Fault Detection System For Heterogeneous Wireless Communication Networks Based On Joint Feature Parameter Extraction

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Absrtact: In order to solve the problem of poor fault detection accuracy in heterogeneous wireless communication networks, a design method of fault detection system for heterogeneous wireless communication networks based on joint feature parameter extraction is proposed. By using ARM9 chip to optimize the hardware configuration of the system, in order to ensure the operation effect of the system hardware, the software running algorithm of the fault detection system of heterogeneous wireless communication network is optimized based on the joint feature extraction method. According to the segmented features of the extracted fault data of the heterogeneous wireless communication network, the reconstruction and diagnosis operation are carried out, The dynamic fault time of communication network is regulated, and the fault detection system of heterogeneous wireless communication network is established. Finally, the experimental results show that, compared with the traditional methods, the detection accuracy of fault detection system based on joint feature parameter extraction is significantly improved, and the detection speed is relatively faster, which fully meets the research requirements.

Keywords: joint feature parameter; heterogeneous; wireless communication; communication network fault; fault detection; dynamic fault time; joint characteristic parameter

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Introduction

With the development of social economy, heterogeneous wireless communication network is more and more important for the national economy and people's livelihood. At the same time, higher requirements are put forward for the safety and reliability of wireless communication. Therefore, the fault of heterogeneous wireless communication network must be quickly responded, accurately searched and repaired in time. Nowadays, the competition of wireless communication market is becoming more and more fierce, and the requirement of users for

communication service quality is higher and higher. Improving the detection rate of heterogeneous wireless communication network fault detection system, timely isolation and compensation, is an effective way to improve the reliability. The traditional fault detection methods of heterogeneous wireless communication network mostly adopt asynchronous serial or parallel mode[1]. Due to the limitation of transmission speed and distance, it can not meet the requirements of large-scale data exchange in communication system. This paper proposes a design method of fault detection system for heterogeneous wireless communication network based on joint feature parameter extraction Accurate calculation, accurate classification of heterogeneous wireless communication network fault, so as to better judge the type and severity of the fault. Take emergency measures before the fault occurs, and trigger the corresponding fault compensation measures according to the severity of the fault. Because of this, heterogeneous wireless communication network fault detection system based on joint feature parameter extraction is widely used to record the fault process of heterogeneous wireless communication network fault detection system, monitor the operation of the device, and provide the basis for analyzing the fault reason and accurately finding the fault.

1 Fault detection system for heterogeneous wireless communication networks

1.1 Hardware configuration of wireless communication network fault detection system

When the wireless communication network failure is serious, it will directly lead to the network service paralysis, including hardware problems, virus intrusion, software vulnerabilities and so on. Due to the frequent occurrence of communication network failures, the unbalanced communication network appears serious instability[2]. The instability of communication network means that all the running data cannot maintain its original transmission rate in a certain time, and the change of the transmission rate always shows strong uncertainty with the increase of total operation data. Due to the influence of various uncertain factors, the amount of data in the communication network is often too large or too small to meet the requirements of the rated transmission task, thus affecting the stability of the communication network itself. In order to effectively solve the problem of communication network failure under unbalanced environment, the hardware configuration of wireless communication network fault detection system is optimized[3]. The application structure of high-level heterogeneous wireless communication network is separated from the underlying execution equipment. The directional elimination of communication network disconnection is realized by adopting the way of data packet hosting and transmission. In order to solve this problem, on the basis of the original system, in view of the instability of the communication network environment, with the support of compiler, database table and other software and hardware equipment, a new communication network disconnection fault diagnosis system is constructed. In order to ensure the normal operation of the deployed communication network, fault location is considered as the core function to meet

various specific business requirements[4]. Through the analysis of the fault characteristics of the communication network, the specific location of the communication network fault is summarized. The hardware of heterogeneous wireless communication network fault detection system mainly consists of 16 / 32-bit RISC CPU, 16 KB instruction and 16 KB data cache in ARM9 S3C2410 chip, standardizing system manager, adding Mu unit for virtual memory management, system manager of nonlinear flash boot unit, asynchronous serial interface, pulse modulation timer, I / O port, 100 M communication network port, expansion slot, GSM/GPRS expansion board, antenna and SIM card. Based on this, the function of heterogeneous wireless communication network fault detection system is effectively extended. The hardware framework of fault detection system for heterogeneous wireless communication network is optimized, as shown in Figure 1:

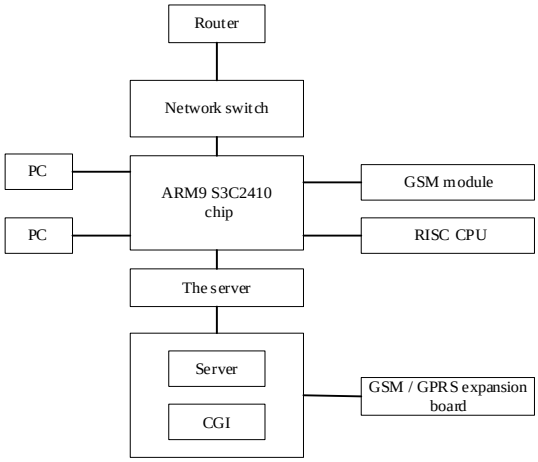

Figure 1 System hardware structure framework

Furthermore, DM 9000 is used to optimize the structure of the terminal server. The PC in the heterogeneous wireless communication fault communication network system logs into the fault detection system to complete the initial working parameter configuration. After completing the configuration of the system, dynamic web technology is used to detect the fault of online equipment. Communication network structure includes database server and communication network terminal server[5]. They are mainly installed in Oracle database. All servers are installed on Apache server and deployed on corresponding communication network pages for business logic on front page. Axis2 server is deployed internally by communication network terminal server. The database and network terminal servers are public servers[6]. The required database servers are public servers. The servers connected by different routers are located in the communication network. The communication network with data transmission and data sharing as the main content has gradually become a new feature of communication network. The deployed communication network can meet the needs of various special services and operate normally. Based on the analysis of the fault characteristics of communication network, the

specific fault location of communication network is summarized with the core function of fault location[7]. In order to ensure accurate fault location, the structure of communication network terminal server needs to be further optimized. The specific structure is shown in Figure 2:

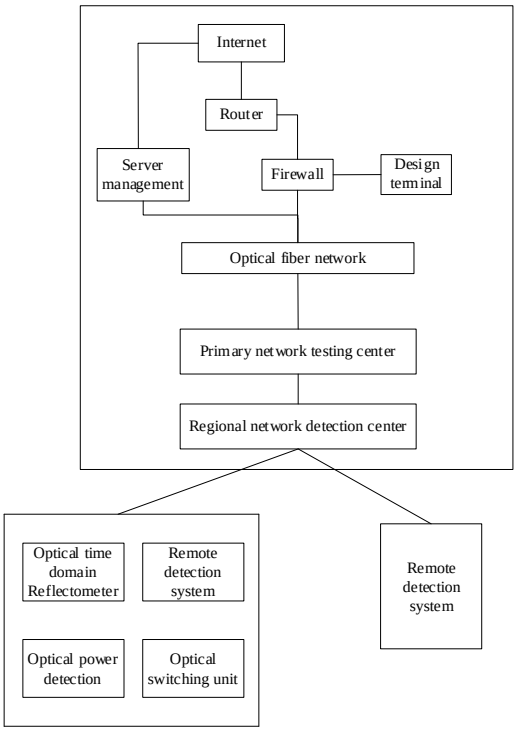

Figure 2 terminal service structure

Based on the configuration structure of Figure 2, the research goal of fast locating the fault area of communication network is realized to ensure the accuracy of fault detection.

1.2 Software algorithm optimization of fault detection system for heterogeneous wireless communication networks

Heterogeneous wireless communication network failures include equipment failure and link failure, which will affect the normal operation of communication network, resulting in abnormal resources of communication network, including service failure, host alarm, and not connected with other hosts. The fault diagnosis process of communication network is to infer the cause of the fault from abnormal signal[8]. The software operating environment is established by the design of the troubleshooting server, the design of the communication network disconnect data table and the unbalanced and unstable design of the communication network lock protocol. Combined with the hardware operating environment, the design of the communication network fault software elimination system is completed. The knowledge stored in the knowledge base is used to judge the communication network failure according to the received input information. If

a fault is diagnosed, the fault is output; if the cause of the fault is not determined, the administrator needs to judge according to experience and expertise, and then update the knowledge base according to the relevant knowledge obtained[9]. Due to the limitation of communication network bandwidth and the influence of random data flow, there will be a long delay in the signal transmission process, which is the induced delay of communication network. Because of this delay, the transmission performance of communication network will be decreased, which seriously affects the reliability of signal transmission[10]. The fault of long delay communication network is analyzed. Considering the running state of the system, the network structure of long-time delay communication is analyzed based on process output and fault signal, The expression is shown in formula (1).

$$\begin{cases} q(k+1) = Aq(k) + Bh(k) + Cf(k) \\ p(k) = Dq(k) + Eh(k) \end{cases} \quad (1)$$

In the formula, $q(k)$ represents the normal operation state of the communication network, the output of $p(k)$ hour detection operation results, $h(k)$ represents the interference signal of wireless communication network, $f(k)$ is the communication network fault signal, and A、B、C、D、E are the communication network dimension constant matrix[11]. When the sensor of wireless communication network fails, the nonlinear state estimation method is needed to detect the signal transmission due to the large transmission delay of the communication network. According to the communication network delay in the figure, the nonlinear communication network fault state evaluation mechanism is constructed.

$$\begin{cases} q'(k+1) = Aq'(k) + Bg(k) + L\left(\overline{p'}(k) - p'(k)\right) \\ p'(k) = Dq'(k) \\ r(k) = M\left(\overline{p}(k) - p'(k)\right) \end{cases} \quad (2)$$

In the formula, $q'(k)$ is the operation state estimation of the communication network, $p'(k)$ is the output of the communication network with time delay; $g(k)$ is the evaluation output; $r(k)$ is the residual signal with delay; L and M are the gain matrix of communication network fault detection and residual signal respectively. Considering the path delay in the process of nonlinear communication network fault estimation, the distribution sequence of

communication network is satisfied

$$\begin{aligned} &p\left(\beta(k)-q'(k+1)\right)=R\left\{\beta(k)\right\}=\overline{\beta} \\ &p\left(\beta(k)\text{-}p'(k)-r(k)-1\right)=1-R\left\{\beta(k)\right\}=1\text{-}\overline{\beta} \end{aligned} \quad (3)$$

Taking data set as the main object, the request is extracted from the response module to obtain the response data, and the transformer fault detection is completed through the data mining process, so as to realize the intelligent detection of transformer fault. It includes the analysis of mining business objects, including multi-level data management. When the phenomenon of random packet loss exists, the loss fault can be detected by analyzing the phenomenon of random packet loss, output calculation and statistical signal eigenvalue. If there is no long-term delay and packet loss failure, then the error caused by other interference factors in the operation of communication network can be ignored[12]. When the communication network fails, the output value of communication network is 1 and the observation error of communication network is 0. Through the collection and description of wireless communication network fault information characteristics, the nonlinear state estimation method is used to detect the signal transmission from sensor to fault detection filter. On this basis, the process of fault state estimation of nonlinear communication network is designed, the mechanism of fault state estimation of communication network is established, the delay characteristics of communication network are analyzed, the characteristic value of signal is counted, and the detection of long delay fault is realized. In the process of transmission, data packets are lost due to the congestion of communication network and the interruption of connection. This situation will cause packet loss, which will lead to the decline of communication network transmission performance, and seriously affect the reliability of data packet transmission. The reason of this communication network failure is analyzed[13]. Data mining refers to mining unknown and reliable data information directly from large database, and using these information to make target decision. Based on this, the heterogeneous communication network fault data mining process is optimized, as shown in the Figure 3.

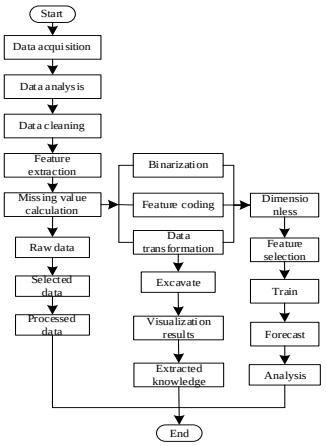

Figure3 Fault data mining flow of heterogeneous communication network

When the control error of communication network increases, due to the joint characteristic parameter control law, the observation error of communication network fault should be treated as residual error, and the overall operation state of communication network can be analyzed by observing the change of residual error, so as to realize the discarding of communication network fault[14]. The main function of fault data mining in heterogeneous communication network is to collect real-time operation parameters, calculate and analyze logic, so as to distinguish whether there is transient or permanent fault. When the fault occurs, the fault data will be uploaded actively. For the data of each sampling period, the time, original data and sampling period are recorded, and all data are stored in external flash memory. When receiving a data call command from the Lora network of the data concentrator, the data packets corresponding to the command are searched, and then the sensor unit uploads these packets directly to the remote server through the 4G network. Operation information and other parameters are transmitted to the data concentrator through Lora communication.

Based on the above analysis, this paper proposes a new communication network detection method: when the absolute bit error difference (BER) is less than the output result threshold, the communication network is in normal operation; when the absolute bit error difference is greater than or equal to the output result threshold, the communication network produces more delay loss packets. Based on this model, a fault compensation mechanism is designed to control the fault tolerance of communication network system, and effectively compensate for the fault tolerance in fault detection.

1.3 Implementation of fault detection in heterogeneous wireless communication networks

Compared with traditional communication networks, the fault detection method based on joint feature parameters extraction is more flexible. The existing fault detection methods all utilize the characteristics of the split route communication network, which has the advantages of low probe requirements and support egmp fault location. Therefore, based on the existing research results, a fault detection system based on segment routing is realized[15]. The fault points in the segment routing communication network are found and analyzed, including providing the probe configuration scheme for users, automatically establishing monitoring path, finding and locating the fault points of communication network, balancing the task and cost of configuration probe. The system is controlled by command line and the fault detection results are fed back to the user. The topology of communication network should be considered reasonably, and the redundancy of monitoring should be reduced as much as possible, and the influence of the system on communication network should be reduced. In order to reconstruct the features of diagnosis fault data, the irregular fault data is divided. According to the characteristics of irregular fault data

segmentation, a volume layer structure is adopted, in which the communication network operation module is composed of four data nodes. The principle of fault data feature reconstruction and diagnosis is introduced. By setting up the communication network operator module of four data nodes, the fault data characteristics can be reconstructed and the fault diagnosis results can be obtained by using the joint formula. The main function of the module is to realize the communication between sensor unit and data concentrator. The sensor unit is composed of stm32l4r5zi MCU, 4G module and Lora module. The sensor monitors the operation data of the equipment through the internal command and sends it to the Lora module. After that, the Lora signal modulated as spread spectrum in the Lora module converges to the data concentrator. The data concentrator collects the data through the Lora module, and after demodulation, it is sent to the remote server by the 4G module through the Internet, the expression is shown in formula (4).

$$g=\delta\left(\sum_{\alpha_1}^{\beta_1}\sum_{\alpha_2}^{\beta_2}k(n)+h_n^2\right) \quad (4)$$

In the formula, δ is the piecewise feature of reconstruction coefficient of abnormal fault data in communication network, and h_n^2 is the fixed diagnostic function. The key to the influence of the randomness of communication network on the data model is to identify the fault parameters. On the basis of understanding the characteristics of convolution structure irregular fault data segmentation, the data node location of communication network operator module remains unchanged. When a fault occurs, the time interval between adjacent nodes can be expressed as follows:

$$e=\min 1\text{-}\overline{\beta}\left[g\sum_{t=1}^{\infty}R(w+u)\right] \quad (5)$$

(5)

In the formula, R represents the basic identification standard, w and u represent the ideal and practical targets of segmentation features of irregular fault data in communication network. The dynamic fault time warping operation of communication network realizes the dynamic time division of communication network by controlling the fault parameters, adding multiple moving window tags, and using the adjacent window tags to control the fault data of different frequencies. The mobile window marking technology is used to sort the irregular control fault data in all communication networks according to the storage space, and

automatically convert the single sequence data into the corresponding multi sequence high-dimensional fault data, so as to improve the basic control frequency of the fault data.It is assumed that the number of mobile window tags added in the communication network does not exceed ψ. The lower limit is ξ.Then the dynamic failure time of the communication network can be expressed as follows:

$$t' = \frac{r}{i}\int_{\xi}^{\psi}\frac{eP(\tau)}{u}d\tau \quad (6)$$

i is used to represent the storage space of irregular control fault data in communication network, r is the standard storage coefficient, and P is the function of dynamic adjustment of fault data. On this basis, the constraint judgment of communication network time warping results on fault data is completed, and the fault data model under irregular control is established. The real-time smoothing index of detection data is the main reference index to determine the physical weight of the data to be detected. It uses the selected and processed communication network to carry out irregular control on the detected fault data, predicts the weighted sum of the detected fault data, and carries out accurate calculation through the existing physical verification methods. From the perspective of irregular control fault data model, real-time detection of smoothing index can not only effectively predict the development trend of data, but also can make use of the limitations of the numerical value itself to summarize the abnormal phenomena in the detection results. The prediction of fault data under unconventional control not only needs to respond to the existing state of the data itself, but also needs to affect the physical operation cycle of the communication network. Therefore, in data detection, it is necessary to connect all the physical nodes where the fault data is located, and establish a new time series through fuzzy correlation. Based on a new fuzzy time detection sequence, the irregular control fault data are sorted into the communication network according to the physical standard. Under the condition of good fuzzy data acquisition, the fuzzy boundedness of irregular control fault data is expressed as follows:

$$z = 1 - \frac{|m - x|}{Ct'} \quad (7)$$

Among them, C is the benign extraction parameter of fuzzy data, m is the first byte number of irregular control fault data on communication network, and x is the first byte number of irregular control fault data on communication network. Furthermore, the similarity of time-frequency characteristic distribution of transient traveling wave is optimized, and the

parameter identification method for different fault types is given. According to different fault detection results, the optimal fault detection scheme is selected. Furthermore, the transient traveling wave fault of infinite communication network can be classified and detected accurately to realize the accurate location of transient fault area, thus effectively improving the speed and accuracy of fault detection. Through the fusion of fuzzy theory, the membership conditions under the joint characteristic parameters are determined, and the fault detection is realized, and the schematic diagram is given, as shown in Figure 4.

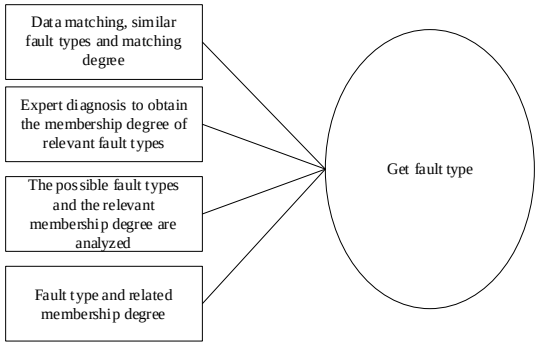

Figure 4 Schematic diagram of infinite communication network fault detection

Based on the above detection methods, the fault types of heterogeneous wireless communication networks are accurately detected, and the appropriate detection methods are selected according to the fault conditions. Finally, the detection results can be transmitted to the coordination control unit to resolve the conflict, and improve the accuracy and effectiveness of wireless communication network fault detection results under joint feature parameter extraction.

2 Experimental results

In order to test the effectiveness of fault detection system for heterogeneous wireless communication networks based on joint feature parameter extraction, experimental verification is needed. Taking communication network fault detection error as the test standard, the traditional communication network fault detection error and nonlinear state estimation methods are compared. From 12:00, December 1, 2018 to 12:00, December 2, 2018, 100 groups of communication network fault detection data variables were selected, and normal data were extracted according to the historical records. The sampling frequency was set to 10 times per minute, and the data set was standardized. In the process of testing, some test parameters are needed to support the software environment for comparative testing. The operating frequency is 410mhz ~ 441mhz. There are 23 channels in total with 1MHz frequency as step channel. When put into use, at instruction can modify various parameters such as serial port rate, transmitting power, air rate and working mode on line. It has small volume, low power consumption and long transmission distance. In this paper, two groups of test parameters are set as the comparison

environment between the method and the traditional method, as shown in the table. The test parameters used in the references and the test parameters of the manual test method are given. The test parameters of the current fault detection method used in the references are given in the table 1.

Table 1 Comparison of experimental parameters

Name	Data (type)
Operating system	Windows7
CMT	Express Edition
Open NI	Version 2
Programing language	C++
Frequency conversion	No / Yes

The openni model provides the fault range of circuit board for the operator. Considering the change of parameters in different frequencies, after the initialization of the equipment, a data task is started. Its function is to transmit the required data to the integrated guidance and display console system in the communication network in real time according to the time interval specified in the protocol, and to conduct continuous timing query on the current communication network adapter. When the communication network adapter continues to monitor the current communication network adapter, if it finds that one of the communication network adapters is invalid, it switches to another. If the communication network adapter switches successfully, it becomes the current communication network adapter and continues to broadcast data. Thus, the fault communication network link is eliminated without affecting the data transmission, and the system reliability can be improved. Based on this, the accuracy and time-consuming values of the two methods are compared and recorded. The specific test results are shown in the Figure 5:

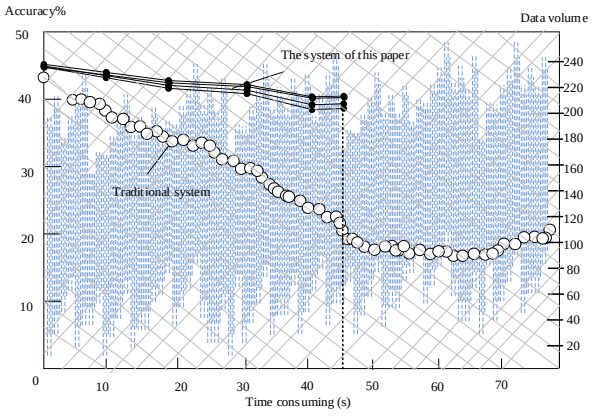

Figure 5 Comparison test results

In the Figure 5, the fault detection of heterogeneous infinite communication network is detected under the interference environment. According to the comparison results in the figure, compared with the traditional fault detection system, the fault detection system of heterogeneous wireless communication network proposed in this paper based on the extraction of joint feature parameters has better effect in the practical application. With the increase of the amount of data to be detected, the detection accuracy of the fault detection system based on joint feature extraction is stable and time consuming is low. In the practical application process, with the increase of data, the detection accuracy of the traditional detection system is obviously decreasing, and it takes more time. Therefore, it is proved that the heterogeneous wireless wireless system based on the joint feature parameter extraction is proved The practical application of the communication network fault detection system is better and fully meets the research requirements.

3 Conclusions

With the rapid development of communication network technology, people have higher requirements for communication network security. Heterogeneous wireless communication network fault detection system has become the focus of current research. Based on the previous research results, this paper introduces the research background and development status of heterogeneous wireless communication network fault detection system based on joint feature parameter extraction, analyzes the common communication network fault diagnosis schemes, mainly including passive diagnosis and active diagnosis, understands the characteristics and research focus of various schemes, optimizes the detection data packet processing difficulties and in the conventional communication network Fault detection problems. This paper analyzes the system functional requirements, detection points and path construction, and provides users with the detection results, and at the same time, it should also plan the optimization scheme. Through a large number of experiments, it is proved that the fault detection system of heterogeneous wireless communication network based on joint feature parameter extraction can automatically detect the equipment, and greatly reduce the consumption of human, material and financial resources. In the future, it can be widely studied in the wireless communication system, such as multi node, low power consumption and so on.

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