

ARTICLE

Mathematical Model of Short Circuit Fault Diagnosis in management and collaborative System Based On Improved SOM Neural Network

Hui Li

Department of Network and Communication Engineering, Shijiazhuang Information Engineering Vocational College, Shijiazhuang, 052160, China

Yali Li

Department of Network and Communication Engineering, Shijiazhuang Information Engineering Vocational College, Shijiazhuang, 052160, China

Ning Chen*

Department of Network and Communication Engineering, Shijiazhuang Information Engineering Vocational College, Shijiazhuang, 052160, China

ABSTRACT

The existing mathematical model for short-circuit fault diagnosis of management and collaborative system has the problem that the session characteristics of communication link are not clear, resulting in the slow upload speed of fault data. In order to solve this problem, a short-circuit fault diagnosis mathematical model of communication system based on improved SOM neural network and the innovative strategies also management and collaborative system is describing in this paper. Firstly, the early warning information of the system is collected, combined with the repeated information, the session characteristics of the communication link are extracted by using the quasi Newton algorithm, the mutually orthogonal physical resource blocks are transformed, the short-circuit fault diagnosis mode is optimized, the parameters of the components to be detected are estimated, the feature space vector is truncated, and the mathematical model is established by using the improved SOM neural network. Experimental results: the average value of the management and collaborative system short-circuit fault diagnosis mathematical model designed in this paper is 8.244 Mbps, and the average values of the other two management and collaborative system short-circuit fault diagnosis mathematical models are 5.756 Mbps and 5.863 Mbps respectively. The results show that the designed mathematical model for short circuit fault diagnosis of management and collaborative system has high application value.

Journal of Commercial Biotechnology (2021) 26(2), 125–135. doi: 10.5912/jcb1048

Keywords: Improved SOM neural network; management and collaborative system; Short circuit fault diagnosis; Mathematical model; Management and collaborative system; Early warning information;

INTRODUCTION

The new technological innovation like the innovative strategies of the field of biotechnology is used to solve the problems related to the communication or information industry. Today's society is an information society. As an

effective means of information transmission, communication technology has been widely used in our social life. The development of management and collaborative system promotes the development of world economy and improves people's living standards [1-2]. And then to the third generation of mobile communication technology supporting mobile multimedia communication services. In order to support multimedia services with higher data transmission rate, the research on the fourth generation mobile communication technology has quietly sprung up. At present, the relevant organizations of the International Telecommunication Union and the major communication companies in the world have begun the research plan on the fourth generation mobile communication technology. Future mobile communication technology needs mobile multimedia communication services that can support high data transmission rate. The development trend of wireless mobile communication technology is to develop higher frequency band, make effective use of spectrum resources and digitization. The rapid development of communication technology, in addition to being driven by the market economy, should also be supported by corresponding technical forces to meet people's growing demand for wireless communication. However, with the development of society, the number of communication user terminals has increased sharply, and mobile communication has higher and higher requirements for data transmission rate. The capacity of management and collaborative system and available spectrum resources have become the main factors hindering the development of mobile communication technology. It is necessary to introduce new communication technologies to improve the resource utilization of management and collaborative system and expand the capacity of management and collaborative system. The improved SOM neural network is a tutorless, self-organizing and self-learning network composed of fully connected neuron arrays [3-4]. When a neural network accepts external input patterns, it will be divided into different response regions, and each region has different response characteristics to the input patterns. Self-organizing feature mapping is a neural network model commonly used in cluster analysis. It can automatically cluster the input patterns, project the high-dimensional data on the one-dimensional or two-dimensional network, and maintain the topology of the original input patterns as much as possible. The SOM neural network can learn not only the distribution characteristics of the input vector of training data, but also the topology of the input vector of training data. The important feature related to SOM topological sorting feature is that the weight vector of

each neuron and its nearest neighbor neuron is also updated according to a "nearest neighbor function". At present, the academic research data on improving SOM neural network and short-circuit fault of management and collaborative system is not very comprehensive, which needs to be further discussed.

Short circuits are known to result because of the passage of a large amount of current from a single wire instead of passing through different wires. In most communication networking systems the problem of short circuit results that causes a problem in the management and collaborative system. The classification of fault is mostly of three types. The first fault may result in the area of signal processing. The second fault may result due to the missing of useful information, the third fault is due to the change in the process of pattern of data. All these problems give the signal that there is a fault in the communication lane. The short circuit can result in various damages like damage to the appliances, and can also cause fire outbreaks. In the process of diagnosing the short circuit fault it is important to first find out the position, location as well as size of the short circuit. The fault of short-circuits is usually detected using a software-based system that is termed as fault detection system. This software detects the minor short circuit and provides information about the nature of the short circuit. The management and collaborative system holds a great place in the world of today as it is the main system that connects people. Any problem in this system will ultimately cause damage to the management and collaborative system of the world. So it is essential to diagnose the fault of the short circuit for the better working of the management and collaborative system. The diagnosis of the circuit fault improves the working of the communication or any other system. And if the management and collaborative system is working better than all the fields related to communication field will progress. The short circuit can be diagnosed using various methods and models. The best method for the diagnosis of short circuits is the mathematical model that is based on the neural network. This network works on the intelligence system and gives thorough information about the solution of the short circuit and by using this information the problem of short circuit is solved in the management and collaborative system.

Mathematical model of short circuit fault diagnosis in management and collaborative system based on improved SOM neural network

1.1 Collecting system warning information

Every system has its warning information that helps in detecting the problem. In a communication networking system, the collecting of warning information is very essential for dealing with the problems related to the communication network. In the process of collecting warning information or data, the fault diagnosis method is used. Fault diagnosis is a process of forming feasible troubleshooting opinions according to fault characteristics, following certain rules, analysis and treatment of early warning [5-7]. Early warning information refers to the rule representation of abnormal events in the system. The starting system makes announcements with sound, light, word and other information. Fault diagnosis is to analyze and preprocess the early warning information. According to different types of early warning, it is divided into characteristic early warning and non-characteristic early warning. Because the non-characteristic early warning events are not clear, the amount of early warning information is large, and there is information redundancy. It is also possible that the data is incomplete, the time is not synchronized, and it will contain some information that is not related to the event. Due to different early warning attributes, managers with many years of work experience are required to analyze and screen, and combine multiple early warning or different types of early warning into a few early warning information with high accuracy. First check the number, and then grasp the cross platform faults of the whole network from a macro perspective. It is necessary to find the early warning at the first time, present the early warning information and carry out early warning preprocessing. Therefore, collecting system early warning information is an important means for short-circuit fault analysis and preprocessing [8-10]. Early warning information collection is the process that the system obtains data from different equipment network management servers, converts the data into the basic data required by the diagnosis module, and then converts the diagnosis results into the data form that the system can identify. It is a two-way interactive process of the system. Its function is realized by the user interface module, facing the network management interface acquisition and completing format conversion. The pin signal representation is shown in Table 1:

Table 1 Pin signal parameters

number	state	Symbol	Explain
1#	input	RXD	Fault data reception
2#	output	DCD	Data carrier detection
3#	output	GND	Signal transmitting place
4#	input	DTR	Data terminal
5#	input	RTS	Alert information sending request
6#	output	CTS	Alert message sending allowed

It can be seen from table 1 that for a large amount of collected information, including a lot of repeated information, incomplete data and information useless for diagnosis, some repeated information and some redundant information attributes have a great impact on the effectiveness and accuracy of data. In order to convert the original information into the key information required by the system, it is necessary to analyze the secondary, the general the flash warning is removed, the incomplete information is improved, the duplicate information is merged, and the data format type conversion is completed. Combined with the output mode of the given training sample, the expression formula of the observation sample is obtained as follows:

$$W = (\beta) \times \frac{\sqrt{e}}{q^2} \quad (1)$$

In formula (1), β represents the set of prediction functions, q represents independently distributed observation samples, and e represents unknown variables. On this basis, the expression formula of expected value of early warning information is obtained as follows:

$$P(\varepsilon) = \int T(g, l) \times \varepsilon \quad (2)$$

In formula (2), T represents the number of samples, g represents the estimated distribution density, l represents the label category, and ε represents adjacent continuous variables. In addition, the reasoning rules and expression forms of system early warning information are similar to people's way of thinking, and the rules are independent of each other, which is convenient for others to understand and accept. The purpose is to help managers extract key information from complex fault early warning, analyze the relationship between equipment, and eliminate redundant information according to certain rules in combination with early warning information analysis method [11-12]. Effectively sort out the fault performance characteristics between functional components, quickly locate faults and form troubleshooting opinions. Before reasoning, the collected early warning information data is processed in a unified format. The information fields in the unified format include: early warning time, early warning level, early warning type, early warning description, etc., and then reasoning analysis is started. Filter the same events, opposite events, similar events, same fault source events and network topology events, and select the most representative early warning or key fault source early warning information. The expression form and expression method of rules are divided into rule conditions and rule results. Based on this, complete the steps of collecting system early warning information.

1.2 Quasi Newton algorithm for extracting session characteristics of communication links

To determine the characteristics of communication links as well as to determine the strength of communication links various algorithm has been used by researchers in the past. The quasi-Newton algorithm is the most acceptable method for solving the problems related to the communication skills. Quasi Newton algorithm only requires to know the gradient of the objective function at each iteration. This kind of method is much better than the steepest descent method, especially for difficult problems. Communication technology means that under the control of the control link of the base station, two user terminals close to each other use the wireless resources allocated to them by the base station for direct data communication. The data information

transmitted between the communication user terminals does not need to be forwarded through the base station. Since the base station needs to control the communication of the communication user through the control link and does not need to communicate with the communication user, the communication technology can reduce the load of the base station. Since the boundary between users can be equal to the distance between samples in the communication space, the expression formula of the optimal distance is:

$$G_s = \min \frac{|t \times r + d|}{\|r\|} \quad (3)$$

In formula (3), t represents the classification interval, r represents the support vector, and d represents the number of communication ports. In the management and collaborative system, the wireless resources of the system are divided into many orthogonal physical resource blocks. Each physical resource block contains 180 kHz in frequency, and then is allocated to different user terminals for communication. Since the wireless resources allocated to each user terminal are orthogonal to each other, it is unnecessary to consider the mutual interference between user terminals in the cell of the communication link. At the same time, in order to improve the spectrum resource utilization of the communication link, the frequency reuse factor between cells is usually set to 1. Therefore, there will be interference between adjacent cells in the communication link. In order to make full use of the spectrum resources of the existing system, an improved SOM neural network is introduced into the cellular communication link. The communication session establishment process is as follows: first, the user terminal device P1 sends a session request report for communication with the user terminal device P2 to the base station. Then, the base station checks whether the two user terminals can communicate directly. At this time, it needs to consider the impact from the cellular communication network. If the detection result shows that the two user terminals can communicate, the base station will send measurement requests to the user terminal equipment P1 and the user terminal equipment P2 respectively, Let them detect the communication environment between them. The two user terminals send spying signals to each other to measure the channel state information between them, and then send the measurement results to the base station to judge the severity of short-circuit fault, and then take maintenance

measures [13-14]. The base station detects whether the direct communication mode between the two user terminals can achieve better system performance than the ordinary cellular communication mode. If the detection result of the base station shows that the direct communication mode between them can achieve better performance, the base station will allocate wireless resources and configure corresponding transmission power to the two user terminals. Then, the two user terminals will communicate directly. The session process of the communication link is shown in Figure 1:

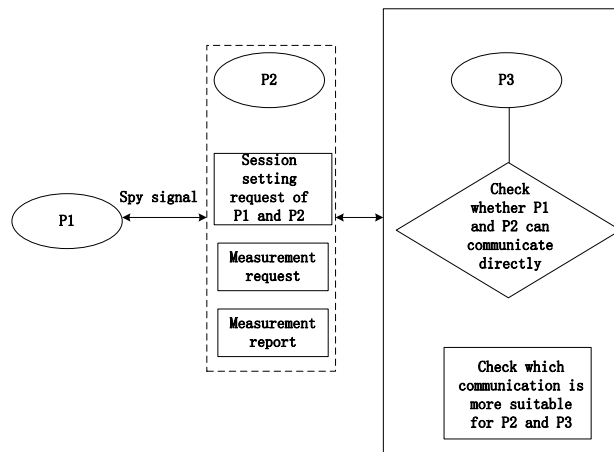


Fig. 1 Session establishment process of communication link

As can be seen from Figure 1, the typical application scenario of communication technology is that the user terminal needs to share files with other nearby user terminals. In the management and collaborative system, it is not necessary to select the name of a non-descriptive Bluetooth communication device or the service area identifier of a WLAN device. The cellular communication network can connect the device identifier with the user identifier. Through the direct communication between user terminals, the file sharing experience of local users in the management and collaborative system can be greatly improved. After introducing local communication technology into cellular management and collaborative system, it is necessary to introduce effective interference control technology. When the interference is controlled, the communication technology can share the wireless resources of other cellular communication users in the system, so as to improve the resource utilization of the management and collaborative system. In the management and collaborative system with small traffic, if there are free wireless resources in the system, the system can

let the data communicate with special wireless resources. At this time, the communication will not interfere with the cellular communication. According to formula (3), the expression formula of constraint conditions is:

$$\eta[w(s+\eta)-1]=0 \quad (4)$$

In formula (4), η represents the complexity factor, w represents the classification threshold, s represents the optimal solution, and η represents any integer. If the traffic of the system is large and there are no redundant wireless resources in the system, the system can share the wireless resources of other cellular communication users in the cell. Based on this, the session characteristics of communication link are extracted.

1.3 Optimizing short circuit fault diagnosis mode

Optimization is a key element for the optimized working of any circuit. Optimizing the management and collaborative system helps in reducing the chances of short circuits. The optimization of short circuit fault is a diagnosis method for the short circuit problem. Due to the complexity of fault causes and short-circuit conditions, it is necessary to adopt a variety of methods to optimize the fault diagnosis process of management and collaborative system. The diagnosis abstract class is the hub of the global database of the short-circuit fault diagnosis management and collaborative system and the outside world. If a fault occurs, some fields of the object of the class derived from it will be reset in the reasoning process, including the fault diagnosis conclusion. Finally, it will be returned to the main program and provided to the user. Parameter identification method is to estimate or solve the parameters of components by collecting sufficient independent feature space and state space data in a known circuit structure. Its essence is also a parameter estimation method. By abstracting the base class, the diagnosis class of each diagnosis object is derived from the base class to meet the needs of real-time change of diagnosis knowledge in the reasoning process of fault diagnosis (i.e. comprehensive database) [15-16]. The specific value of the data is obtained according to the acquisition module, and then fed back to the working memory. The storage method is used to obtain the results of reasoning and diagnosis in the working memory, display them to the

user or store the diagnosis results. The specific structure of the abstract class of short-circuit fault diagnosis is shown in Figure 2:

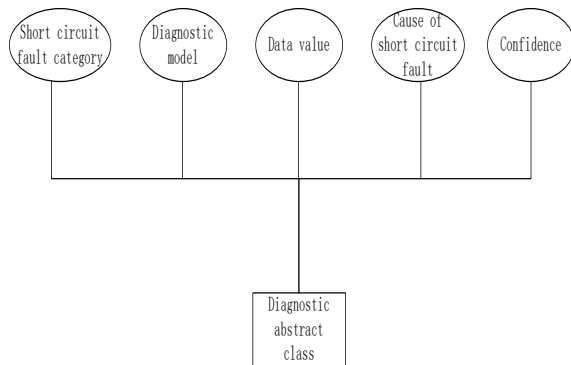


Fig. 2 Abstract class of short circuit fault diagnosis

As can be seen from Figure 2, the diagnosis model represents the diagnosis number in fault diagnosis, which is used to identify which type of fault occurs [17-18]. The parameter value defines the object parameters related to the diagnosis type, and the data value is used to store the actual parameter value. The fault cause is used to record the result of reasoning fault and is stored in string format. The confidence degree represents the reliability of fault reasoning rules, which is expressed by score, 1 represents complete trust, 0 represents complete distrust, and its value is generally between 0 and 1. The bottom module is responsible for the collection of communication data, receiving the original data from the data analysis module and transmitting the data to the upper layer transparently. On this basis, the calculation formula of fault explicit index set is obtained as follows:

$$K = \{ f | h_i + y \} \quad (5)$$

In formula (5), f represents the fault interval, h represents the number of fault points, y represents the given threshold, and i represents the number of fault points to be detected. After the relevant data and speculation are consistent with each other, it can be said that the fault location is successful, and the diagnosis is completed. Based on this, the steps of optimizing the short-circuit fault diagnosis mode are completed. After the relevant data and speculation are consistent with each other, it can be said that the fault location is successful, and the diagnosis is completed. Based on this, the steps of optimizing the short-circuit

fault diagnosis mode are completed.

1.4 Improving SOM neural network to construct mathematical model

The improved SOM neural network is composed of processing unit, network topology and learning rules [19-20]. Processing unit is the basic unit of neural network, which is used to simulate the function of biological neurons. A processing unit has multiple input and output paths. The output terminal simulates the axon function of brain neurons and outputs the information processing results to the outside world. The commonly used modules are composed of input layer and output layer. This connection is a mutual excitation relationship. After training, different nodes in the output layer represent different classification patterns. Therefore, the output layer of SOM is also called feature mapping layer. The diagnosis diagram of improved SOM neural network is shown in Figure 3:

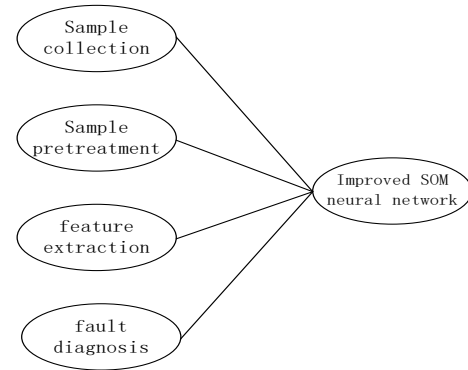


Fig. 3 Schematic diagram of improved SOM neural network diagnosis

As can be seen from Figure 3, the mathematical model centered on the improved SOM neural network fully embodies the essence of hierarchical distributed model structure from selecting neural network, extracting fault features, network learning to fault diagnosis. Since the out of limit alarm can truly reflect the current temperature range of short-circuit fault, the operator considers it safe to keep the temperature high in the model, but the temperature continues to decline and tends to be normal. If the temperature is normal or low, but rises rapidly, there are great potential safety hazards. Therefore, a concept of

derivative of short-circuit fault temperature value with respect to time change shall be introduced, and the specific expression formula is as follows:

$$E = \frac{\lambda M}{\lambda H} \quad (6)$$

In formula (6), λ represents the temperature difference of sampling value, M represents the temperature change trend, and H represents the temperature difference threshold. The combination of the two can improve the accuracy of fault diagnosis and avoid the diagnosis deviation caused by parameter setting. Under discrete conditions, the expression formula of mathematical expected value of random variables is obtained as follows:

$$F = \sum_{j=1}^{\infty} v_j u_j \quad (7)$$

In formula (7), V represents the linear combination component, U represents the principal component, and j represents the corresponding eigenvalue. Principal component analysis includes feature selection and feature extraction. The feature selection process maps the data space to the same dimensional feature space through a reversible transformation, so as to obtain the input features, that is, the input principal components. The purpose of feature extraction process is to reduce dimension, that is, truncate the transformed feature space vector, select the main feature component and discard other feature components. On this basis, the distance expression formula between vectors is obtained as follows:

$$\|N - R\| = \left[\sum_{\varphi=1}^{x=1} (N_{\varphi} - R_{\varphi})^2 \right]^{\frac{1}{2}} \quad (8)$$

In formula (8), N represents the neurons in the output layer of the improved SOM neural network, R represents the weight vector, x represents the neuron feedback layer, and φ represents the input vector. In order to improve the response speed of fault diagnosis, asynchronous multithreading fault diagnosis strategy is adopted for local fault diagnosis, and the function execution of other parts of the program is not affected. The multi-threaded diagnosis

mode shall use the underlying data obtained by the user module through all nodes in the whole monitored domain and preprocessed by the data analysis module to obtain the data transmitted by the data acquisition module. According to the collected data format information, the system will start the fault diagnosis reasoning mechanism for diagnosis and automatically generate multiple corresponding asynchronous threads, so as to avoid congestion and improve fault processing efficiency, so as to meet the strict requirements of communication guarantee real-time. We can also guess the fault location in the circuit first, and then verify the correctness of this guess according to the measured relevant data. Based on the above description, the steps of constructing the mathematical model are completed.

Experimental analysis

2.1 Build an experimental environment

In order to verify the effectiveness of the designed mathematical model for short-circuit fault diagnosis of management and collaborative system, experimental tests are carried out. The design software of fault diagnosis mathematical model is mainly developed by Visual C++, and the complete object-oriented method is used to develop the application program, which greatly saves the development cycle of the application program and reduces the development cost. The mathematical model of fault diagnosis in the domain designs the asynchronous multithreading mechanism to improve the system efficiency. By using the WSASocket function in Visual C++, the node data acquisition mechanism is realized to achieve the purpose of system link fault diagnosis. The inter domain diagnosis function is realized by using C / S architecture, which is fully called client / server architecture, that is, client / server architecture. That is, the well-known software system architecture reduces the communication overhead of the system by reasonably allocating tasks to the client and server. The client has no program, and the upgrade and maintenance of application programs can be completed on the server, which provides convenience for future upgrade and maintenance, so as to realize the system link diagnosis function. The Openfire server is connected to Apache through proxy bosh, and the database MYSQL is directly connected to Openfire. It is deployed on a Toshiba notebook. The operating system is the ultimate version of windows, PC1 is the server, and the browser version is the stable version of chrome. PC2 is a Lenovo all-in-one machine,

the operating system is the ultimate version of windows, and the browser version is the stable version of chrome. The network environment is the laboratory intranet. The server is the intranet website of PC1. PC2 and PC1 are in a LAN, and the intranet of PC2 is connected through a switch. The WSASocket in VC is used to receive the data collected by the data collector, and the fault diagnosis of the system link and software is realized. Inter domain fault diagnosis adopts C / S mode to simulate the system link fault diagnosis state.

2.2 Experimental result

The mathematical models in references [19] and [20] are compared with the short-circuit fault diagnosis mathematical model of management and collaborative system designed in this paper, and the fault data upload rates of the three mathematical models under different distances between conventional channel and base station are tested. The larger the value, the better the performance of the model. The experimental results are shown in table 2-4:

Table 2 Upload rate of fault data set 1km away from the base station (Mbps)

Number of experiments	Literature [19] mathematical model	Literature [20] mathematical model	The mathematical model of short circuit fault diagnosis of management and collaborative system designed in this paper
1	9.551	8.656	13.116
2	8.664	9.132	12.545
3	8.768	9.006	13.097
4	9.232	8.745	12.564
5	8.771	8.343	13.205

Table 3 Upload rate of fault data set 5km away from the base station (Mbps)

Number of experiments	Literature [19] mathematical model	Literature [20] mathematical model	The mathematical model of short circuit fault diagnosis of management and collaborative system designed in this paper
1	6.325	7.203	9.416
2	7.103	7.151	10.203
3	6.845	6.844	11.646
4	7.133	8.202	9.320
5	6.458	7.484	9.548

Table 4 Upload rate of fault data set 10km away from the base station (Mbps)

Number of experiments	Literature [19] mathematical model	Literature [20] mathematical model	The mathematical model of short circuit fault diagnosis of management and collaborative system designed in this paper
1	1.415	1.387	1.974
2	1.503	1.456	1.856
3	1.612	1.533	1.624
4	1.455	1.389	1.755
5	1.514	1.421	1.802

According to table 2-4, the average upload rate of fault data set of three management and collaborative system short-circuit fault diagnosis mathematical models can be obtained, as shown in Figure 4:

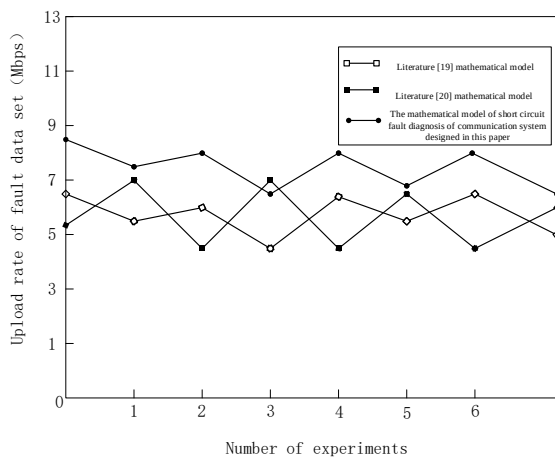


Fig. 4 Average upload rate of fault data set

As can be seen from Figure 4, the average value of the management and collaborative system short-circuit fault diagnosis mathematical model designed in this paper is 8.244 Mbps, and the average values of the other two management and collaborative system short-circuit fault diagnosis mathematical models are 5.756 Mbps and 5.863 Mbps, which proves that the mathematical model designed in this paper has higher performance.

Conclusions

In this paper, a mathematical model for short circuit fault diagnosis of management and collaborative system based on improved SOM neural network is designed. The early warning information of the system is collected, combined with the repeated information, the session characteristics of the communication link are extracted by using the quasi Newton algorithm, the mutually orthogonal physical resource blocks are transformed, the short-circuit fault diagnosis mode is optimized, the parameters of the components to be detected are estimated, the feature space vector is truncated, and the mathematical model is established by using the improved SOM neural network to realize the short-circuit fault diagnosis of the management and collaborative system.

In this research paper, complete information about the management and collaborative system and its working has been discussed. The problem of short circuits and their consequences on the management and collaborative system has been studied. management and collaborative system or organization is the most significant organization in any country. All the communication processes are controlled by this organization. The main function of communication centers is to transmit and receive useful information. There are many management and collaborative system. The five most important management and collaborative system include the electrical communication system, radio system, optical system, duplex, and half-duplex management and collaborative system. All these management and collaborative system work by providing information according to their respective area by using the strategies based on the innovative. Any fault in these systems results in the overall failure of the system. If any type of short circuit results in any of the

management and collaborative system it ultimately affects the management and collaborative system of other systems because all the management and collaborative system are linked with each other in one or another way. short circuits, not an only damage the whole system of communication but also results in the loss of useful information. to solve the problem of short circuit various method based on a neural network has been studied in the research paper. The models and the methods include the warning information collecting system. Quasi-Newton method for the extraction of the characteristics of communication links. Short circuit fault diagnosis method of optimization. And the last model is improving SOM neural network for constructing the mathematical model. All these models help to understand the basic reason for short circuits and how the short circuit and be diagnosed in various communication networks. However, due to the limitation of research conditions, the research on the extension level of management and collaborative system knowledge base is not deep enough. The next step is to deeply analyze the inter departmental collaborative diagnosis knowledge base.

REFERENCES

1. Adouni, A., & Cardoso, A. (2020). Thermal analysis of low-power three-phase induction motors operating under voltage unbalance and inter-turn short circuit faults. *Machines*, 9(2), 11.
2. Dubey, V., D Chadha, & Chandra, V. (2020). Cooperative fso communication system with rf backup as an application to level crossing warning systems for railways. *Optical and Quantum Electronics*, 52(6), 1-14.
3. Ehya, H., & Nysveen, A. (2021). Pattern recognition of inter-turn short circuit fault in a synchronous generator using magnetic flux. *IEEE Transactions on Industry Applications*, PP (99), 1-1.
4. Energy. (2020). New intelligent fault diagnosis (ifd) approach for grid-connected photovoltaic systems. *Energy*, 211(1), 118591.
5. Fan, Y., Cui, R., & Zhang, A. (2020). Torque ripple minimization for inter-turn short-circuit fault based on open-winding five phase ftfscw-ipm motor for electric vehicle application. *IEEE Transactions on Vehicular Technology*, 69(1), 282-292.
6. Ghanaatian, M., and S. Lotfifard. (2019) "Sparsity-Based Short-Circuit Analysis of Power Distribution Systems With Inverter Interfaced Distributed Generators". *IEEE Transactions on Power Systems*, 34(6):4857-4868.
7. Gholami, M., Tehrani-Fard, A. A, Moeini-Aghaie, M., et al. (2020). Detecting the Location of Short-Circuit Faults in Active Distribution Network Using PMU-Based State Estimation[J]. *IEEE Transactions on Smart Grid*, 11(2):1396-1406.
8. GuanJun. (2019). Ber and channel capacity of a deep space fso communication system using 1-ppm-msk-sim scheme during superior solar conjunction. *Optics express*, 27(17), 24610-24623.
9. Khelif, A. M., Azeddine, B., & Eddine, C. (2020). Short-circuit fault diagnosis of the dc-link capacitor and its impact on an electrical drive system. *International Journal of Electrical and Computer Engineering*, 10(3), 2807-2814.
10. Lasjerdi, H., and Z. Nasiri-Gheidari.. (2020). "A Comprehensive Analysis of Short-Circuit Fault in Wound-Rotor Resolvers". *IEEE Transactions on Vehicular Technology*, PP (99), 1-1.
11. Ma, K., Soltani, M., Hajizadeh, A., Zhu, J., & Chen, Z. (2021). Wind farm power optimization and fault ride-through under inter-turn short-circuit fault. *Energies*, 14(11), 3072.
12. M'Hamed, B., Djamel, T., Bessedik, S. A., & Mohamed-Fouad, B. (2020). Least square support vectors machines approach to diagnosis of stator winding short circuit fault in induction motor. *Diagnostyka*, 21(4), 35-41.
13. Mohamed, Z., Chemseddine, R., Djamel, B., & Azeddine, R. (2019). Automatic condition monitoring of electromechanical system based on mcsa, spectral kurtosis and som neural network. *Journal of Vibroengineering*, 21(8), 2082-2095.
14. Noroozi, N., M. Yaghoubi, and M. R. Zolghadri. (2020). "A Short-Circuit Fault Diagnosis Method for Three-Phase Quasi-Z-Source Inverters." *IEEE Transactions on Industrial Electronics* PP (99),1-1.
15. Noroozi, N., Yaghoubi, M., & Zolghadri, M. R. (2020). A short-circuit fault diagnosis method for three-phase quasi-z-source inverters. *IEEE Transactions on Industrial Electronics*, PP (99), 1-1.
16. Shafiabadi, M. H., Ghafi, A. K., DD Manshady, & Nouri, N. (2019). New method to improve energy savings in wireless sensor networks

- by using som neural network. *Journal of Service Science Research*, 11(1), 1-16.
17. Taul, M. G., Pallo, N., Stillwell, A. , & Pilawa-Podgurski, R. C. N. . (2021). Theoretical analysis and experimental validation of flying-capacitor multilevel converters under short-circuit fault conditions. *IEEE Transactions on Power Electronics*, 36(11), 12292-12308.
 18. YANG Yan-jie, YUAN Jing-jing, ZHANG He. (2021). Fault Diagnosis of Excitation Unit Based on Improved Convolution Neural Network. *Computer Simulation*, 38(6), 444-449.
 19. Yasid, N., Alawady, A. A. , Yousof, M. , Talib, M. A. , & Kamarudin, M. S. . (2020). The effect of short circuit fault in three-phase core-typed transformer. *International Journal of Power Electronics and Drive Systems*, 11(1), 409.
 20. Yi, R., Xu, Y. , Qiu, H. , Yang, C. , & X Zhao. (2020). Influence of inter-turn short circuit on the performance of 10 kv, 1000 kw induction motor. *International Journal of Emerging Electric Power Systems*, 21(3), 655-9.