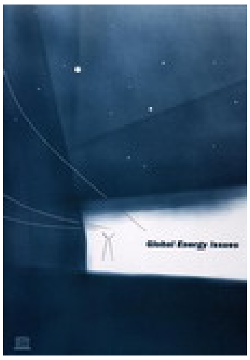

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# Optimisation of computer network reliability based upon sensor technology and genetic algorithm

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**Abstract:** In today's society, there has been a trend towards high digitisation, which means that the importance of computer networks is also increasing. Computer network reliability is the concept of measuring the security and stability of computer network system based on its importance. Nowadays, network reliability detection systems at home and abroad have their own standards. It is not conducive to the measurement between different system networks. This article is dedicated to optimising the reliability of the computer network, making it more convenient, quick and easy to operate. For this reason, this paper proposes a network reliability analysis algorithm based on sensor technology, and then uses genetic algorithm to optimise it. The proposed optimisation algorithm is to solve the problems of high algorithm complexity and low-computational efficiency. In the experiment, the original algorithm was compared with the optimised algorithm. A number of tests have also been conducted for network reliability analysis. Experimental results show that the optimised algorithm can increase the accuracy rate to more than 90%, and can recall a high percentage of correct matching pairs. The average time overhead is also around 300 ms.

**Keywords:** sensor technology; genetic algorithm; computer network; reliability optimisation.

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## 1 Introduction

### *1.1 Background*

The 21st century is the age of the Internet. The development of computer networks provides us with indispensable conditions for advancing the intelligent construction and overall development of cities. As a tool of the new century, it is revolutionary. As a place with a virtual nature, the Internet has gradually become inseparable from our lives and has brought great changes to our way of life. It is also our dependence on the network, the greater the role of the computer network, even affecting the social economy, education and medical care. At the same time, due to the development of emerging technologies such as semiconductors, sensor technology is also changing with each passing day, which is also affecting computer networks. At the same time, its research on genetic algorithms has become more in-depth. For this reason, the status of computer networks in life has also been consolidated.

Whether the computer network can be reliable and whether it can operate stably has become a question of great concern to related workers and user scholars. For now, there are different studies on the reliability of computer networks. However, the relevant detection standards and detection elements are not the same, but this is actually detrimental to the optimisation of our network reliability. Therefore, this article will also focus on the optimisation of network reliability and discuss the optimisation content based on genetic algorithm.

### *1.2 Significance*

We usually think that network reliability refers to the stability of the network, and people often complain about the phenomenon of 'disconnection' in life. But network reliability also includes its vulnerability, security, etc., which is also the focus of the article's analysis. A secure network can add fun to our daily lives, provide orderly governance for society, and provide stability for national security and the military. If there is no network security, our lives will be deadlocked, and social governance will be more complicated. Therefore, the current research on the reliability of computer networks is so hot and vigorous.

With the advancement of the strategy of building a strong country through science and technology, the popularisation of computer networks is also in full swing, and with it comes related research on network reliability. It can be said that the research on it has become a hot spot now. Moreover, the penetration of computer networks into daily life is very thorough. It can be said that people have been unable to leave the Internet for normal life. Therefore, it is of great significance to carry out the analysis of computer network reliability now. It also has a strong reference significance for various reliability testing models today.

### *1.3 Related work*

If the computer is a powerful rocket, then the computer network is the fuel that provides power. So the importance of computer networks can be imagined. The study of computer networks began with a telecommunications disaster. Because of the huge losses it brings, the research on network reliability is so important. Today, when computers are highly developed, related research on computer networks is also very hot. Xi et al. (2017) proposed an overall framework for the communication interference between Wireless HART networks, and applying existing methods to such coexistence networks will lead to performance degradation. It can optimise the reliability and timeliness of multiple coexisting networks. Experimental results show that their algorithm performance is stable, and the packet loss rate is reduced by 36%. For scheduling algorithms, simulations show that compared with existing algorithms, the more coexisting networks, the less resources our algorithm uses. When eight networks coexist, our algorithm outperforms existing algorithms by consuming up to 63% of channel resources (Xi et al., 2017). Yeh and Fiondella (2017) believed that modern society depends on the stability of computer networks. One way to achieve this goal is to determine the optimal redundancy allocation to maximise system reliability. In the article, they study the application of the relevant binomial distribution to characterise the state distribution of each edge in the network. And they proposed a redundancy optimisation method that integrates Simulated Annealing (SA), minimum path and related binomial distribution. This method is applied to four actual computer networks to prove the computational efficiency of the proposed SA relative to several popular soft computing algorithms (Yeh and Fiondella, 2017). Chantre and Fonseca (2018) studied the problem of locating edge devices in a small cell network based on ultra-dense 5G NFV to provide reliable broadcast services. The solution he proposed is to optimally place the VNF for broadcast transmission on selected edge devices to ensure high reliability and minimise the cost of providing broadcast services, as well as the possibility of service request loss. The results show that the solution he proposed achieves a high level of reliability and low latency (Chantre and Fonseca, 2018). Bistouni and Jahanshahi (2016) first used the decomposition method to introduce the reliability analysis of the Ethernet single-ring mesh network in detail. They used a new method called spanning tree set method to accurately analyse the reliability of Ethernet multi-ring mesh networks. Then, they used a hierarchical model to analyse the availability of ring networks with imperfect coverage and online repair assumptions. Each subsystem is modelled as a series of independent Markov component systems (Bistouni and Jahanshahi, 2016). Koryachko et al. (2017) researched is to develop and study an improved multi-path adaptive routing model in a computer network with load balancing. In this study, they focused on the jitter optimisation index between paved paths and the deviation between the alternate route and the optimal route. They compared and estimated the provided algorithm with some existing methods, and modelled and analysed various topological structures of computer networks (Koryachko et al., 2017). For computer research, algorithms are equally important. For the genetic algorithm, Aggarwal et al. (2017) proposed a method for time-dependent system availability analysis of the production system, and used the genetic algorithm to optimise the performance of the system. They established a systematic mathematical formula based on Markov's life and death process. And based on the assumption that the failure and repair rate of each subsystem obeys an exponential distribution, they developed the first-order Chapman-Kolmogorov differential equation. The experimental results prove that the algorithm can greatly improve the efficiency of the production system (Aggarwal et al., 2017). Tavakkoli-Moghaddam et al. (2017) studied the redundancy strategy, and they proposed when the redundancy strategy can be selected for each subsystem. They proposed a Genetic Algorithm (GA) for the redundancy allocation problem of series-parallel system. The experiment proves that genetic algorithm is an effective method to solve such problems. Finally, they gave the calculation results of typical scenarios and discussed the practicability of the proposed algorithm (Tavakkoli-Moghaddam et al., 2017). Gong et al. (2018) focused on the Interval Multi-Objective Optimisation Problem (IMaOP). It involves more than three goals, and at least one is affected by interval uncertainty. It is everywhere in practical applications. They proposed a set-based genetic algorithm to solve them effectively. Numerical results prove the superiority of their method (Gong et al., 2018). All in all, with the development of computer networks today, there are no few researches on this. However, there are not many studies on the reliability of computer networks based on the combination of sensor technology and genetic algorithms.

### 1.4 Innovation

The research on network reliability has a long history at home and abroad. Whether it is to innovate and improve its detection methods, or to optimise the reliability, there are many related studies. But society is progressing, technology is developing, and computer networks are also changing with each passing day. Therefore, the research on it will not be outdated. This article also makes some technical innovations based on previous research, specifically the following two points. (1) This paper proposes a method for optimising network reliability based on sensors, which is rarely studied at home and abroad. We know that the development of computer technology is inseparable from the support of various sensors, so computer networks are also dependent on sensors. (2) This paper proposes an improved algorithm based on genetic algorithm for the optimisation of the algorithm. This algorithm for network reliability can significantly improve efficiency.

## 2 Introduction to related technologies

### 2.1 Sensor technology

The invention of sensor technology is to provide convenience in industrial production. Later, due to its small size, detachability and strong functions, it was gradually used in various aspects. Computer sensor network is one aspect (Song et al., 2016). It is a detection device for external information, and transmits the processed data to the observer instead of the original collected data. Owing the development of information perception technology, the development of electronic computer technology, and the development of wireless communication technology, wireless sensor network technology has also developed rapidly (Itani et al., 2016).

The wireless sensor network is based on sensor technology, with intelligent sensors as the bottom layer, data as the centre, and sensor nodes as the foundation of WSN. The main task is to collect the data information of their respective ranges, and other nodes on the network. According to the basic raw information measured by the sensors (Shafique et al., 2020), each sensor node will be assigned one when it is deployed. Such a node can not only save complicated and bloated wiring, but also realise real-time information sharing (Zhang et al., 2018). It can save energy and improve network performance such as throughput. It processes the collected information, and then transmits the information to the upper node. The traditional sensor unit is composed of various traditional analogue or digital sensors (Shahzad et al., 2016). In wireless sensor networks, the transmission of a large amount of redundant data is bound to cause data packet collisions. All sensor nodes are connected to each other, it collects relevant information through collaboration, which is easy to cause network congestion (Zhang and Chiong, 2016).

For the in-network information processing technology of wireless sensor networks, sensors are used to output data information in the form of electrical signals. The programs running on each node can be exactly the same, and they enable the wireless sensor network to perform non-contact measurement to solve the problem from the root cause. It becomes an intelligent network that is different from the traditional network (Gaxiola-Camacho et al., 2017). Therefore, sensor technology is also particularly important in the application of computer networks (Liu et al., 2016). In this article, sensor network is also one of the important networks in network reliability detection.

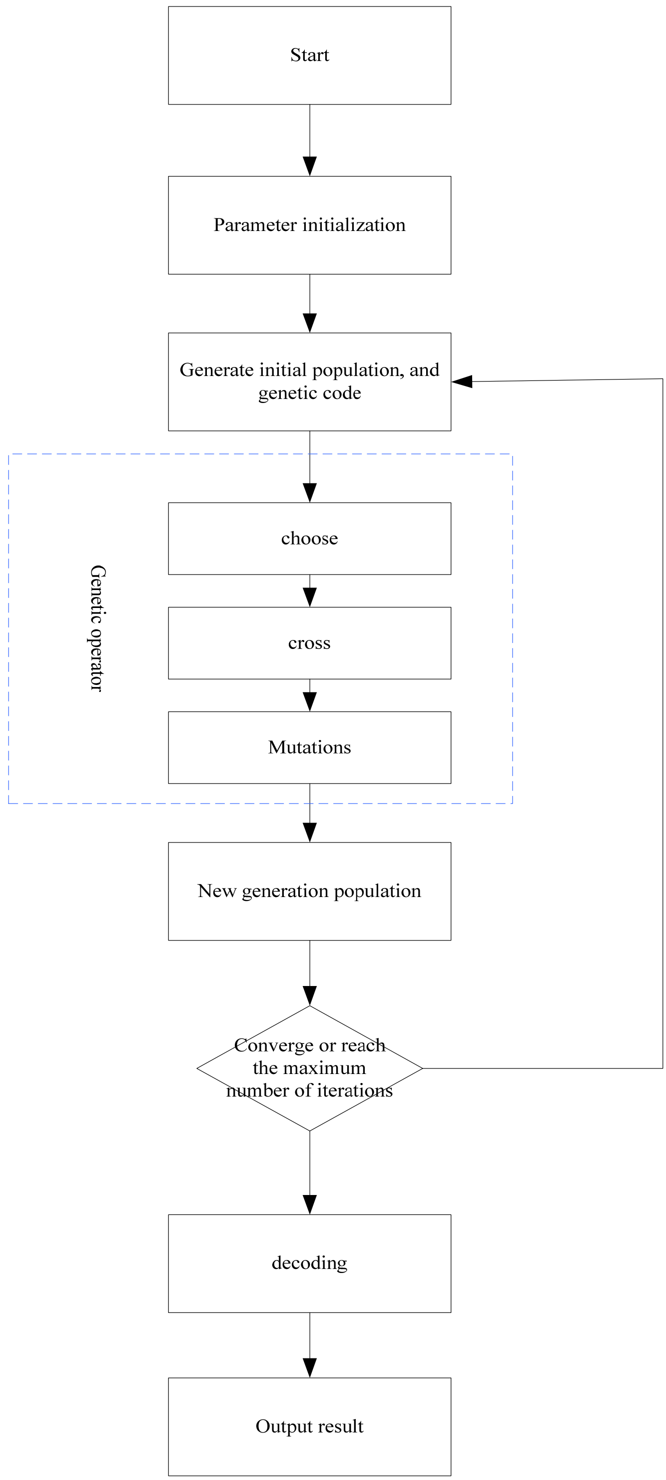
### *2.2 Genetic algorithm*

The genetic algorithm is based on Darwin's theory of species evolution. It is similar to the idea of natural selection in the theory of evolution. In the overall situation, selection, heredity, and crossover in nature are used as algorithms. It performs directional selection first, and then non-directional mutation (Kurimoto et al., 2018). It starts evolutionary iteration from multiple solutions. Because of the limitations of the sample, the algorithm easily enters the local optimum. Therefore, it is necessary to avoid this situation through a suitable fitness function, and calculate the fitness value of each chromosome according to the designed fitness function (Azad and Jha, 2016). Then, first judge whether the optimal algorithm is reached, if not, continue to use the three genetic operators of selection, crossover, and mutation. These three operators perform different steps of gene evolution. So it has a certain degree of uncertainty. It is also that the algorithm has randomness in the selection of operators, and the probability of selecting each operator may vary. Therefore, genetic algorithm has advantages in solving more complex algorithms such as large spaces, and it is not easy to be interfered by external forces (Asrari et al., 2016). Usually in the algorithm process, it is necessary to manually set the threshold when deciding whether to inherit to the next generation (Liu et al., 2017). The threshold can control the traits of genes, so it needs to be preset in advance.

1) *Basic process*: The execution process of genetic algorithm is shown in Figure 1.

In Figure 1, the middle part is the crossover, genetic, and mutation process, which is the core part of the algorithm. In this part, the algorithm is responsible for processing the data. It inputs variables from the beginning, and then undergoes data cleaning and coding. This article uses binary coding, assigns values, initialises the population and evaluates the fitness of the population. This article uses Pareto fitness, which has the advantage of being able to perform rapid screening analysis. The specific algorithm introduction is described in the following text (Spiliotis et al., 2016). For the population that has passed the fitness evaluation, it can be output. If it does not pass, then the core algorithm, or crossover, or mutation, or inheritance is carried out, until the optimal solution is output through the fitness evaluation (Shamna and Lillykutty, 2017).

**Figure 1** Flow chart of genetic algorithm execution



2) *Pareto fitness*: There are many fitness functions, this article chooses Pareto fitness. Because it can quickly classify and execute operators, it is more efficient (Li et al., 2019). At the same time, the fitness function also needs to change continuously:

$$\min M = (m_1(x) + m_2(x) + .... + m_k(x)) \quad s, t, x \in \omega \tag{1}$$

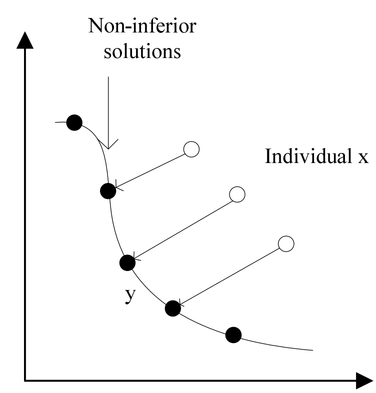
In equation (1), $m_k(x)$ is the *k*-th sub-objective of m, w represents all feasible solutions, and the optimal set is composed of Pareto optimal solutions. The population boundary formed by the Pareto optimal set in the objective function graph is called the Pareto non-inferior front (Selvi and Ramakrishnan, 2020; Cordeschi et al., 2017). In order to obtain a dense and complete Pareto front, the niche theory is used to expand the dispersion of the population. Then, calculate the target value of each individual in the population and obtain the fitness according to the Pareto theory (Ahmad et al., 2016). The specific formula is as follows:

1) According to the algorithm in equation (1), calculate the pseudo-ranking number of all individuals, as in equation (2):

$$R(i) = \left|\left\{ j \middle| j \in P, j > i \right\}\right| \quad \forall i \in P \tag{2}$$

In equation (2), '>' represents the Pareto dominance relationship, that is, how many individuals dominate in the current population. The black dot in Figure 2 is the non-inferior front, which dominates the white dot at the start position of the corresponding arrow (Aminshokravi et al., 2018).

**Figure 2** Pareto frontier solution




2) Calculate the ranking number of individual *i*

$$R(i) = R'(i) + \sum\nolimits_{j \in R} R'(j) \tag{3}$$

Use equation (3) to convert the pseudo-ranked number to the ranked number.

3) Calculate the number of niches

Use equation (4) for normalisation.

$$f_{ih} = m_{ij} \Big/ \sum_{k \in s} m_{kj} \tag{4}$$

4) Pareto fitness is positively correlated with the number of individual niches, and inversely correlated with the number of individual rankings. In case the denominator is 0, add the constant $N$ to the denominator to get the following equation (5):

$$fitness(i) = \frac{s_t}{R(i) + N} \tag{5}$$

5) *Introduction to related variables*: In equation (6), $D$ is the distance matrix, which is a three-dimensional matrix:

$$D_k = \begin{bmatrix} d_{1,1}^k & \cdots & d_{1,n}^k \\ \vdots & \ddots & \vdots \\ d_{n,1}^k & \cdots & d_{n,n}^k \end{bmatrix} \tag{6}$$

In equation (7), $C$ is the candidate set of the transportation mode, and it is also a three-dimensional matrix.

$$C^l = \begin{bmatrix} c_{1,1}^l & \cdots & c_{1,n}^l \\ \vdots & \ddots & \vdots \\ c_{n,1}^l & \cdots & c_{n,n}^l \end{bmatrix} \tag{7}$$

In equation (8), $S$ represents the average speed of various transportation methods.

$$S = \{s_1, s_2, \ldots, s_n\} \tag{8}$$

In equation (9), $D$ is the transportation cost matrix.

$$D = \{d_1, d_2, \ldots, d_n\} \tag{9}$$

In equation (10), $M$ is the transshipment cost matrix:

$$M = \begin{bmatrix} m_{1,1} & \cdots & m_{1,k} \\ \vdots & \ddots & \vdots \\ m_{k,1} & \cdots & m_{k,k} \end{bmatrix} \tag{10}$$

In equation (11), $ZTW$ is the time window matrix, $ZZ$ is the earliest time to reach the destination, and $ZW$ is the deadline.

$$ZTW = [ZZ, ZW] \tag{11}$$

In equation (12), $MT$ is the initial time matrix.

$$MT^2 = \begin{bmatrix} mt_{1,1}^2 & \cdots & mt_{1,n}^2 \\ \vdots & \ddots & \vdots \\ mt_{n,1}^2 & \cdots & mt_{n,n}^2 \end{bmatrix} \tag{12}$$

In formula (13), *QT* is the time interval matrix.

$$QT^2 = \begin{bmatrix} qt_{1,1}^2 & \cdots & qt_{1,n}^2 \\ \vdots & \ddots & \vdots \\ qt_{n,1}^2 & \cdots & qt_{n,n}^2 \end{bmatrix} \tag{13}$$

In equation (14), *T* is the time taken by the conversion method.

$$T = \begin{bmatrix} t^{1,1} & \cdots & t^{1,k} \\ \vdots & \ddots & \vdots \\ t^{k,1} & \cdots & t^{k,k} \end{bmatrix} \tag{14}$$

In equation (15), *P* is the capacity matrix.

$$P^k = \begin{bmatrix} p_{1,1}^k & \cdots & p_{1,n}^k \\ \vdots & \ddots & \vdots \\ p_{n,1}^k & \cdots & p_{n,n}^k \end{bmatrix} \tag{15}$$

In equation (16), *O* is the emission matrix.

$$O = \{O_1, O_2, \ldots, O_k\} \tag{16}$$

So far, the introduction of the variables required by the algorithm has been completed, which will not be repeated in subsequent experiments (Khoshraftar and Heidari, 2020). The evaluation indicators for the algorithm are as follows:

Equation (17) is the accuracy rate:

$$Z = \frac{\sum_{i=1}^{K} c_i}{n} \tag{17}$$

Among them, *n* represents the number of individuals and *i* represents the cluster number. Equation (18) is the average accuracy rate:

$$Z_p = \frac{\sum_{i=1}^{N} z}{N} \tag{18}$$

Among them, *N* represents the number of experiments and *i* represents the number of experiments.

In equation (19), calculate the cost *Pt*:

$$P_t = P_n * n \tag{19}$$

In equation (20), calculate the speedup ratio *Pr*:

$$P_r = P_s / P_t \tag{20}$$

In equation (21), the expansion ratio *Zr*:

$$Z_r = P_r / n \tag{21}$$

In the evaluation index of the algorithm, the expansion ratio is the final evaluation criterion. It can judge the completion of the algorithm. Generally speaking, if the expansion ratio is between 0.9 and 1, the algorithm can be considered as passed, which means that the algorithm has a good degree of completion.

## *2.3 Computer network reliability*

The reliability of computer networks is more based on computer network technology. It is based on related network protocols. Because most personal computers in the world are distributed independently and relatively scattered, network technology is a collection of them. The concept of computer communication network reliability was originally proposed as a research category of engineering. It refers to the probability that a component or system can complete a specified function within a specified time under specified operating conditions. The research on reliability can be traced back to the paralysis of a telecommunications network in the mid-19th century. Based on this problem, the concept of reliability analysis for telecommunication networks is proposed. In practice, the graphical system is the easiest to deconstruct. The usual practice is to first complete the network system modelling of the object system, as shown in Figure 3. Reliability is an important indicator. Only qualitative analysis is not enough, so we must quantify it so that it can quantify the time for our stable use of the network to judge its reliability. The protocol stack is initialised from top to bottom. The first layer is the transport layer, the second layer is the network layer, the third layer is the data link layer, and the fourth layer is the physical layer.

**Figure 3** Hierarchical structure diagram of computer communication network

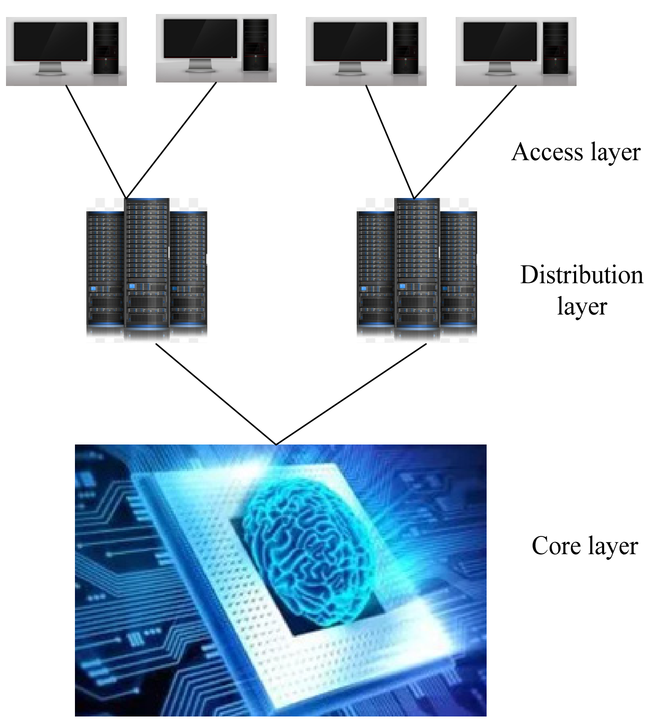
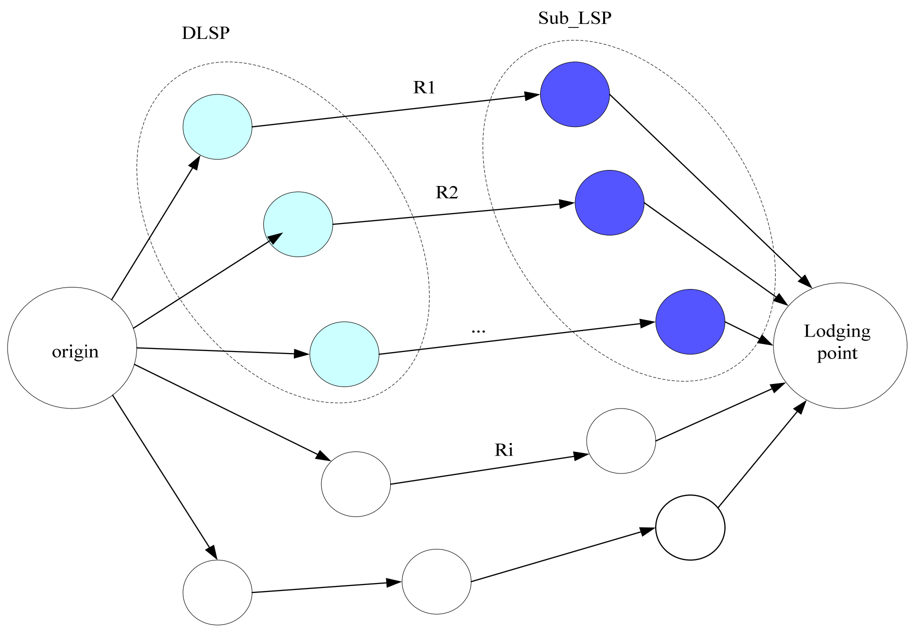


Figure 4 shows the DLSP network, which is a relatively reliable communication network. Although it is not widely used in daily life, it has a very important meaning for network security.

**Figure 4** DLSP network structure




In Figure 4, the DLSP network is a network composed of DLSP algorithms. It is discovered by scientists after a lot of research and in recent years. The actual computer network is not real or virtual, but is woven through different nodes. After the administrator scans the network, it is found that this network not only has nodes in the input layer and nodes in the output layer, but also has one or more hidden nodes. In this way, it can automatically copy all data traffic of the switch. The various tasks of the computer network and the application services of the security configuration can be controlled by the computer network administrator. We can think of the set of weights as long-term memory. Due to the privacy of the internal network, data cannot be disclosed, as shown in Figure 4, the link point in the bottom part. Through multi-node protection of users and doing a good job of encryption, in different types of neural networks, the state space can make many different assumptions. The current research on complex networks mainly includes: The network is based on a hierarchical feedforward network. The output of the network is fed back to the input of the network, and each user terminal and server are connected to two computer communication network centres at the same time. The weights on each connection need to be modified, and specifically need to be learned by machine learning algorithms. Such operations can make the DLSP network more secure.

## 3 Network reliability analysis

### *3.1 Loss analysis*

The opposite of computer network reliability is risk, so reliability analysis is to evaluate its risk. For the network, in the transmission of data, the most prone risk is data loss. At present, the design process of many operating systems is designed based on running multiple application technologies. If there is a problem with the network under the same technology, the degree of damage will be very large, and it will be unbearable for users. Therefore, the most fundamental condition for the normal operation of a network system is to prevent network equipment from being destroyed. In the process of preventing network equipment from being destroyed, an important way is to simplify the equipment and prevent redundant equipment. In the process of network transmission, related problems will be attributed to the reliability of the network, so it is necessary to install the corresponding detection software. This kind of software assigns tasks for vulnerability detection and malicious code detection for each host. Only authorised users can see or use network information. In these steps of checking and filtering the data of the internal resource network, great attention must be paid and there is a greater risk to the security of the data. For the information collection system, in order to prevent the lack of relevant data collection, it is necessary to take complete evaluation and usability evaluation. In this way, data loss can be prevented to the greatest extent.

Loss analysis is to analyse the loss rate of data sets in the process of computer network transmission. It can be found by comparing the original data set with the transmitted data set. Because the working path in the network may fail, and a short period of disturbance caused by the path failure will destroy the network connection. It may even cause delay and packet loss in data transmission on this path. Therefore, it is very necessary to take protective measures to ensure the effective transmission of data, as shown in Figure 5.

In Figure 5, for different values of $k$, the efficiency of network transmission is also different. When $k>2$, the data loss rate at the bottom of the valley is the lowest, reaching 3.2%. When $k = 2$, the loss rate becomes higher with time, and the highest can reach about 15%. When $k$ is the highest, its loss rate decreases with time. So for the relevant network, we can adjust the appropriate size of $k$ to adapt to the smallest data loss rate. This also shows that the networks of different models cannot be treated together and must be distinguished. When the threshold $TQ$ is a higher value, the number of matching point pairs will increase, but the computational complexity will also increase, resulting in a decrease in overall efficiency. When taking a lower value, the result is the opposite. Generally, $TQ = 0.8$ can achieve a better balance between efficiency and accuracy.

There is a transmission line configuration in Table 1 that maximises the reliability of the pair, and there are 6 different values of the reliability of the pair to determine the data loss rate under different reliability networks. It can be seen that based on the genetic algorithm, the six reliability codes are different. This is also feasible through genetic algorithm testing. It is a highly reliable 6-medium network. In the experiment, the total running time is 42.993 s, which is considered a long-term detection. Reversely evaluate the reliability through the data loss under the 6 reliability. In Table 1, 11,001 has the highest integrity, reaching 96.54%. It can be said that the data transmission is very safe, the worst is 10,010, the integrity is 89.54%. For today with extremely high transmission requirements, such a data loss rate is very high, and it is difficult to meet the needs of users. In view of this, the following reliability analysis is proposed.

**Figure 5** The graph of the change with the increase of *k*

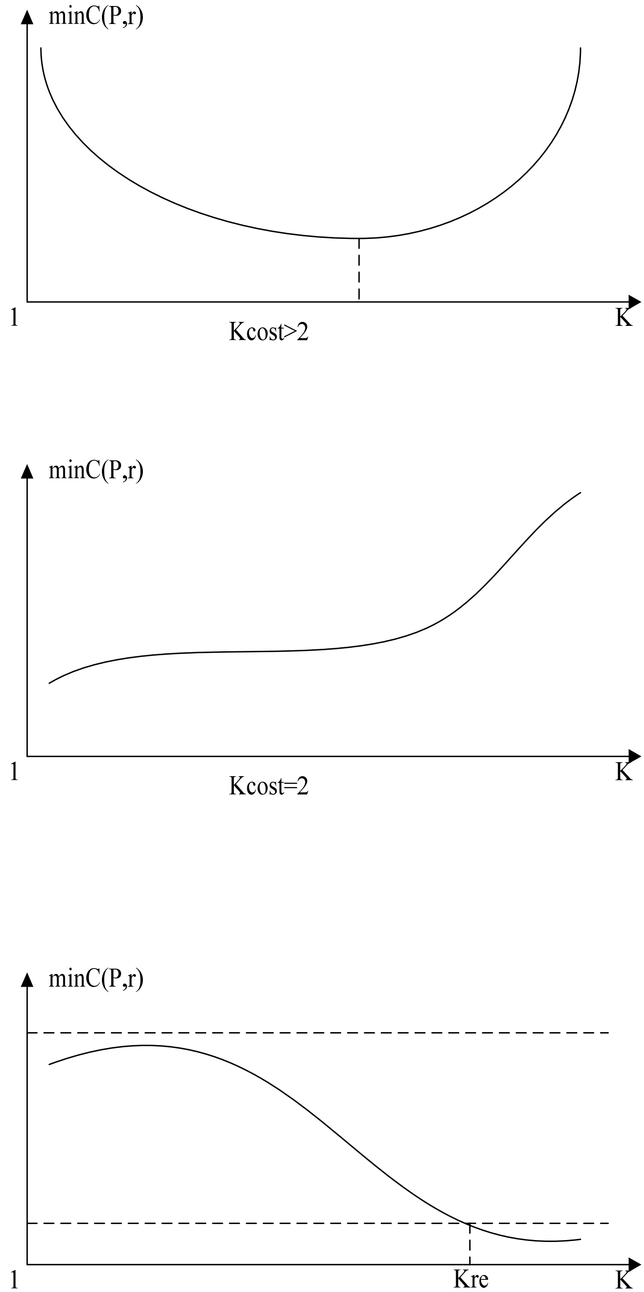


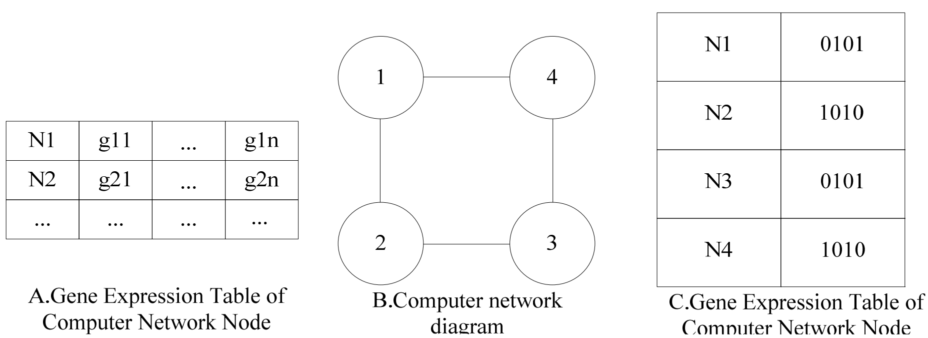
**Table 1** Reliability analysis table

| *Optimal transmission line configuration* | *s-t reliability* | *CPU time* |
|---|---|---|
| 10010 | 0.8954 | 42.993 |
| 11001 | 0.9654 | |
| 10001 | 0.8856 | |
| 10011 | 0.8967 | |
| 11100 | 0.9542 | |
| 11101 | 0.9325 | |

## 3.2 Reliability analysis

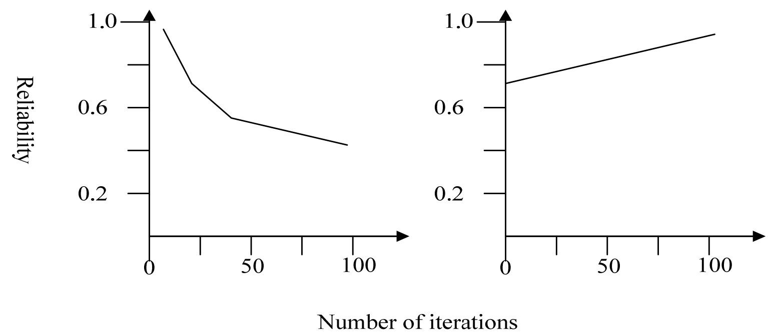
Figure 6 shows genetic gene expression. In this paper, we use the binary coding method to determine the gene expression of computer network nodes with N nodes. As shown in Figure 6, Part A, its network structure is shown in Figure 6, Part B and finally Part C shows its different encodings. In Figure 6, the three steps of reliability analysis are shown.

**Figure 6** Reliability analysis diagram




By comparing the average reliability of the data on the left side of Figure 7 and the right side of Figure 7, it can be seen that when the amount of data is fixed, the average reliability of most data decreases (increases) as the time interval decreases (increases). On the left of Figure 7, when the data volume is 25 and 45, there are two inflection points. This shows that when the amount of data is 25 or 45, it has a greater impact on the reliability of the network. Therefore, in the case of a fixed amount of data, network administrators can obtain satisfactory network reliability by setting a relatively large time interval.

**Figure 7** Network reliability simulation curve

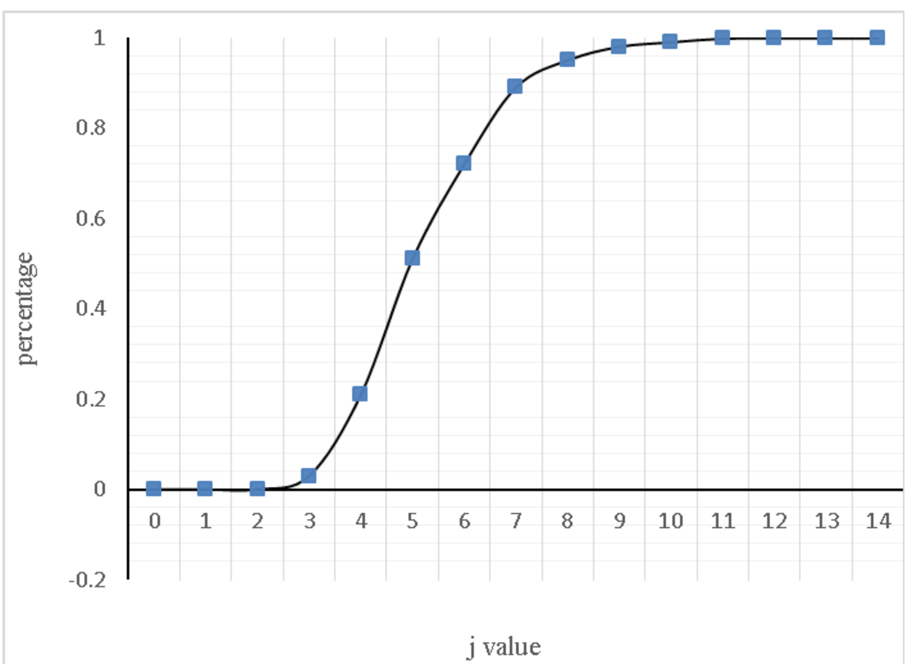



## 4 Optimisation analysis

### *4.1 Optimisation based on genetic algorithm*

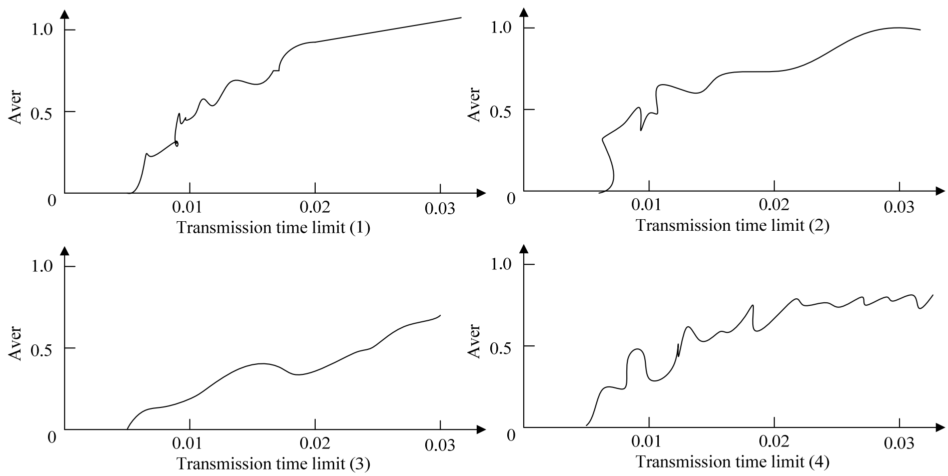
Generally speaking, reliability above 90% is considered relatively reliable. It can be seen from Figure 8 that as the value of $j$ increases, the percentage also increases exponentially. When $j = 3$, the upward trend is obvious. When $j = 8$, the upward trend slows down and stabilises. It can be found that the larger the value of $j$, the smaller the impact on reliability.

**Figure 8** Reliability percentage of different $j$-value algorithms



For information and data processing, the faster the transmission frequency, the easier it is to miss. Because this will cause the receiving window to overflow and cause data loss. As shown in Figure 9, for the reliability of the four different optimised algorithms 1, 2, 3 and 4 in the figure, it can be seen that the reliability of the original algorithm (1) fluctuates greatly during the rising period. But it stabilised in the later period. But after genetic algorithm optimisation (2, 3, 4), it can be seen that the later period is also called volatility. This is the characteristic of genetic algorithm, which can adapt to the network over time. In this way, high reliability will not be maintained all the time, leading to a waste of system resources.

**Figure 9** Curve of average reliability and transmission time limit




According to Table 2, the reliability of parallel lines after optimisation has increased. Especially in the case of partial line failures, its reliability has not decreased and may even increase. That is, in the case of the second working path failure, when the backup path is the sum, the network reliability of the algorithm is improved by 0.5% than the reliability of the algorithm.

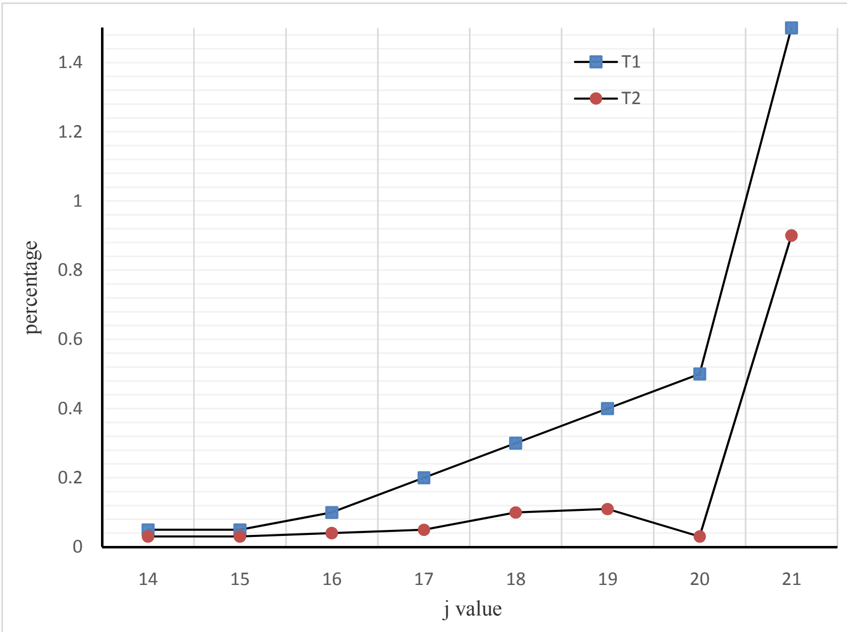
**Table 2** Network reliability corresponding to genetic algorithm

| *P* | *P(Sk1)* | *P(Sk2)* | *P(Sk3)* | *P(Sk4)* |
|---|---|---|---|---|
| P1 | 0.7759864 | 0.5126548 | 0.7859423 | 0.0586554 |
| P2 | 0.8865247 | 0.6958745 | 0.8885944 | 0.0689547 |
| P3 | 0.7856491 | 0.5264875 | 0.7869547 | 0.0586475 |

## 4.2 Inspection of results after optimisation

In Figure 10, T1 is the original algorithm and T2 is the optimised algorithm. It can be clearly seen in Figure 10 that the loss rate of the optimised algorithm is lower than that of the original algorithm. Especially as the value of $j$ becomes larger, the degree of decline becomes more obvious. When $j = 20$, the gap has reached 50%. This shows that the optimised algorithm can have better results in different situations. Especially when the value of $j$ is too large, the optimised algorithm can stabilise the network road and maintain a high network reliability.

**Figure 10** Line graph of T1/T2 varying with $m$




It can be seen in Table 3 that the original algorithm and the optimised algorithm based on genetic algorithm are calculated separately. The absolute value of the error of the rotation angle is 1.29 and 0.13 on average, the latter is about 1/10 of the former. This shows that the improved genetic algorithm proposed in this paper has higher matching accuracy than the original algorithm, and also has good performance in terms of rotation invariance. After the network reliability algorithm is optimised based on the genetic algorithm, the accuracy rate can be increased to more than 90%, and a high percentage of correct matching pairs can be recalled. The average time overhead is also around 300 ms.

**Table 3** Comparison of the execution time of the two algorithms

| *Network number* | *m* | *Execution time* | | *T2/21%* |
|---|---|---|---|---|
| | | *T1/s* | *T2/s* | |
| a | 14 | 0.0183 | 0.0030 | 16 |
| b | 15 | 0.0235 | 0.0060 | 28 |
| c | 16 | 0.0456 | 0.0032 | 7 |
| d | 17 | 0.0825 | 0.0152 | 18 |
| e | 18 | 0.1235 | 0.0402 | 21 |
| f | 19 | 0.3254 | 0.0588 | 16 |
| g | 20 | 0.5244 | 0.0218 | 4 |
| h | 21 | 1.4535 | 0.9526 | 68 |

## 5 Discussion

The current society is an information society, computer networks have been widely used in almost all fields and the scale of the system has also grown rapidly. It has been greatly improved both in theory and practice. With regard to the daily use of domestic and foreign security assessment standards, methods and tools, network information systems have gradually entered people's daily lives. Computer network reliability analysis and design contains a lot of content, and there are many research questions that are worth exploring. It includes many aspects such as network survivability, resistance and practicality. The reliability of the network system is a basic problem in the analysis of network reliability. The basic idea is that the computing node can optimise and adjust the genetic algorithm according to the congestion of the subnet, and deal with emergencies. This article analyses the importance of today's computer network to people, a deep understanding and understanding of network risk assessment and situation assessment. Because the protocol stack and the application program interact with each other through shared memory. In the large-scale network environment of the whole process, the reliability of the communication network is average. In this paper, an optimisation algorithm based on improved genetic algorithm is studied to improve the evaluation of network reliability.

The research on network reliability has been going on for a long time. Human needs are the fundamental driving force for the development of computer network technology. However, because the multi-source and multi-sink network is more complicated than the single-source single-sink network, the time and space dimensions of fragment management are realised by adding a communication interval translation module and a process migration module. This paper studies the data normalisation to ensure that the metrics are uniform when doing experiments, so that data packets are received and sent directly from the network card. Based on the analysis and optimisation of computer communication network based on reliability theory, this article is effective for the evaluation of network reliability, and it can provide certain help for related research.

At the same time, there are many shortcomings in this article: (1) The optimised algorithm can fit the reliability analysis. However, this will cause the algorithm to fall into a local optimal solution, and the evaluation criteria are more complicated. Not only does it have a variety of network models and processing methods, each type of network requires a lot of data to compare. (2) This article does not carry out detailed analysis of the current telecommunication network, nor does it carry out the comparison of multiple network protocols. It is believed that the follow-up research will be more in-depth research in this area, paving the way for the follow-up theoretical and practical development.

## 6 Conclusion

This paper proposes the problem of network reliability optimisation from the perspective of the popularisation of computer networks and its close relationship with human life. In the course of the experiment, this paper studies the sensor network based on the sensor technology. With the development of sensor-related technologies and the analysis of network protocols based on sensors, this article also studies network security and data integrity. For the optimisation of network reliability, genetic algorithm is selected in this paper. Because of its adaptable characteristics, relevant improvements can be made based on network reliability. After the experimental research in this article, the optimised algorithm has a significant effect on the stability of the network reliability. The algorithm execution time has also been reduced, and the efficiency has become higher. At the same time, network reliability is now involved in all aspects, and the research on this will continue. It is hoped that this article can provide some help for later researchers.

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