
Scalable Computing: Practice and Experience, ISSN 1895-1767, http://www.scpe.org

Volume 25, Issues 3, pp. 1863–1871, DOI 10.12694/scpe.v25i3.2775

OPTIMIZATION OF INTERNAL CONTROL FOR BUDGET OPERATIONS IN PUBLIC INSTITUTIONS BASED ON RANDOM FOREST ALGORITHM

YANG JIN*

Abstract. In order to promote the construction of internal control in public institutions and improve work efficiency, the author proposes an optimization of internal control in public institution budget business based on random forest algorithm. We have constructed a big data audit framework for internal control of A Maritime Bureau based on the financial cloud platform and sorted out its audit process. By using the random forest algorithm to identify suspicious points in the internal control audit of administrative institutions at the data level, an example analysis is conducted using some data from A Maritime Bureau's assets, budget, revenue and expenditure, infrastructure, and contract business. The results indicate that the design of the internal control big data audit plan for administrative institutions will promote the innovation of audit information technology and application in A Maritime Bureau, provide theoretical guidance for the internal control big data audit carried out by administrative institutions, and effectively solve the problems of high workload and low work efficiency when A Maritime Bureau conducts internal control big data audits, thereby improving audit efficiency.

Key words:
Random forest algorithm; Public utility units; Budget business; internal controls

1. Introduction. The main purpose of internal control is to control risks, continuously improve control measures around internal control objectives, and implement them in place to play a role in risk prevention and control. When carrying out internal control work for budget business in public institutions, budget work is carried out in accordance with relevant policies and regulations, in order to achieve internal control objectives for budget business, continuously improve the internal control system for budget business, effectively solve problems in the process of budget work, promote pre planning, in-process control, and post assessment of budget business, and urge public institutions to do a good job in fund management, in order to better fulfill public service functions [1]. The internal control of budget business can play a good promoting role in the budget management work of public institutions [2,3].

The management content involved in internal control of budget business in public institutions mainly includes risk assessment of budget business, separation of incompatible positions, construction of budget and financial information systems, organizational structure setting, internal control environment, supervision and assessment mechanisms, etc.

When carrying out specific budget operations, internal control work involves many links such as budget preparation, approval, execution, adjustment, final accounting, and evaluation. Public institutions need to implement budget work into specific business operations, and internal control is responsible for controlling this process. Public institutions need to conduct regular or irregular risk assessments on budget operations, and timely identify risk points based on the degree and type of risk, and then take effective measures to address them. The orderly implementation of internal control over budget business in public institutions can ensure the efficient use of funds and legal compliance of budget activities, effectively supervise budget revenue and expenditure, prevent fraudulent behavior, ensure the authenticity and completeness of budget information, and promote the stable operation of public institutions to achieve established work goals.

With the development and popularization of new information technologies, emerging technologies such as big data and cloud computing have pushed social informatization to a new peak. The ecological pattern of interaction between the Internet space and real society has deeply influenced social change.

More and more enterprises, national governments, and administrative institutions have established cloud

*School of Economics, Henan Polytechnic Institute, Nanyang, Henan, China, 473000 (2003015@hnpi.edu.cn)

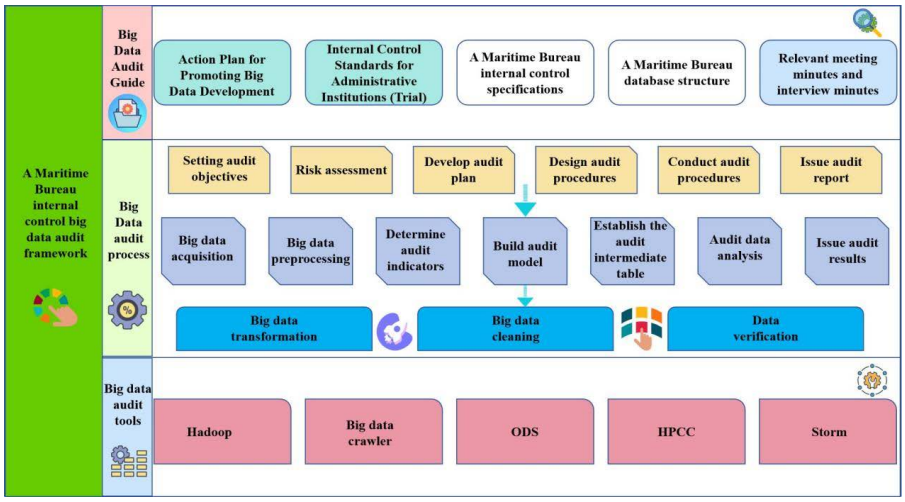

Fig. 2.1: A Maritime Administration's Internal Control Big Data Audit Framework

systems related to their actual business, such as the Golden Tax Project of tax authorities Enterprise financial shared service centers, among which many are financial cloud platforms [4]. In order to strengthen internal control and improve financial work efficiency, A Maritime Safety Bureau has established a financial cloud platform to connect the financial work of all subordinate units. The financial cloud platform summarizes all financial data and other related data from various departments, subordinate maritime departments, public institutions, etc. of the headquarters of A Maritime Bureau, forming big data with characteristics such as large data volume, diverse data types, fast data generation and transmission speed, and low data value density [5]. With the rise of cloud computing and big data technology, it has become a trend for administrative institutions to establish their own financial cloud platforms based on new information technologies in order to improve financial work efficiency. The financial cloud platform can effectively collect, store, and manage relevant economic business data of administrative institutions, but how auditors can effectively leverage the platform and data advantages provided by the financial cloud platform to achieve efficient internal control auditing of administrative institutions from the data level has become an urgent problem to be solved. Therefore, the author's research objective is to explore possible methods for administrative institutions to fully utilize big data audit methods based on financial cloud platforms to achieve efficient internal control auditing by designing corresponding big data audit plans for internal control in administrative institutions.

2. Methods.

2.1. Internal Control Big Data Audit Framework. The A Maritime Bureau's financial cloud platform utilizes big data technology to integrate Kingdee K3 financial accounting software and other business systems, achieving effective collection, storage, preprocessing, and analysis of A Maritime Bureau's internal control big data, which is helpful for the subsequent audit work. The internal control big data audit framework of A Maritime Administration should include three dimensions: Big data audit guidelines, big data audit processes, and big data audit tools, as shown in Figure 2.1 [6].

2.1.1. Big Data Audit Guide Dimension. The Big Data Audit Guidelines refer to the documents and materials that need to be referenced when conducting big data audits. Among them, the "Action Outline for Promoting the Development of Big Data" issued by the State Council, the "Internal Control Standards for Administrative Institutions (Trial)" issued by the Ministry of Finance, and the internal control standards issued by the A Maritime Administration and the Maritime System are policy guidelines and important reference basis for the application of big data [7,8].

The various databases of A Maritime Administration are important data sources for conducting big data audits, and their data structure is the foundation for implementing big data audits. The relevant meeting minutes

and interview minutes reflect the specific implementation of the internal control system of A Maritime Bureau on the financial cloud platform, and are an important basis for conducting big data audit implementation.

2.1.2. Big Data Audit Process Dimension. The internal control big data audit process of A Maritime Safety Administration based on the financial cloud platform reflects the specific implementation process of audit work, including six steps: determining audit objectives, risk assessment, developing audit plans, designing audit procedures, executing audit procedures, and issuing audit reports, the design of audit procedures can be further divided into steps such as big data collection, big data preprocessing, determination of audit indicators, construction of audit models, establishment of intermediate tables, analysis of audit data, and issuance of audit results. These are specific methods for carrying out big data audit implementation work.

Through this process, a large amount of data with a wide variety can be obtained the internal control big data with fast generation and transmission speed and low value density can be transformed into audit evidence that can provide support for audit doubts.

2.2. A Maritime Bureau's Internal Control Big Data Audit Process.

2.2.1. Determine audit objectives. Clarifying the audit objectives of internal control in administrative institutions is a prerequisite for discovering audit doubts. In the cloud accounting environment, auditors not only need to consider the compliance of the internal control system design and the effectiveness of internal control execution in administrative institutions, but also need to consider the integrity of internal control under the cloud platform when determining audit objectives [9].

2.2.2. Risk assessment. The audit risk of A Maritime Bureau's internal control big data audit under cloud accounting is not only negatively related to the degree of importance, but also closely related to whether the process and results of big data preprocessing meet certain processing rules. If the preprocessing process of big data does not comply with relevant regulations or the processing results do not meet audit requirements, audit risks will increase [10,11]. At the same time, the credibility of A Maritime Bureau's financial cloud system is also related to audit risks. The low credibility of A Maritime Bureau's financial cloud system not only affects the final audit results, but also greatly increases audit risks. In order to control audit risks, auditors should monitor the entire process of big data preprocessing, at the same time, the credibility evaluation results of A Maritime Bureau's financial cloud system and other business systems were obtained through third-party experts.

On the basis of considering the importance of the audit business itself, combined with the evaluation results of A Maritime Bureau's financial cloud system provided by third-party experts, the possible audit risks are ultimately identified and evaluated qualitatively based on the types and indicators of risks.

2.2.3. Develop audit plan. In the cloud accounting environment, the audit plan for big data audits should plan an audit schedule that includes audit time, audit scope, and audit human resources. In particular, the time and manpower required for the big data preprocessing process in big data audits should be reflected in the audit schedule [12]. Among them, the audit scope of big data auditing has become larger compared to traditional audit methods.

After big data preprocessing, various types of data stored in the audit data warehouse, including business data and external data of A Maritime Bureau, can be selected by auditors as long as they are related to internal control of A Maritime Bureau, rather than only focusing on the causal relationship between data and business.

2.2.4. Design audit procedures. The audit procedure for the internal control big data audit of A Maritime Safety Administration should include steps such as big data collection, big data preprocessing, determining audit indicators, constructing audit models, establishing intermediate tables, analyzing audit data, and issuing audit results. In the process of designing the internal control audit program for A Maritime Bureau, algorithmic tools such as SQL statements, database technology, semi Markov chain models, and random forest algorithms can be used to implement big data audits [13].

Data collection: In order to meet the internal control big data audit needs of A Maritime Bureau, auditors should collect the actual business process data of A Maritime Bureau on the cloud accounting platform, including business data and financial data. A Maritime Bureau's financial cloud platform can store data from different format business systems such as DBMS, Filc, Excel, etc. in the business synchronous replication

database, then use ETL (extraction, transformation, loading) tools to preprocess the data in the business synchronous replication database. At the same time, auditors should also obtain the current internal control system of administrative institutions, audit knowledge base, and standard documents such as the "Internal Control Standards for Administrative Institutions (Trial)", and uniformly store them in the audit database for management.

Building an audit model: Auditors can build an audit model based on audit indicators. The audit model is an important tool for implementing data auditing, which can be constructed in various ways. The author intends to use a semi Markov chain model to achieve mathematical expression of internal control in administrative institutions, in order to structure internal control data, and then use random forest algorithm to construct a specific audit model, and use the algorithm to discover audit doubts in internal control of administrative institutions.

There are many algorithms that can be used in the process of discovering audit doubts, such as BP neural network algorithm, naive Bayesian algorithm, random forest algorithm, etc. The random forest algorithm has the advantages of fast training speed, good noise resistance, and simple implementation. Therefore, the author chooses to use the random forest algorithm to discover suspicious points in internal control audits of administrative institutions [14]. The principle of the random forest algorithm is to randomly extract a portion of data samples from the target dataset to construct multiple decision tree models, which are training sets. Multiple decision trees composed of training set data samples are independent of each other, forming a random forest. After completing the construction of the random forest model, the samples from the original dataset need to be judged separately by each decision tree in the forest to determine which category the sample should belong to. The final judgment result is voted by the judgment results of all decision trees in the random forest, and the majority of votes obtained is the final judgment result. The use of random forest algorithm in the discovery of audit doubts is to extract training sets from the thematic data mart to construct a random forest model, and then make judgments. After data collection, data preprocessing, and setting audit indicators, the raw data collected by the auditor should be converted into a dataset mathematically expressed by a semi Markov chain model, which includes eigenvalues used for decision tree judgment, such as state transition probability matrix, dwell time matrix, etc., and stored in a thematic data mart according to different business processes and audit indicators required by internal control, then, a random forest algorithm can be used to construct an audit model and identify audit doubts.

Constructing a training set using an audit knowledge base to construct a random forest model: The following assumptions need to be made when constructing a training set using an audit knowledge base to construct a random forest model.

Assumption 1: The data samples without audit doubts in the training set are normal data samples, and the data samples with audit doubts are doubtful data samples.

Assumption 2: When the judgment result of the decision tree model shows that there are doubts, the output result is y=0, if it is determined that there are no audit doubts, the output result is y=1.

Assuming that the final judgment result of the random forest algorithm is determined by the voting of each decision tree, the final judgment made by the random forest model can be expressed as:

$$z = \begin{cases} 1, count(y=1) > count(y=0) \\ 0, count(y=1) < count(y=0) \end{cases} \tag{2.1}$$

Using the random forest model for auditing, it was found that based on the previous assumption, when the sample size of the training set is large enough, the voting results of the random forest can divide the original dataset into two subsets: z=1 and z=0, usually, the data samples in the z=1 subset are normal data samples, while the data samples in the z=0 subset have audit doubts [15].

By constructing an audit model and audit intermediate table, preliminary audit doubts can be obtained. For the sake of audit prudence, further analysis of audit doubts still requires professional judgment or other means from auditors. After analyzing the audit data, the final audit results can be obtained. The audit doubts need to be sorted and summarized by the auditors to form a summary table of audit doubts, and communicated with the leaders of administrative institutions to conduct preliminary verification of the doubts

Table 3.1: Internal Control of Asset Business

classification	Number of samples	-		
Normal Data Samples	1420			
Doubtful data samples	3			
Business number	Accounting Month	Accounting voucher number	amount of money	Asset nature
470	05	33	16000	Science and Technology Information Department
1184	12	02	50000	

and clarify whether there are audit doubts caused by force majeure. These doubts and subsequent verification need to be separately listed in the internal control audit report.

2.2.5. Execute audit procedures. Execute audit procedures according to the designed audit plan, monitor the entire process of obtaining, cleaning, and storing big data, and combine third-party experts or institutions' comprehensive evaluation of A Maritime Bureau's financial cloud system and other business systems to fully leverage the advantages of combining financial and business data brought by A Maritime Bureau's financial cloud system with other business systems of the enterprise, forming audit doubts, search for audit evidence and obtain audit results. Any issues discovered during the big data audit process should be promptly reported to the relevant leaders and management personnel of A Maritime Bureau, and these issues also need to be reviewed and evaluated.

2.2.6. Issue audit report. Big data auditing reflects the business from a data perspective, and at the same time, doubts can only be discovered from the data. Whether there are problems in the actual business needs to be further collected based on the audit doubts. According to the process of big data auditing, the audit doubts obtained by auditors through big data auditing methods are classified according to audit indicators, and should ultimately be summarized to form a summary Table of audit doubts. Then, according to the actual audit business needs, tasks are assigned for audit evidence collection, and audit doubt point evidence collection reports are prepared to provide the final audit results [16]. When issuing audit results, summarize the audit opinions obtained through the implementation of big data audits and audit evidence collection, and combine the business background of the big data audit and the initially established audit objectives to obtain the final audit results. Then, based on the problems discovered during the audit process, propose management suggestions to the relevant leaders and management personnel of A Maritime Safety Bureau, and after communicating with them, obtain their relevant responses to the management suggestions, finally, issue an audit report.

3. Results and Analysis. There are many types of business in A Maritime Bureau, and the author intends to analyze the internal control big data audit of A Maritime Bureau using data from some of the five types of business: Assets, budget, revenue and expenditure, infrastructure, and contracts as examples.

3.1. Internal Control Big Data Audit of Asset Business of A Maritime Administration.

3.1.1. Internal Control Audit Doubts Discovery Based on Random Forest Algorithm. After completing the mathematical expression of the internal control process, data samples were extracted from the audit knowledge base using Python language to form a training set, and a random forest algorithm was used to analyze some asset disposal data for 2016. The final summary results are shown in Table 3.1 [17]. The experimental results indicate that out of the 1421 selected data samples, 1419 are normal data samples, and 2 are doubtful data samples. The doubtful data samples reflect the asset disposal business of A Maritime Bureau, which is recorded in the 3rd accounting voucher in April and the 1st accounting voucher in November, respectively.

Table 3.2: Internal Control of Asset Business

Business number	Accounting Month	Accounting voucher number	amount of money	Asset nature
19	10	168	3250	Marine Department

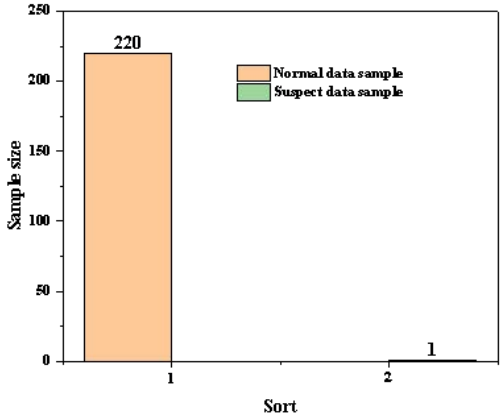

Fig. 3.1: Comparison of Findings of Doubtful Points in Internal Control Audit of Accounting Business

3.1.2. Verification of audit doubts . After using the random forest algorithm to find audit doubts, it is necessary to verify the audit doubts, that is, in order to search for raw data through SQL statements in the SQLSERVER2008R2 environment to confirm the effectiveness of the random forest algorithm in the discovery of internal control audit doubts [18]. Through verification, it was found that the asset recorded in the accounting voucher No.33 of A Maritime Bureau in April belongs to the bureau, but was approved by a subordinate maritime department leader in the actual disposal process; The asset recorded in the November 2nd accounting voucher of the A Maritime Safety Bureau belongs to technical assets, but during the disposal process, it was not approved by the Science and Technology Information Department, and instead was approved by the Infrastructure and Equipment Department.

3.2. A Maritime Bureau Budget Business Internal Control Big Data Audit.

3.2.1. Internal Control Audit Doubts Discovery Based on Random Forest Algorithm. After completing the mathematical expression of the internal control process, data samples were extracted from the audit knowledge base using Python language to form a training set. The random forest algorithm was used to analyze some additional budget adjustment data for 2016. The final summary results are shown in Table 3.2 and Figure 3.2. The experimental results indicate that out of the 221 selected data samples, 220 belong to normal data samples, and 1 is a doubtful data sample. The doubtful data sample reflects the additional budget adjustment business of A Maritime Bureau, which was recorded in the accounting voucher No. 168 in October.

3.2.2. Verification of audit doubts. After using the random forest algorithm to find audit doubts, it is necessary to verify the audit doubts, that is, in order to search for raw data through SQL statements in the SQLSERVER2008R2 environment to confirm the effectiveness of the random forest algorithm in the discovery of internal control audit doubts. Through verification, it was found that the application data submitted by the grassroots maritime department in the accounting voucher No.68 of A Maritime Bureau in October is missing, and the reason is unknown.

Table 3.3: Internal Control of Revenue and Expenditure Business

classification	Number of samples	-		
Normal Data Samples	6643			
Doubtful data samples	3			
Business number	Accounting Month	Accounting voucher number	Amount of money	Nature of expenditure
13	1	84	624	Daily expenses
142	3	66	1443	Daily expenses

Table 3.4: Internal Control of Infrastructure Business

Classification	Number of samples
Normal Data Samples	30
Doubtful Data Samples	0

3.3. Internal Control Big Data Audit of Revenue and Expenditure Business of A Maritime Bureau.

3.3.1. Internal Control Audit Doubts Discovery Based on Random Forest Algorithm. After completing the mathematical expression of the internal control process, data samples were extracted from the audit knowledge base using Python language to form a training set, and a random forest algorithm was used to analyze some expenditure approval data for 2016. The final summary results are shown in Table 3.3 [19]. The experimental results show that out of the 6644 selected data samples, 6642 belong to normal data samples, and 2 are doubtful data samples. The doubtful data samples reflect the expenditure approval business of A Maritime Bureau, which is recorded in the accounting voucher No.84 in January and the accounting voucher No.66 in March, respectively.

3.3.2. Verification of audit doubts. After using the random forest algorithm to find audit doubts, it is necessary to verify the audit doubts, that is, in order to search for raw data through SQL statements in the SQLSERVER2008R2 environment to confirm the effectiveness of the random forest algorithm in the discovery of internal control audit doubts. Through verification, it was found that the transactions recorded in the January 84th accounting voucher and March 66th accounting voucher of A Maritime Bureau should be daily expenses, but they were approved by the leaders of the responsible business units, which is inconsistent with the internal control system.

3.4. A Maritime Safety Bureau's Internal Control Big Data Audit of Infrastructure Business.

After completing the mathematical expression of the internal control process, data samples were extracted from the audit knowledge base using Python language to form a training set. The random forest algorithm was used to analyze the bidding data of some infrastructure projects in 2016. The final summary results are shown in Table 3.4. The experimental results indicate that out of the 30 selected data samples, 30 belong to normal data samples, undoubtedly point data samples.

3.5. A Maritime Bureau Contract Business Internal Control Big Data Audit.

After completing the mathematical expression of the internal control process, data samples were extracted from the audit knowledge base using Python language to form a training set, and a random forest algorithm was used to analyze some contract signing data for 2016. The final summary results are shown in Table 3.5 [20]. The experimental results indicate that out of the 1021 selected data samples, 1021 belong to normal data samples without any doubts.

Table 3.5: Internal Control of Contract Business

Classification	Number of samples
Normal Data Samples	1021
Doubtful Data Samples	0

4. Conclusion. Big data auditing is an audit method that applies big data technology to audit business, with the aim of reflecting the business from a data perspective. Applying big data technology to internal control auditing of administrative institutions can discover problems in the internal control system and execution of administrative institutions from a data perspective. The author constructed a big data audit framework for internal control of A Maritime Bureau and sorted out the audit process. In terms of specific audit methods, a combination of random forest algorithms was used to effectively utilize a large amount of data from the cloud, and an audit model was constructed to carry out the audit work. Finally, relevant data on internal control of A Maritime Bureau's assets, budget, revenue and expenditure, infrastructure projects, and contract business were analyzed as examples. Research has shown that big data technology can effectively assist auditors in discovering internal control doubts in administrative institutions from a data perspective, greatly reducing audit workload, improving audit efficiency, and solving problems in internal control audits of administrative institutions, achieving comprehensive and real-time audits, meeting new requirements in the context of new technologies. Big data auditing utilizes big data technology for auditing, which can effectively help auditors improve audit efficiency while having a data foundation. But at present, big data auditing has just started to rise and has not been widely applied. It is necessary to accumulate experience and summarize lessons in the practical process, and promote and practice on the basis of continuously improving the theoretical system.

REFERENCES

[1] Chen, Y., Guo, A., Chen, Q., Quan, B., & Hao, Z. . (2021). Intelligent classification of antepartum cardiotocography model based on deep forest. Biomedical Signal Processing and Control, 67(2), 102555.
[2] Azhar, Y., Mahesa, G. A., & Mustaqim, M. C. . (2021). Prediction of hotel bookings cancellation using hyperparameter optimization on random forest algorithm. Jurnal Teknologi dan Sistem Komputer, 9(1), 15-21.
[3] Abbassi, A., Mehrez, R. B., Abbassi, R., Saidi, S., Albdran, S., & Jemli, M. . (2022). Improved off-grid wind/photovoltaic/hybrid energy storage system based on new framework of moth-flame optimization algorithm. International Journal of Energy Research, 46(5), 6711-6729.
[4] Zhang, Z., & Bai, D. . (2022). Optimization of improved pid control strategy based on genetic algorithm. Journal of Physics: Conference Series, 2417(1), 012025-.
[5] Zheng, X., Yi, S., & Deng, X. . (2021). Evaluation model construction of automobile appearance design based on random forest algorithm. Journal of Physics: Conference Series, 1941(1), 012072 (9pp).
[6] Zhang, X., & Wang, M. . (2021). Weighted random forest algorithm based on bayesian algorithm. Journal of Physics: Conference Series, 1924(1), 012006 (6pp).
[7] Zvonareva, T. A., Kabanikhin, S. I., & Krivorotko, O. I. . (2023). Numerical algorithm for source determination in a diffusion–logistic model from integral data based on tensor optimization. Computational Mathematics and Mathematical Physics, 63(9), 1654-1663.
[8] Li, Y., Li, F., & Song, J. . (2021). The research of random forest intrusion detection model based on optimization in internet of vehicles. Journal of Physics Conference Series, 1757(1), 012149.
[9] Lin, H., & Tang, C. . (2021). Analysis and optimization of urban public transport lines based on multiobjective adaptive particle swarm optimization. IEEE Transactions on Intelligent Transportation Systems, PP(99), 1-13.
[10] Zhao, Y., Ren, X., & Zhang, X. . (2021). Optimization of a comprehensive sequence forecasting framework based on dae-lstm algorithm. Journal of Physics: Conference Series, 1746(1), 012087 (12pp).
[11] Yu, H. . (2021). Economic dispatching optimization of power grid based on igwo algorithm. Journal of Physics: Conference Series, 1748(3), 032009 (6pp).
[12] Yiyue, L., Yu, F., & Xianjun, C. . (2021). Research on optimization of deep learning algorithm based on convolutional neural network. Journal of Physics: Conference Series, 1848(1), 012038 (5pp).
[13] Sun, J., Guo, B., Hu, Y., & Zhang, Y. . (2021). Multi-objective optimization of spectrum sensing and power allocation based on improved slime mould algorithm. Journal of Physics: Conference Series, 1966(1), 012018-.
[14] Li, Y., Chen, J., Xu, X., Lin, Z., & Chen, X. . (2021). Optimization of garbage dumping mechanism of intelligent sanitation vehicle based on particle swarm algorithm. Journal of Physics: Conference Series, 1939(1), 012063 (8pp).
[15] He, Y. H., Luo, Y., Li, A. H., Wang, T. F., & Peng, Y. H. . (2021). Research on protection optimization of distribution network containing distributed power generation based on sparrow algorithm. Journal of Physics Conference Series,

1820(1), 012147.
[16] Lu, C., Xian, X., & Li, C. . (2021). Research on optimization of fuzzy network control system based on new smith predictive time delay compensation. Journal of Physics: Conference Series, 2132(1), 012019-.
[17] Hu, B., & Li, J. . (2021). An edge computing framework for powertrain control system optimization of intelligent and connected vehicles based on curiosity-driven deep reinforcement learning. IEEE Transactions on Industrial Electronics, 68(8), 7652-7661.
[18] Jiang, F., Sha, K., Lin, C., & Wu, Z. . (2023). Node layout optimization strategy based on aquaculture water quality monitoring system. Wireless Personal Communications, 132(4), 2839-2856.
[19] Gülah Gülba, & Gürcan etin. (2023). Lifetime optimization of the leach protocol in wsns with simulated annealing algorithm. Wireless Personal Communications, 132(4), 2857-2883.
[20] Dao, T. K., Nguyen, T. T., Ngo, T. G., & Nguyen, T. D. . (2023). An optimal wsn coverage based on adapted transit search algorithm. International Journal of Software Engineering and Knowledge Engineering, 33(10), 1489-1512.

Edited by: Zhigao Zheng
Special issue on: Graph Powered Big Aerospace Data Processing
Received: Oct 31, 2023
Accepted: Nov 15, 2023