Research on the Application of Fractional Down in Neural Network Control System Based on Computer Technology

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Abstract. Since the establishment of the first network in the world in the 1970s, after several years of development, the network has become the most abundant information resource in the world. The network provides a variety of services for individuals, families, society and other institutions, such as video chat, data transmission, web services and so on. The 21st century has entered the information age, the development of information technology and the development of computer information combined to bring mankind into the beginning of the fifth information revolution. The development of science and technology brings automatic control into a new field, which requires network communication to realize industrial control. Artificial neural network is a system that imitates the synaptic connection of human brain to transmit information. It simulates the characteristics and structure of human brain neural network by mathematical method, and has the functions of memory, calculation and self-learning. Nowadays, artificial neural network has been paid attention to by many countries in the world, and it has been applied in many fields, such as scientists in the face of global warming, artificial neural network has been widely used.

Keywords: Computer Technology, Fractional Descent, Neural Network Control System

1. Introduction of fractional descent method

Fractional calculus, corresponding to traditional integer calculus, can be traced back to the birth of integer calculus 300 years ago [1]. In 1695, Lopida and Leibniz discussed the question: "What would happen if the order of differentiation was not an integer?"Although this problem was not solved at that time, it later opened an important research direction: fractional calculus. The early fractional calculus has always been a pure mathematical problem and lacks practical physical significance. Therefore, it has not been paid attention to in physical and practical engineering applications, and its development is extremely slow. Up to the last century, scholars have found that fractional calculus can describe many physical phenomena and practical processes more succinctly and accurately, such as heat conduction systems, anomalous diffusion, viscoelastic materials, charge and discharge processes of super capacitors and power batteries, and non-Newtonian liquids, etc. Since then, fractional calculus has attracted the attention of scholars and has been successfully applied in practice. With the fractional...
order model. The stability analysis and controller design of fractional order system are beginning to attract the attention of scholars. Many stability theories of fractional order systems have been proposed. Firstly, for the simplest linear fractional system, the stability theorem of bounded input and bounded output and the criterion of linear matrix inequality are proposed. Then, the direct Lyapunov method for the mittag leffer stability of nonlinear fractional systems is defined. On this basis, an indirect Lyapunov method for incoherent fractional order systems is presented. With the rapid development in recent years, the concept of "fractional order" has far exceeded the range of fractional calculus and has a richer extension. The degree of freedom of order introduced by fractional order makes the fractional order optimization algorithm more superior. In particular, in recent years, the fractional gradient descent method has begun to attract the attention of scholars, but the related research is just in its infancy, the basic theory is not perfect, there are still many problems to be solved, such as the convergence of the algorithm, the online calculation of fractional differential. Further, considering the rich extension of "fractional order ", the design of gradient descent method and fractional disturbance gradient method based on fractional order system theory have not been widely concerned by scholars. Therefore, this dissertation is devoted to perfecting the theoretical basis of the fractional step-down method, making a comprehensive study of the fractional step-down method from the three angles of the fractional step-down direction, the fractional step system theory and the fractional-order random disturbance, and initially establishing the theoretical framework of the fractional step-down method to lay a solid foundation for its practical application.

The development of fractional calculus equation has been three centuries, and its development is based on integer calculus equation. The numerical solution of fractional calculus equation has always been a hot topic in the field of mathematics. Through three centuries of development, fractional calculus has formed a numerical definition, in which Rieman-Lioville, Grinwald-Letikov and Caputo definitions are widely used [2]. GL definition extends integer order calculus to any real number, and fractional order calculus is summed up from the unity of finding n order integral and differential. By analogy the n derivative of f(x) can be obtained as

\[
f^{(n)}(x) = \frac{d^nf}{dx^n} = \lim_{h \to 0} \frac{1}{h^n} \sum_{r=0}^{n} X_r (-1)^r \binom{n}{r} f(x - rh)
\]

From the above derivation process, it is not difficult to deduce any derivative of (x) f the function.

2. Research status of optimization algorithm based on fractional step direction

Gradient descent method is the most simple and effective method to solve unconstrained convex optimization problem. It has perfect theory and mature practical application. In order to improve the convergence characteristics of the algorithm, many improved gradient descent methods have been proposed, such as Newton method, momentum gradient method and conjugate gradient method. As a new mathematical tool, fractional calculus is just in its infancy. Compared with the traditional integer ladder descent method, it has more degrees of freedom. By adjusting the order, it can provide a new possibility for the improvement of the performance of the algorithm. In particular, when the order is 1, the fractional is degenerated into the integer step method. Because fractional order integral operation is needed to calculate fractional order differential, it is a difficult problem to calculate fractional order differential online in practice. Considering that the fractional differential of quadratic objective function has explicit expression and is easy to analyze and design, most of the existing studies are aimed at quadratic objective function. At the same time, many of the current analyses are aimed at scalar functions. When extended to vector cases, scholars often only discuss the problem of complete decoupling. The method of fractional ladder descent has been developed for a period of time. Many scholars have put forward some preliminary ideas and achieved good results in some practical applications, but the current research is still limited to quadratic objective functions. For general differentiable functions, how to ensure the convergence of fractional step descent method and how to
give it. How to give the online implementable form of the fractional step down method is the problem that this dissertation will focus on solving [3].

3. Research status of network control system
In recent years, many research results on network control system have been published in some famous journals at home and abroad, and the research on related problems of network control system has become a hot topic in the field of international control. The study of service quality is aimed at the communication medium in the network control system. It studies the network control system from many aspects, such as system structure, task scheduling, medium access, control layer protocol and so on, and puts forward corresponding solutions to the problems existing in these aspects, so as to meet the requirements of optimizing system performance. A deep study is made on the structure of the NCS system, which includes many kinds of system topology, model reliability and factors affecting the whole network performance. The wireless network control system is analyzed and studied, and a new network protocol is proposed, which has the characteristics of real-time monitoring. Of course, there are many loopholes in the network control system in its infancy, and it is likely to be attacked maliciously, as shown in Figure 1.

![Figure 1](image_url)

Figure 1. The proportion of network attack in network control system.

As shown in Figure 1, we can know that there are many dangers in today's network control, so the first task is to improve the performance of network control system. The study of control performance is very important for control system. In general, the evaluation criteria of system control performance can be referred to as "stability ", "fast" and "accurate ", that is, stability, speed and accuracy. The research in the NCS is mainly carried out from two aspects, on the one hand, the data modeling and control of the NCS with data packet loss or timing disorder, on the other hand, the mathematical modeling and control of the NCS with network delay. In view of the network delay and packet loss, a reasonable solution is proposed, such as the study of state observer and controller, so that the performance of the control system can meet the specified requirements [4].

4. Research significance of neural network control system
The emergence of neural network control system is the result of the fusion of knowledge between computer field and control field, which solves many problems for industrial control, and improves the productivity and production efficiency of enterprises. In real life, the network control system has been widely used and contributed to the rapid development of society. In the near future, more network control systems will be put into use. After years of development, the network control system has made great progress, but there are still many problems worth studying. Information is transmitted through a certain communication line in the network, which is affected by the limited network bandwidth, resource conflict and network carrying capacity. The stability of the system is related to the above problems. When the above problems are more serious, the system will be unstable, so the study of these problems is particularly important and of great significance. In recent years, with the
development of wireless technology, wireless sensor network technology has made a great breakthrough, and the technology has been gradually applied to the network control system system [5].

5. Application of fractional descending method in neural network control system
The artificial neural network model is mainly based on the characteristics of neurons, the topology of the network, learning rules and so on. After 60 years of development, there are 40 network models, such as perceptron, back-transmission network, self-organizing neural network, radial basis neural network and so on. Because of the variety of network models, according to different situations and the actual requirements of the system to decide which neural network model to adopt. The existing neural network model can be divided into two types according to its topology:

5.1. Forward network
Figure 1 shows the forward neural network topology. It can be seen from the diagram that in the forward neural network, the signal is transmitted to the next neuron through the previous neuron, and there is no feedback between each other, and the information is processed by multiple recombination of simple nonlinear functions. As can be seen from figure 2, the leftmost represents the output layer of the network, the rightmost represents the output layer of the network, and the middle cross network represents the middle layer. The structure of the whole network is simple, easy to implement and powerful. Therefore, it is widely used in engineering practice. Anti-transmission network is a typical forward network [6].

![Figure 2](image)

**Figure 2.** The structure diagram of forward neural network system.

5.2. Feedback network
There may be feedback between any two neurons. When the signal enters the neural network, the signal needs to be transmitted to each node many times before it can be output. The structure of the network is complex and the function is very powerful. The system can automatically adjust the structure of the network according to its own dynamic parameters, so as to achieve the optimal performance. So what are the advantages of artificial nerve? As shown in Figure 3.
Artificial neural network has many advantages: first, it has self-learning and self-organizing function: self-learning ability means that the system can adjust the weight value according to the change of environment, summarize the relationship between input and output, and solve the problem. The system can perfect itself in the process of continuous learning, not limited to prior knowledge and rules, so it has strong adaptability. Secondly, it has certain parallelism: Compared with seriality, parallelism has higher operational efficiency. The traditional computing method is based on serial processing, and the calculation and storage of data are two independent parts. The computing speed of the system depends on the connection channel between the processor and the memory, which limits the computing power of the system. There are a lot of connections between neurons in neural network. After the information enters the network, it can be transmitted to each neuron quickly. In the process of information transmission, the neuron will complete the calculation and storage of the information. Finally, it has strong fault tolerance: the connection strength between neurons is usually called weight value, which is determined by the mapping relationship of input and output. The storage of information is distributed on the weight of the whole neural network. Compared with the traditional computer network, the neural network has strong invulnerability. When a few neurons are damaged, the performance of the system may decrease to a certain extent. But it does not destroy the entire network. Therefore, the neural network has strong fault tolerance.

6. Conclusion
Network control system is a control system which is connected by actuators, controllers, sensors and other links through the network. It has the characteristics of intelligent nodes, simple wiring, easy expansion and maintenance. It is a new type of control system after DCS and FCS. The research of network control system has become a hot topic in the field of control. Aiming at many problems existing in network control system, the corresponding control strategy is put forward to make the performance of control system optimal. In practical engineering applications, network delay exists objectively because of the limitation of science and technology, and the control system has certain requirements for the real-time transmission of information, so it is of great significance for the study of network delay. The analysis and design methods of traditional control theory are limited to NCS because of the particularity of NCS relative to other control systems. The fractional-order control theory is an extension of the integer-order control theory addition of calculus parameters makes the

Figure 3. The advantages of artificial neural network.
design and optimization of the controller more flexible.

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