Scholar Publishing Group
Distributed Processing System
https://doi.org/10.38007/DPS.2022.030406
ISSN 2790-0916 Vol. 3, Issue 4: 45-52

Distributed System Coordination Predictive Control for Network Information Mode

Mallik Alasser*

Jimma University, Ethiopia

**corresponding author*

Keywords: Network Information, Distributed Systems, Coordinated Prediction, Predictive Control

Abstract: With the rapid development of network information technology, distributed system coordinated control has become an indispensable part of the network information industry in the world today. In this paper, the concepts and classifications of the distributed system coordinated control method for network information mode are introduced first, then the problems existing in the traditional network structure are analyzed in detail. Then, from the point of view of genetic algorithm theory, a support vector machine (SVM), fuzzy logic and transfer function are established to solve the actual non-linear load dispatch, in which the data is processed by neural calculation. Finally, the improved decision table achieves the same control effect as the original model through experimental validation, and improves the system coordination performance index and stability. The experimental results show that the prediction time of this model is within the range of 4s-7s, and its stability, feasibility and prediction accuracy are up to 90%. This indicates that the distributed system coordination prediction model under network information mode performs well.

1. Introduction

The distributed network information platform is a multidimensional and non-linear system based on data mining. In practical projects, due to different types, different periods and space, as well as various environmental factors, their impact [1-2]. Therefore, a load balancing model (SDH) adapting to dynamic interactions in multiple application scenarios is needed to solve the problem of heavy losses caused by these load changes, predict user behavior, and provide scheduling strategies to ensure that network information quality is not seriously disturbed [3-4].

In view of the characteristics of distributed network information mode, domestic and foreign scholars have studied it from different perspectives. There are many research results on dynamic load balancing, non-linear planning and collaborative filtering algorithms abroad. The research on distributed network information mode started late in China [5-6]. For renewable energy power generation system, a multi-stage coordinated control system model composed of solar energy, wind energy, biomass energy is established. Others use the fuzzy algorithm to solve the performance of the neural network controller based on the neuron adaptive strategy, which is 0.02 times better than the traditional robust control method. Others have established mathematical models to achieve the design of neuron dynamic configuration and on-line optimization based on the synergistic algorithm of neural network, and verified the algorithm performance [7-8] with practical applications. Therefore, this paper studies and controls the coordination prediction of distributed systems based on the network information mode.

This paper introduces the concept of distributed network information mode, studies its development at home and abroad, and puts forward the prediction and analysis of the coordinated control strategy of distributed system in the next few years. Aiming at the problems of related theory and technology mentioned in the existing literature and the solving method based on model algorithm, etc. The key factors that affect the degree of collaboration between nodes and the synergistic effect of nodes are the relationship matrix and weights between independent variables, intermediate objective function and support vector machine combined characteristic parameters to construct a predictive control strategy for the dynamic behavior of the system under the weight constraints.

2. Discussion on Coordination and Prediction Control of Distributed System Oriented to Network Information Mode

2.1. Network Architecture

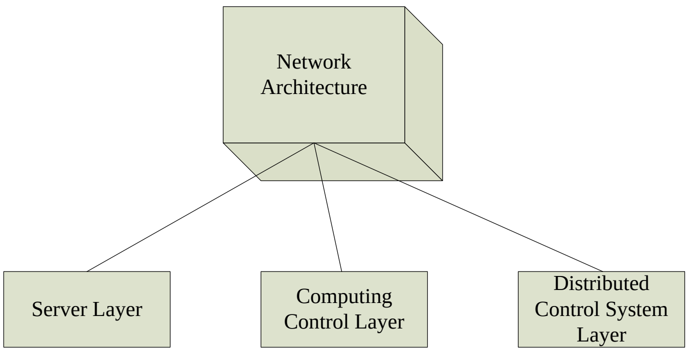

Figure 1. Network architecture

The network architecture is designed to coordinate and optimize distributed system control processes (as shown in Figure 1) to meet the needs of users, which is also the issue we need to study [9-10]. In this article, the network groups include:

(1) Server layer. It is mainly used to manage data and maintain information security, and is also responsible for communication with other external members, sharing resources and other work tasks. In addition, there are functions and requirements to index the links between various businesses and to achieve scheduling, query and control, so that the system can run normally and meet user needs.

(2) Computing the control layer. A distributed network structure consisting of multilevel operations assigned to each level unit for the purpose of realizing different types and coordinated relationships between layers is called a hierarchical system communication protocol system. In order to satisfy multiple servers, each layer switch can be connected as an independent single-target

computer through hierarchical processing to achieve the coordinated control of the interactive information flow and load transfer data among the substations in the whole communication link. At the same time, the method of combining distributed network structure and hierarchical analysis (AHP) can be used to solve how to ensure the dynamic balance of the substations in heterogeneous system environment. Stable transmission and dynamic response.

(3) Distributed control system layer. In this layer, different function modules are set up, which can be used to manage all types of devices in a unified way, provide various service requests and execute corresponding instructions and other ancillary work, provide a reliable basis for system operation, maintenance and control decision-making, and also realize various application functions such as network performance monitoring and fault diagnosis.

2.2. Coordinated Predictive Control

In the network information platform, in order to achieve coordinated control between network nodes, online real-time scheduling and dynamic updates are required. Therefore, it is necessary to design an ability to provide real-time interactive services according to user needs, satisfy distributed system load balancing, data mining analysis and so on [11-12]. By using virtualization technology, the multistage decision-making process is considered as a non-linear model, and by using the connection characteristics of SVM and network nodes, all possible dynamic changes in the link can be predicted, controlled and processed. In the process of coordinated control for distributed systems with network information mode, it mainly achieves resource allocation among nodes in the network through data transmission and scheduling among multiple devices. This is due to the scoring method used to determine the attribute values owned by each user and their usage status. Therefore, these eigenvalues can be given as weights to get the weight set at different levels, and then the solution that is closest to the real situation can be obtained by calculating the maximum degree of synergy between tasks under each level, and then the decision can be made according to this result combined with the actual control requirements. In distributed networks, information acquisition and processing rely on artificial neural networks. The artificial neuron itself is composed of a large number of repetitive memories. Therefore, a certain method is needed to predict the system behavior. Traditional algorithms generally use fixed weights as control variables to build a dynamic model, and then use the weighting function to calculate the required control amount. Although this method can achieve good results, the disadvantage is that it can not meet the requirements of real-time data processing and low accuracy, and it is difficult to adapt to the changes in network environment. Figure 2 shows the structure of the coordinated predictive control.

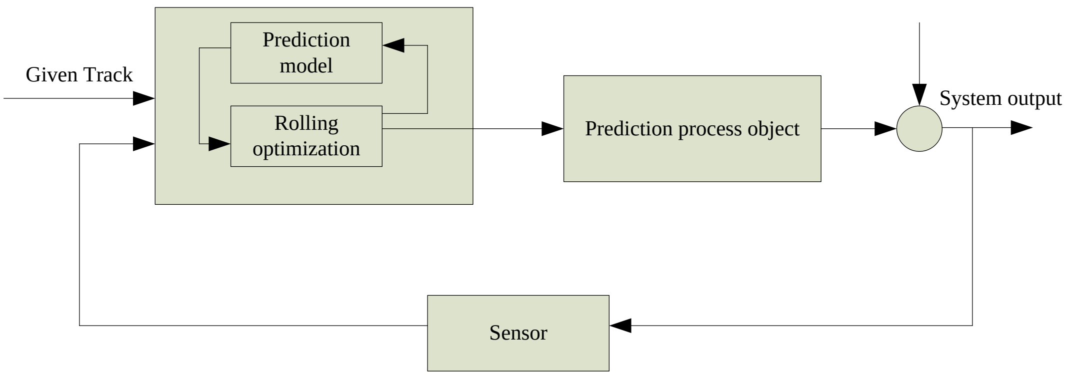

Figure 2. Coordinated prediction model control

2.3. Predictive Control Algorithm

In a distributed network, we need to collect and organize the data of these devices to calculate the deviation between the required control quantity and the actual value through some methods. Therefore, the best way to get a true and reliable dynamic effect is to select an appropriate and stable model to predict. Nodes in the network will produce a certain number of chains and branches when the system works normally, which need different functions. Therefore, in order to coordinate and control the relationship between data points, we have designed to establish a relationship between these objects (such as users, servers) to complete the task [13-14]. Because the distributed systems of network information mode are complex and non-linear processes which are independent, influence, interact and restrict each other, a combination of several methods can be used in this case to improve the efficiency and reliability of the whole system. Based on the actual situation and historical data, a corresponding probability distribution schema is established to estimate the number of relationships between nodes in future processing, and then these parameters are used to calculate specific values and substituted into the network to obtain the final desired prediction results, which can achieve real-time control, adjustment and tracking of unknown events or processes [15-16].

$$J(k,x,u) = \min J(k,x,u) \tag{1}$$

$$L(x(k+l|k), u(k+l|k)) = \|x(k+l|k)\|Q^2 + \|u(k+l|k)\|R^2 \tag{2}$$

However, due to the large amount and variety of data resources in the distributed environment, it has some complexity and uncertainty factors. At the same time, because of these complex and diverse and multi-level structure characteristics, it is also difficult to coordinate control between different types of information sources. Positive definite matrix Q, R and P need to meet certain conditions to ensure the stability of the system [17-18].

3. Experimental Process of Distributed System Coordination Predictive Control for Network Information Mode

3.1. Distributed Coordination Predictive Control Model

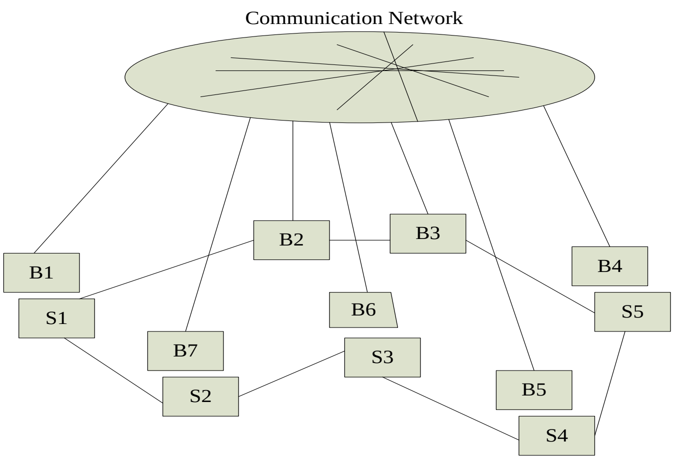

Figure 3. Distributed coordinated predictive control structure

The control block diagram of a distributed system is shown in Figure 3. It is clear that the controller coordinates the control of the network, including: (1) load balancing. For cases with multiple loads and fewer nodes on the bus arriving at the same time. First, make sure that each user's assigned device is compensated for any device failure. Secondly, after considering the load imbalance between nodes and the communication channel difference between different regions, further improve the system performance indicators and reduce network loss, so that the distributed system can better adapt to the changing load requirements. (2) Hierarchical analysis. The network model is built on the basis of the decision-maker's past experience and important enlightenment, and the discrete input vectors are judged as the basis. The most rational structure weight value is the optimal solution based on a certain criterion - weights are determined and then combined to optimize.

3.2. Distributed System Coordination Prediction Control Test Steps

In this paper, the online transfer control of distributed network information mode is tested. The main steps are as follows: Determine the degree of coordination matrix of each part in the system unit, and establish the corresponding weight function based on the relationship between these values and nodes. Under these sub-goals and control strategies, the appropriate method is selected as the test variable. In a network information environment, you can know if there is a logical or physical relationship between the devices by analyzing the data of the devices and the environment. Then, according to these situations, a corresponding mathematical model is established to predict the number of objects accessed and the trend curve of location change under different user types. Finally, the actual results are compared with the recorded values in the database tables to obtain the validity of the real-time dynamic regularity distributed system control method and adjust the relevant parameters to improve its performance.

4. Experimental Analysis of Distributed System Coordination Predictive Control for Network Information Mode

4.1. Distributed System Coordination Predictive Control Test

Table 1 shows the performance data of this distributed system for coordinated predictive control.

Table 1. System-coordinated predictive control test

Test times	Feasibility (%)	Stability(%)	Forecast time(s)	Forecast accuracy(%)
1	98	96	5	95
2	90	99	6	95
3	95	95	5	93
4	94	96	7	97
5	96	93	4	94

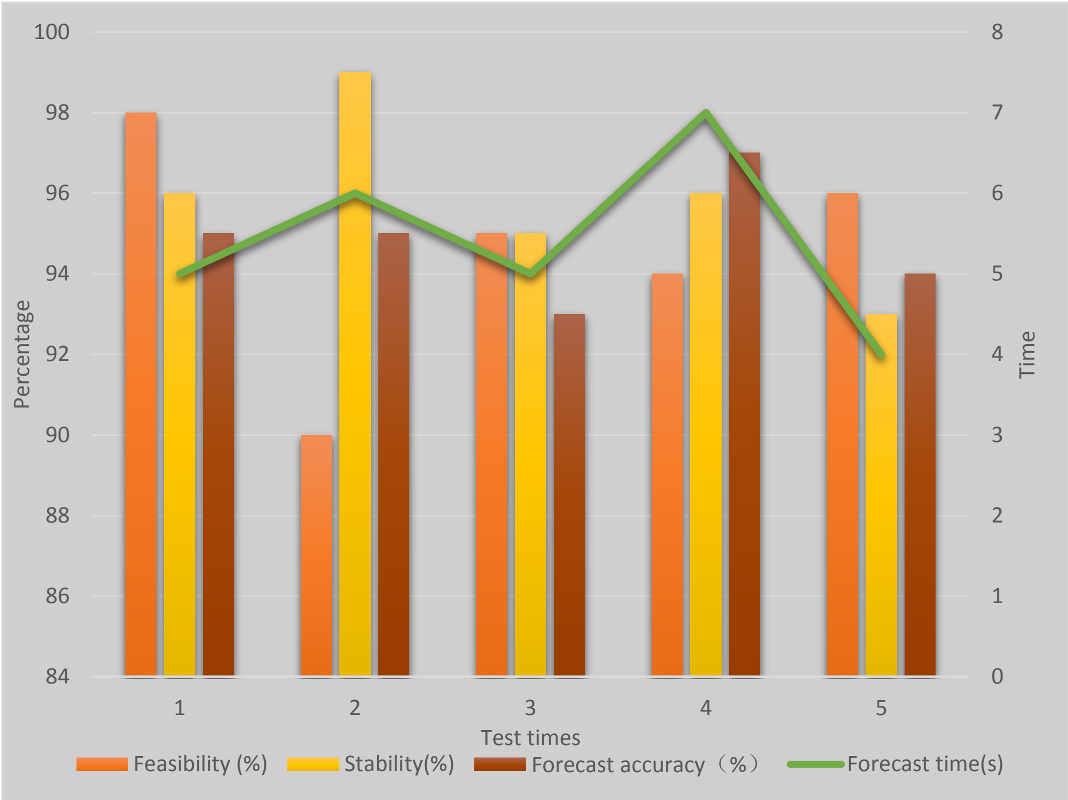

Figure 4. Predictive model testing

In the process of building an online model of distributed network coordinated control, the feature information is extracted first, and then the synergy among subsystems is determined according to the controller structure. Then, an adaptive algorithm in the network is used to calculate the output value and transfer weight vector between each node. Finally, the simulation results of MATLAB software show that the prediction time of this model is within the range of 4s-7s, and its stability, feasibility and prediction accuracy are up to 90%. This indicates that the distributed system coordination prediction model under network information mode performs well.

5. Conclusion

Based on the characteristics of the network information age, a distributed system collaborative control model is proposed and analyzed. Firstly, the complex problems and influencing factors in the multi-stage decision-making process are explained in theory. Secondly, the coordination between different types of tasks such as multi-state, non-linear and time-varying tasks is improved through the network environment. In this paper, genetic algorithm is used to solve the optimal value of dynamic virtual mixed integer programming controller performance indicators compared horizontally with the actual operating conditions, which provides support for scheduling optimization and predictive control for future development.

Reference

[1]Anas M. Al-Oraiqat, Oleksandr Ulichev, Yelyzaveta Meleshko, Hazim Saleh Al-Rawashdeh, Oleksii Smirnov, Liudmyla I. Polishchuk:Modeling strategies for information influence

dissemination in social networks. J. Ambient Intell. Humaniz. Comput. 13(5): 2463-2477 (2022).
[2]Abdul Razaque, Syed S. Rizvi, Meer Jaro Khan, Muder Almiani, Amer Al-Rahayfeh:State-of-art review of information diffusion models and their impact on social network vulnerabilities. J. King Saud Univ. Comput. Inf. Sci. 34(1): 1275-1294 (2022).
[3]Kevin Kam Fung Yuen:Decision models for information systems planning using primitive cognitive network process: comparisons with analytic hierarchy process. Oper. Res. 22(3): 1759-1785 (2022).
[4] P. V. Sunil Kumar, Adheeba Thahsin, Manju M, Gopakumar G:A Heterogeneous Information Network Model for Long Non-Coding RNA Function Prediction. IEEE ACM Trans. Comput. Biol. Bioinform. 19(1): 255-266 (2022).
[5]Jiarui Jin, Kounianhua Du, Weinan Zhang, Jiarui Qin, Yuchen Fang, Yong Yu, Zheng Zhang, Alexander J. Smola:GraphHINGE: Learning Interaction Models of Structured Neighborhood on Heterogeneous Information Network. ACM Trans. Inf. Syst. 40(3): 45:1-45:35 (2022).
[6]Asadullah Khalid, Arif I. Sarwat:Unified Univariate-Neural Network Models for Lithium-Ion Battery State-of-Charge Forecasting Using Minimized Akaike Information Criterion Algorithm. IEEE Access 9: 39154-39170 (2021).
[7]Josué Aarón López-Leyva, Esperanza Guerra-Rosas, Josué Álvarez-Borrego:Multi-Class Diagnosis of Skin Lesions Using the Fourier Spectral Information of Images on Additive Color Model by Artificial Neural Network. IEEE Access 9: 35207-35216 (2021).
[8]Jan Treur:Modeling the emergence of informational content by adaptive networks for temporal factorisation and criterial causation. Cogn. Syst. Res. 68: 34-52 (2021).
[9]Rafiullah Khan, Mohib Ullah, Atif Khan, Muhammad Irfan Uddin, Maha Al-Yahya:NN-QuPiD Attack: Neural Network-Based Privacy Quantification Model for Private Information Retrieval Protocols. Complex. 2021: 6651662:1-6651662:8 (2021).
[10]Narihisa Matsumoto, Yoh-ichi Mototake, Kenji Kawano, Masato Okada, Yasuko Sugase-Miyamoto:Comparison of neuronal responses in primate inferior-temporal cortex and feed-forward deep neural network model with regard to information processing of faces. J. Comput. Neurosci. 49(3): 251-257 (2021).
[11]Sanjay Kumar, Muskan Saini, Muskan Goel, B. S. Panda:Modeling information diffusion in online social networks using a modified forest-fire model. J. Intell. Inf. Syst. 56(2): 355-377 (2021).
[12]Gasper Begus:CiwGAN and fiwGAN: Encoding information in acoustic data to model lexical learning with Generative Adversarial Networks. Neural Networks 139: 305-325 (2021).
[13]Qamar Abbas, Syed Ali Hassan, Haris Pervaiz, Qiang Ni:A Markovian Model for the Analysis of Age of Information in IoT Networks. IEEE Wirel. Commun. Lett. 10(7): 1596-1600 (2021).
[14]Balázs Varga, János Farkas, Rodney Cummings, Yuanlong Jiang, Don Fedyk:Flow and Service Information Model for Deterministic Networking (DetNet). RFC 9016: 1-20 (2021).
[15]Suman Kundu, Tomasz Kajdanowicz, Przemyslaw Kazienko, Nitesh V. Chawla:Fuzzy Relative Willingness: Modeling Influence of Exogenous Factors in Driving Information Propagation Through a Social Network. IEEE Access 8: 186653-186662 (2020).
[16]Hussain K. Chaiel, Ahmed A. Alabdel Abass:Game theoretical model for information transmission in structure-free wireless sensor networks. IET Commun. 14(17): 3080-3086 (2020).
[17]María Flavia Guiñazú, Víctor Cortés, Carlos F. Ibáñez, Juan D. Velásquez:Employing online social networks in precision-medicine approach using information fusion predictive model to improve substance use surveillance: A lesson from Twitter and marijuana consumption. Inf.

Fusion 55: 150-163 (2020).

[18]Samar Mouakket, Yuan Sun:Investigating the Impact of Personality Traits of Social Network Sites Users on Information Disclosure in China: the Moderating Role of Gender. Inf. Syst. Frontiers 22(6): 1305-1321 (2020).