby speeding up the algorithm and using the genetic algorithm to select later. As well as crossover and mutation, chromosomes are generated, and the transmission space is optimized.

The optimized genetic particle swarm is an enhanced learning system featuring distributed computing, parallelism, strong robustness, and faster computing speed.

The source node $s$ of the given information and the node $d$ of the target information is transmitted. The initial information transmission is as follows:

1. The adjacent matrix of the information network is used to compare the relationship between the bandwidth and the delay in the electronic information.
2. Based on the bandwidth requirements of the electronic information network, removing the transmission path that does not meet the bandwidth can simplify the electronic information network and speed up the calculation.
3. The information source node ($s$) is 1 element $G(i, j)$, record element $j$, constitute a set of information nodes, that is, all the paths for information transmission from the information source node, choose one information node from the information set. If the information node is the destination information node $d$, the information transmission path can be generated, and the information transmission path is recorded in the transmission path and then go to step (4) or step (3).
4. Clear the elements of the row and column where the information source node $s$ is located in $G(i, j)$, remove the information that the information source node is connected to, and avoid information transmission to form a loop. If all information nodes around the information node have been visited, the transmission path is considered failed, and the search and transmission are performed again. When the next information transmission node is found, the information node is used as the new starting point $s$, and repeat Step (2);
5. Calculate the delay and other losses of an information transmission path. If the requirements are met, a reasonable transmission path is identified. When the initial path reaches the initial information node required by the particle swarm algorithm, it exits.

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The particle swarm algorithm is used to optimize the initial information elaboration path. Since the function of fitness takes the maximum form, the function of fitness can be defined as the reciprocal of function F.

\[
\text{fitness} = \frac{1}{F} = \frac{1}{A \cdot R(p) + B \cdot \delta^2}
\]

(9)

The following equation is used to update the information paper speed and position

\[
\begin{align*}
x_{p+1} &= x_i + v_{p+1} \\
v_{r+1} &= v_i \oplus r_1(p_{i,x} - x_i) \ominus r_2(p_{i,y} - x_i)
\end{align*}
\]

(10)

where \( v_{r+1} \) represents the moving speed of the current information paper, \( x_{r+1} \) represents the position of the current information paper, \( x_i \) represents the position of the previous information paper, \( r_1 \) and \( r_2 \) are random numbers between \([0,1]\), and the symbol \( \oplus \) can be defined Convert the combined operator sequence into a basic operator sequence. \( r_1(p_{i,x} - x_i) \) is the basic operator sequence \( (p_{i,x} - x_i) \) can be retained with the probability of \( r_1 \), \( r_2 \) \( (p_{i,y} - x_i) \) has a similar meaning, \( r_1 \) and \( r_2 \) are the same size. The degree of influence of \( p_{i,x} \) and \( p_{i,y} \) is determined.

The information selection is operated based on the fitness function value. The optimal path of the bandwidth and delay transmission of the information network is selected to ensure that the algorithm converges to the optimal global solution. The research on automatic control of the integrity of electronic information transmission is completed by the above process.

3. Experimental results and analysis

3.1. Combination of reliable and real-time transmission

In the era of rapid information development, to ensure social stability and security, we must attach importance to the real-time and security of information transmission, which is an essential part of the work of electronic systems. Most of the original electronic information systems used low-speed transmission. In the case of extensive information and data traffic, problems such as information line blockage would occur. In the application of information transmission technology, the data information is packaged and classified first, and then based on the specific transmission requirements of the information data, the distance, time, and other conditions are comprehensively considered, and then the data transmission is carried out. On the one hand, this method ensures the relative independence of data information transmission. On the other hand, it also improves the security and stability of information transmission. In specific practice, the real-time and reliability of data information transmission should be effectively combined. Firstly, a three-level buffer mechanism can be used. That is, to realize the real-time reliability of information transmission on the same channel, it is necessary to introduce a three-level buffer mechanism, including a buffer, a reliable message waiting area and a receipt waiting area; the second is to use two sets of retransmission mechanisms. In information transmission control, the network transmission control service software includes two mechanisms: limited retransmission and limited retransmission, which can significantly improve the efficiency of information transmission and ensure its timeliness.

3.2. Information encapsulation and analysis

Information encapsulation is mainly to make data more clearly classified, thereby improving the speed and efficiency of data transmission. In general, data are transmitted at the same level, or it will be converted based on standard protocols during transmission. Then, data transmissions at different levels are performed. Regarding the simple data information transmitted, restriction by the protocol is not required. However, some advanced data information needs to be formatted first, and then a unified
exchange protocol can be realized. The transmission service needs to use the system interface to implement the data reception and analyze the information data based on the transmission protocol, remove the transmission protocol, calmly release its security settings, and deliver the remaining information to the exchange service layer effectively. Finally, the exchange service layer parses the protocol based on the agreement or requirement and completes the format conversion. If encryption software is used to filter the upper-level information and then convert it based on the set conversion format, this entire process shall be completed within the established exchange protocol and implemented within the corresponding service layer to achieve the ultimate purpose of encapsulation.

3.3. Cross-platform transmission
Over the years of development, my country’s electronic information industry is developing towards diversification and intelligence. There are significant differences in software development, hardware equipment manufacturing, etc. Hence, it is necessary to improve the compatibility of electronic information systems, thereby improving the compatibility of electronic information systems. Promoting the cross-platform application of the system is also an essential trend in the growth of the electronic information industry. In cross-platform data transmission, the data transmission equipment and interfaces should be analyzed to form a data transmission package to ensure that the software has the function of cross-platform and data transmission and reduce errors that may occur in information transmission effectively. To better manage and maintain the system, we should pay attention to the modular construction of the system, adopt a unified coding method and algorithm, and improve the efficiency of data transmission.

The integrity of the automatic control of open electronic information transmission is verified. Experiments are conducted in a simulation environment. The number of selected information is 15, the number of inheritance is 40 generations, the size of the initial population is 30, and the crossover probability is 0.96. Figure 2 shows a diagram of an open electronic information transmission node.

![Figure 2 Diagram of Open Electronic Information Transmission Node](image)

Figure 2. Diagram of Open Electronic Information Transmission Node

Analysis of the results suggests that the currently proposed automatic control method for information transmission has a poor control effect when the information transmission channel is transmitted. It does not control all the information in the information transmission channel. The proposed method can control the information transmission channel because the improved AIMD control method is used to adjust the transmission rate of the status information in the electronic information network, which can control the data of the information transmission effectively.

![Figure 3. Comparison of the packet loss rate under the congested state of the information network](image)
In Figure 3, the circle represents the packet loss rate using the algorithm proposed in this paper, and the triangle represents the packet loss rate using the algorithm proposed in this paper. Hence, the packet loss rate of the triangle is significantly lower than the packet loss rate of the circle. When the algorithm in this paper is not used, the packet loss rate is about 8%–10%, while the packet loss rate using the algorithm in this paper is maintained below 8%. This suggests that in the case of electronic information network congestion, the proposed algorithm can prevent loss and ensure the automatic control of information transmission integrity effectively.

4. Conclusions
In the growth of the electronic information industry, information transmission control technology plays an essential. In this paper, the electronic information transmission is controlled automatically based on the GABP network neural algorithm to improve the quality of information transmission, and the corresponding experiments are conducted. The results indicate that the proposed algorithm can effectively prevent the loss of electronic information during transmission control and significantly improve the correctness and security of information transmission.

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