Research on Self Adjustment Technology of Data Mining Algorithm in Control Engineering

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Keyword: Data Mining Algorithm, Control Engineering, Automatic Adjustment.

Abstract: The research direction is the self-tuning technology of data mining algorithm in control engineering. The main purpose of this research is to develop a new technology of automatic fault identification and diagnosis in various industrial systems based on nonlinear models. The proposed method will be used to optimize such systems through neural networks. The results obtained in the implementation stage show that the neural network with a large number of hidden units (up to 500) can be used as an effective tool to solve nonlinear model problems. The research on self-tuning technology of data mining algorithm in control engineering is to find the best method of using data mining algorithm to control the process. It is also called intelligent system or artificial intelligence (AI). The main goal of this research is to develop an intelligent system that can perform better than human operators in the control process. Self tuning technology refers to the ability of computer systems to learn from past experience and improve performance by using these experiences without any human intervention.

1 INTRODUCTION

Now the numerical solution of the computer is so simple and fast. From the aspect of solution alone (or from the aspect of publishing papers), the frequency domain method seems to have no need to exist (Wang and Shen, et al. 2019). Just like the Routh criterion, it has completed the historical task and can quit the historical dance stage with honor (unfortunately, it is still teaching the Routh criterion now). Moreover, the frequency domain method will eventually be transformed into the time domain algorithm (Xu and Miao, 2018). However, the real engineering of control system, LTI system, still depends on Bode diagram (signal or system) most of the time (Bi and Meng, et al. 2021). Many of the top international companies and engineers I have learned will look at Bode diagram when designing control system, at least before the actual operation of the system (Hong, 2021). And it is not only the control system, but also in the field of signal processing (digital signal processing), even more obvious (Sun and Zhijian, et al. 2019).

Personally, I think the more important reason is physical intuition. This word is actually not rigorous. In fact, the frequency domain method is often not rigorous, but it is useful (Luo and Zheng, et al. 2019). For example, the cut-off frequency / bandwidth, if spectrum peak, low-frequency gain, high-frequency gain, these key points can be seen by experience, roughly (pay attention to roughly) the response curve, robustness, high and low if interference suppression, stability, accuracy, etc., and really can be seen by simple calculation in your mind. More importantly, if you want to change a certain characteristic (response curve, robustness, high and low if interference suppression, stability, accuracy, etc.), you can also directly know which parameters to adjust and what impact this characteristic will have on other characteristics (Chen and Xu, et al. 2021).

In contrast, given a differential equation, even if you can calculate some performance indicators through the computer, if you want to change this indicator to meet a specific requirement, you can almost only try (Tung-and WU, et al. 2019); And most of the time, one performance is good, and the other performance is not good, because there are interactions (Bai and Xiong, et al. 2019). Based on this, this paper studies the self-tuning technology of data mining algorithm in control engineering.

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2 RELATED WORKS

2.1 Data Mining Algorithm

Data mining is the process of discovering useful patterns in data. The purpose of data mining session is to determine the trend and pattern of data. Data mining emphasizes the processing of a large number of observed databases. It is a frontier discipline involving database management, artificial intelligence, machine learning, pattern recognition, and data visualization. From a statistical point of view, it can be seen as the automatic exploratory analysis of a large number of complex data sets through computers. Data source: it is the foundation of data warehouse system and the data source of the whole system. It usually includes internal and external information of the enterprise. Internal information includes various business processing data and various document data stored in RDBMS. External information includes various laws and regulations, market information and competitor information, etc (Liang, 2018).

Data storage and management: it is the core of the whole data warehouse system. The real key of data warehouse is data storage and management. The organization and management mode of data warehouse determines that it is different from traditional database, and also determines its manifestation of external data. To decide what products and technologies to adopt to establish the core of data warehouse, we need to analyze the technical characteristics of data warehouse. The data of existing business systems are extracted, cleaned up, effectively integrated, and organized according to the theme. Data warehouse can be divided into enterprise level data warehouse and department level data warehouse (usually called data mart) according to the coverage of data. Figure 1 below shows the data mining process.

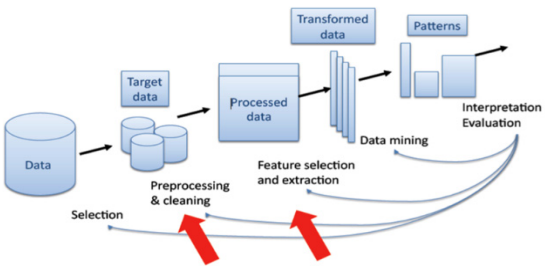

Figure 1: Data mining process

OLAP server: effectively integrate the data required for analysis and organize it according to the multidimensional model, so as to conduct multi angle and multi-level analysis and find trends. Its specific implementation can be divided into ROLAP, MOLAP and HoLap. ROLAP basic data and aggregate data are stored in RDBMS; MOLAP basic data and aggregate data are stored in multidimensional database; HoLap basic data is stored in RDBMS, and aggregated data is stored in multidimensional database.

Front end tools: mainly including various report tools, query tools, data analysis tools, data mining tools and various application development tools based on data warehouse or data mart. Among them, data analysis tools are mainly for OLAP servers, while report tools and data mining tools are mainly for data warehouses.

2.2 Control Engineering Technology

As for master control engineering, first of all, we need to mention the basic theory of control engineering system control process, that is, control engineering cybernetics. Its main research contents are information, state and control engineering topology. Usually, this theory is the reference basis for building master control engineering. The main function of the master control project is to input control commands and parameters, and display the operation and feedback information of the controlled equipment. In addition, from the perspective of the basic framework of the master control of control engineering, it is divided into three control structures: centralized, decentralized and hierarchical. Each control structure has the advantages and disadvantages of dichotomy. Second, the centralized control structure is relatively simple in structure and control, which makes the management and network construction easier, and the delay time is small, reducing the error in the transmission process. However, the installation workload is large and the cost is high, which is not conducive to resource sharing. The advantage of decentralized control structure is its high reliability. Even if the controller fails, the control engineering system will not be completely paralyzed. Therefore, when the system scale meta method is centralized control, the communication is more convenient, or the user requires the use of decentralized control structure, the decentralized control structure can be used. However, the decentralized control structure also has some defects. If the state of the control engineering system cannot be controlled and observed, the hierarchical control structure combines

the centralized and decentralized control structure, which can realize both local control and global coordinated control.

$$P_{loss} = 1 - \frac{1-p_0}{p} = \frac{p_0 + p - 1}{p} = \sum_{n=1}^{N} P_K \tag{1}$$

$$Sim_1(d_i, d_{1j}) = \frac{\sum_{k=1}^{M} W_{ik} \times W_{1ik}}{\sqrt{\sum_{k=1}^{M} W_{ik}^2} \cdot \sqrt{\sum_{k=1}^{M} W_{1jk}^2}} \tag{2}$$

The controlled control engineering system is mainly based on the cybernetics of control engineering. The control mechanism can be implemented through software or hardware to provide certain control services. Generally, the controlled control engineering system can be understood as a data resource, or it can be a control system centered on computer, which combines field control with management and data acquisition. In terms of structure, it mainly includes control engineering control center, acquisition node user interface and intermediate control node. During the design process, certain principles should be followed, that is, the planning of safety detection, safety protection and emergency recovery reflects the principle of integrity, and the classification of safety levels and levels of controlled control projects reflects the principle of hierarchy. The introduction of variable factors in controlled control engineering reflects the principle of dynamic, and the restriction of authority reflects the principle of minimization. Only by ensuring the application of design principles can the safety and controllability of control engineering system be guaranteed.

3 RESEARCH ON SELF-TUNING TECHNOLOGY OF DATA MINING ALGORITHM IN CONTROL ENGINEERING

System analysis refers to the analysis of system performance with known system structure and parameters System design refers to the performance indicators that the control object and the control system are known to achieve. It is required to design a system to achieve these indicators.

If the parameters of the control system cannot fully meet the performance index of the design requirements by adjusting its own parameters, it is necessary to add some devices in the system whose parameters and characteristics can be changed as needed to make the system performance fully meet the design requirements, which is system correction (correction), and the corresponding correction device is also called compensator As shown in Figure 2 below, series correction in automatic adjustment.

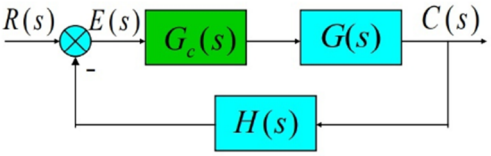

Figure 2: Series correction in automatic adjustment

It infers future data from historical and current data according to time series data, and it can also be considered as related knowledge with time as the key attribute. At present, time series prediction methods include classical statistical methods, neural networks and machine learning. In 1968, box and Jenkins put forward a set of relatively perfect time series modeling theory and analysis methods. These classical mathematical methods predict time series by establishing random models, such as autoregressive model, autoregressive moving average model, summation autoregressive moving average model and seasonal adjustment model. Because a large number of time series are non-stationary, their characteristic parameters and data distribution change with the passage of time. Therefore, only through the training of some historical data, the establishment of a single neural network prediction model can not complete the accurate prediction task. Therefore, people put forward retraining methods based on statistics and accuracy. When it is found that the existing prediction model is no longer suitable for the current data, retrain the model to obtain new weight parameters and establish a new model. Many systems also use the computational advantages of parallel algorithms to predict time series.

In addition, other types of knowledge can be found, such as deviation, which is a description of differences and extreme special cases, and reveals the abnormal phenomena of things that deviate from the Convention, such as special cases outside the standard category, outliers outside the data clustering, etc. All these knowledge can be found at different conceptual levels, and with the improvement of conceptual levels, from micro to meso to macro, to meet the needs of different users at different levels of decision-making.

It reflects the characteristic knowledge of the common nature of similar things and the different characteristic knowledge between different things. The most typical classification method is based on decision tree. It constructs a decision tree from the set of examples, which is a guided learning method. This method first forms a decision tree according to the training subset (also known as window). If the tree cannot give the correct classification of all objects, select some exceptions to add to the window, and repeat the process until the correct decision set is formed. The final result is a tree, whose leaf node is the class name, and the intermediate node is an attribute with branches, which corresponds to a possible value of the attribute Data classification also includes statistics, rough set and other methods. Linear regression and linear discriminant analysis are typical statistical models. In order to reduce the cost of decision tree generation, an interval classifier is also proposed. Recently, some people have also studied the use of neural network methods for classification and rule extraction in databases.

4 CONCLUSIONS

The self-tuning technology of data mining algorithm is the most important part of control engineering. Self adjustment technology is to adjust the feedback signal, which is generated by data mining algorithm to achieve a stable and reliable control system. This paper studies the self-tuning technology of data mining algorithm in control engineering. First, there are two types of algorithms used to adjust the feedback signal: independent algorithm and dependent algorithm. Secondly, there are three methods to adjust the feedback signal: direct method, indirect method and mixed method. In general, it can be said that the focus of these studies is to develop intelligent systems based on the use of AI technology.

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