Design of Power Security Protection System Based on Neural Network Algorithm

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Abstract: Power safety is closely related to production and life, so an essential part of the power safety protection system. Safety accidents are inseparably linked to equipment and the environment. Electricity safety accidents are not rare in causing loss of life and property. The neural network algorithm-based power security system uses the analytic hierarchy process to layer multiple logical structures of the power grid, evaluates the factors that affect safety, obtains the weight of each influencing factor, and selects the higher impact on power system safety interference according to the weight Factors. Now neural network algorithms have begun to be widely used, and electrical safety systems based on neural network algorithms play a significant role in power safety. Combining neural network algorithms with power safety protection systems can effectively guide functions such as aging monitoring, life prediction, and fault identification of power equipment, and can also improve the accuracy of power system reliability assessment.

1. Introduction
A neural network is a mathematical or computational model that mimics the biological neural network, such as the structure and function of the central nervous system of animals, especially the brain, and is used to estimate or approximate functions. The neural network is calculated by a large number of artificial neurons. In most cases, the neural network can change the internal structure based on external information. It is an adaptive system, and in general, it has learning functions.

In the power system, the combination of neural network algorithm and power safety protection can directly participate in the detection, supervision and control of the monitored object. It can ensure the real-time operation of the power system without any attendance and automatically complete the Load analysis, reasonable dispatch, reduce and avoid the occurrence of maloperation. Misjudgments caused by human factors, power failures in accidents, and give full play to the role of safety and real-time protection. Neural network algorithms are applied to power systems, which need to have excellent information collection and processing functions, automatic identification of hidden safety hazards, in order to achieve different application requirements of power safety protection systems. Neural network technology can speed up the discrimination of safety protection, improve the ability of digital protection against current transformer saturation and the ability to adapt to power system fault transient processes, and improve the overall safety, reliability and stability of the power system.
2. Application of neural network algorithm

2.1. Features of neural network algorithms
Artificial neural network is a system that can learn and summarize, that is, it can learn and summarize by known experimental data. The artificial neural network compares and compares the local conditions (and these comparisons are based on the automatic learning in different situations and the complexity of the actual problem that needs to be solved), and it can reason to produce a system that can be automatically identified. Unlike the learning methods based on symbol systems, they also have reasoning functions, but they are created on the basis of logical algorithms, which means that the reason for them to reason is that they need self-learning ability.

2.2. Basic flow of neural network algorithm
The structure of a common neural network algorithm consists of three parts, and many neurons accept a large number of non-linear input messages called the input layer. The input message is called the input vector. Messages are transmitted, analyzed, and weighed in neuron links to form output results called output layers. The output message is called the output vector. The hidden layer is a layer composed of many neurons and links between the input layer and the output layer. The hidden layer has one or more layers. The number of nodes in the hidden layer varies, but the larger the number, the more nonlinear the neural network becomes, and the more robust the neural network becomes. Under the perturbation of parameters of certain structure and size, the control system maintains certain performance characteristics more prominently.

![Figure 1. Basic flow of neural network algorithm](image)

Neural networks are generally called perceptron or multi-layer perceptron. There have been many types of neural networks. This layered structure is not applicable to all neural networks. The process of creating a model by correcting the training samples and correcting the weights of each layer is called an automatic learning process. The specific learning method varies depending on the network structure and model, and it is commonly verified by back-propagation algorithms.

2.3. Advantages of neural network algorithms
Existing neural network structures are either manually designed or automatically obtained through a neural network structure search method. However, these network structures may contain many redundant computing operations and there is room for optimization. In order to optimize the structure of the power safety protection system, a neural network structure converter method is proposed. This method can replace the redundant operation in the power safety protection system with a calculation operation with a lower computational complexity, thereby achieving an increase in performance while ensuring that no additional parameters and calculations are introduced.

The calculation operations in neural networks can be divided into three categories, namely S, N, O. Among them, S represents a skip connection, N represents an empty connection (that is, there is no connection between two nodes), and O represents other operations (such as convolution, pooling operations) other than skip connections and empty connections. Obviously, the order of calculation of
these three is: O> S> N. In order to reduce the computational complexity of the neural network-based security protection system, we hope that the learned NAT will replace redundant operations in the original electrical security protection structure with operations that require less computation. Therefore, NAT follows the following translation rules: ONS, OSN, SON. In summary, the conversion scheme is shown in the following figure.

![Figure 2. Neural network algorithm NAT translation rules](image)

Specifically, for any network structure $\beta$ that obeys the distribution $p(\cdot)$, the goal of NAT is to find and obtain only the optimal structure $\alpha$ obtained by the operation changes allowed above. This optimization problem can be written as:

$$R(\alpha | \beta) = R(\alpha, w_\alpha) - R(\beta, w_\beta), R(\alpha, w_\alpha)$$ (1)

$R$ represents the performance of the network structure $\alpha$ with the optimal parameter $w_\alpha$ on the verification set;

$$c(\alpha) \leq \kappa$$ (2)

Is a constraint on the computational cost of the resulting model.

3. Design of Power Security System

3.1. The necessity of power security systems

The power safety protection system is an important part of the power system, with functions such as data detection, video monitoring, and automatic control. It is an important guarantee for long-term uninterrupted and stable operation of the power safety protection system. With the rapid development of big data and artificial intelligence, the power safety protection system is changing towards intelligence and digitization. The use of neural network algorithms is one of the most profitable.

Nowadays, with the continuous improvement of science and technology, emerging technologies continue to emerge, and the demand for electricity is accelerating due to the acceleration of urbanization. The construction of an intelligent and automated power monitoring and security system is essential for the development of power and the stable operation of the power system. In various industrial sectors, the power safety protection system is a large-scale, complex layer, and real-time strict physical system. Corresponding embedded computer systems are configured at various links and between different levels to measure and adjust the production process of electrical energy. Control and protection to ensure the safe and stable operation of the power system.

3.2. Application of power safety system based on neural network algorithm

The neural network algorithm-based power safety system connects various devices and assets together through sensors to form a customer service bus, thereby integrating information analysis to reduce costs, improve efficiency, and improve the reliability of the entire power grid. A highly information power system that optimizes operation and management.
Figure 3. Application of neural network algorithm in power security system

It is characteristics can be described as: digitization, information, automation, and interaction, which are mainly reflected in three aspects: flexibility, observability and controllability, and interoperability. To realize these functions, we need to rely on advanced sensor technology, network communication technology and automation technology. Flexibility: The flexibility of a power safety system based on a neural network algorithm refers to the ability to maintain stable operation by adjusting the power or load due to the power imbalance caused by large rapid fluctuations in the power or load generated by the power system. In the smart grid, the access of high-penetration new energy causes an imbalance in system power and reduces flexibility, while the access of large-scale electric vehicles as a controllable load increases flexibility and needs to be well utilized. The ability of both. Observability and controllability: observability refer to the complete access to information in the power grid. For example, currently widely installed PMUS can detect the status of the power grid, and controllability refers to having effective means to control the power grid. For example, large-scale equipped electrical components can help electrical safety systems do this. Interoperability: interoperability refers to the ability to ensure that multiple networks, systems, devices, applications, or components communicate with each other and that they can operate efficiently, safely, and coordinated without requiring excessive human intervention. For example, when a fault occurs, the ability to properly start the relay protection device is an interoperability.

In the past, the protection of power security was often passive response, and maintenance was performed after the power system had an alarm or a problem. At this time, business interruptions or equipment failures had occurred. Neural network algorithm technology was used to analyze historical data. In contrast, you can change the passive response to the active response to discover problems in advance. For example, the optical fiber connection can learn historical data, use neural network algorithms to actively learn the optical connector signal attenuation curve, and actively maintain before a problem occurs. The power safety protection system can also analyze and learn from historical data such as current, voltage, inductance, or operating noise, and predict potential failure risks in advance through subtle data changes. In addition, drones and robots have been used for video and photo shooting in power inspections, but the analysis of pictures and videos by human eyes is very inefficient and the accuracy is compromised. The neural network algorithm is used to analyze the pictures and videos. Can
be more efficient and faster, and the accuracy is greatly improved.

Video surveillance cameras are installed in some unattended power sites such as substations and power distribution rooms. The power safety protection system combined with neural network algorithms can warn intrusions and abnormal behaviors of surrounding abnormal people and vehicles to ensure power site safety. In addition, the maintenance personnel's power grid operation is standardized. The neural network algorithm's power safety protection system combined with video monitoring can automatically identify whether the operator is wearing a safety helmet, wearing correct tooling, and operating normally. In addition, the wearable device is used to measure the heartbeat blood pressure and monitor the operator's step and posture, and to compare with historical data to actively analyze whether the operator's physical condition at the time is healthy and suitable for maintenance operations such as tower and pole to ensure the safety of power grid operations.

3.3. Analysis of power safety protection system based on neural network algorithm

Domestic smart grid construction began in 2015. In recent years, China has made great progress in the construction of smart grids. A number of intelligent power transmission and distribution technologies have been applied, which has improved the controllability and flexibility of the power safety protection system, thereby improving the power grid transmission capacity and safety and stability; Improving the level of safe operation of the power system. Accelerating the intelligent substation and distribution automation Application, enhance the interoperability of security protection system. With the widespread application of renewable energy power generation, high-voltage direct current power transmission, flexible compensation, and networking equipment, safety accidents related to power electronics equipment and new energy generation frequently occur in practice.

New energy power systems have the characteristics of high order of state variables, strong non-linearity, and multi-time scale control interactions. The state of the system is comprehensively affected by multi-dimensional characteristic parameters, and the generation model using neural network algorithms can be used for different safety in power systems. A sample set of stability problems is automatically generated. The neural network algorithm can also scan the safety boundary of the power system, so as to judge the system stability and instability mode. From the perspective of overall prevention, the discrimination model of the neural network algorithm can identify the weak and stable links of the new energy power system. This will help arrange the emergency operation of the system after the accident. In addition, the neural network algorithm is applied to the dynamic safety margin estimation of key equipment in the power system, which can fully explore the potential of the safety margin of the current equipment and provide safety support for the safe operating state of the system.

4. Conclusion

In terms of power safety protection, artificial intelligence technology has begun to be widely used. The important national infrastructure for power and national economy and people's livelihood has extremely high security protection requirements. Power security is the foundation, and it has accompanied the entire history of the development of the power grid. Not only the electric power industry, but also the safety experience of how to communicate, finance, transportation, manufacturing and other industries in other industries also applies to the electric power industry. New ICT information and communication technologies are accelerating the rapid development of fully connected smart grids, and improving the efficiency of grid operations in all aspects. The electrical safety protection system based on the neural network algorithm avoids the potential safety hazards that communication equipment may bring to the power grid. The multi-layered safety protection design of the power grid also reduces the security risks that communication equipment may bring. The neural network algorithm-based power security protection system adopts more stringent standards and measures from the architectural design to ensure power security, and the rapid development and large-scale application of artificial intelligence technology will greatly enhance the power security protection capability and ensure the security and stability of the power grid run.
The power safety protection system based on neural network algorithm is an important prerequisite to ensure the stable and sustainable development of the power industry. At present, power safety protection systems based on neural network algorithms have already covered all aspects of power, and they are gradually moving towards networked and comprehensive development, which must be effectively protected, which has an important impact on the overall development of the power industry.

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