Design and Optimization of CAD System for Building Construction Drawings based on BIM

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Abstract. In the course of evaluating and analyzing the effectiveness of CAD system, it is difficult to analyze the construction data automatically by means of image. On the basis of these, the article researches the CAD system of architecture layout and its optimizing approach using BIM technique. This paper sets up an efficient evaluating model for CAD system in the construction planning by using Tabu Search Method. Based on Web of Things and BIM techniques, we set up a variety of CAD graph groups for the construction planning. Based on the needs and data of various building items, we can analyze the CAD system efficiently, and then we can evaluate the precision and suitability of the CAD. It is proved that the IOT technique can be utilized efficiently in constructing CAD system with Tabu Search Strategy. According to building items, BIM technical plan is chosen, which is the most suitable for CAD drawing. Therefore, the total reliability of CAD system can be increased efficiently.

Keywords: Tabu Search Algorithm; Internet of Things Technology; Construction Drawing CAD System; Bim Technology
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1 INTRODUCTION

The optimization of construction drawing CAD system has an important influence on the promotion of the whole construction process. Fan et al. [1] solved the problem of information non circulation in various stages of architectural design. It analyzed the architectural content of the visualization platform structure and explored model accuracy analysis through size parameters. The research has greatly improved the content of the model in the direction of precision parameter driven design, which improves the efficiency of design and drawing. Due to different sites and types, construction projects at the present stage are prone to different on-site problems, which will further affect the overall construction quality and efficiency. Hernández et al. [2] developed a software tool for simplifying, automatically defining, and viewing trajectories in a plane. The algorithm used can be easily implemented in commercial CAD software, which proves the practicality and timeliness of the proposed tool. Although there are many researches on strategy optimization of architectural construction drawing CAD system at home and abroad at the present stage, there is a lack of obvious systematic portability scheme applicable to different scenarios. Sabbaghzadeh et al. [3] has developed a safety measure to appropriately improve fire protection measures within the economic benefits. Restrict budgets by constructing an economic framework for architectural design. The results indicate that it has a significant effect within an appropriate safety range. Therefore, in order to better develop a multidimensional evaluation system for CAD system strategies of different types of building construction drawings, it is necessary to combine BIM technology and Tabu search strategy multidimensional optimization algorithm to realize high-dimensional analysis and classified evaluation of different building construction projects. SęDzicki et al. [4] has adopted a green design and development method to improve the quality of the testing model. At the same time, a conceptual model based on the CDIO framework was developed and analyzed, and a conceptual analysis of the main objectives was conducted on this method model.

The innovation of this paper lies in the combination of BIM technology, which proposes an analysis model and evaluation system of architectural construction drawing CAD system based on Tabu search strategy multidimensional optimization algorithm. With the help of the Internet of Things technology, this model can carry out visual classification and multidimensional value representation for architectural construction drawing CAD corresponding to different types of construction projects. And according to the inherent universality and relevance of value degree matching, combined with different types of site construction requirements and external environment, to achieve the accuracy evaluation of different CAD data sets, and then effectively ensure the accuracy of the system in the design process and optimization process.

This paper studies the application of multidimensional optimization of Tabu search strategy in the intelligent analysis and optimization process of construction drawing CAD system, which is mainly divided into four chapters. The first chapter briefly introduces the construction drawing CAD system scheme, the basic principle of multidimensional optimization algorithm of Tabu search strategy and the chapter arrangement of this study. Chapter 2 briefly introduces the existing achievements in the evaluation model of construction drawing CAD systems both domestically and internationally, and summarizes the areas that need improvement in current research. In the third chapter, the optimization analysis model of construction drawing CAD system based on Tabu search strategy - multidimensional optimization algorithm is constructed. Implemented feature extraction in data internal coupling and centralized control based on internal data class errors. Improve the intelligent accuracy of construction drawing CAD systems. In Chapter 4, a comparative simulation experiment was designed to verify the applicability and feasibility of various datasets commonly used in the intelligent analysis of the construction drawing CAD system constructed in this paper. Chapter 5 summarizes the entire text. The experimental results indicate that the proposed multidimensional optimization algorithm for the analysis model of building construction drawing CAD system based on BIM technology and Tabu search strategy has wider applicability and accuracy advantages.

2 STATE OF THE ART

Most scholars have carried out a lot of research based on the optimization method of architectural construction drawing CAD system, mainly focusing on the planning of construction drawing, correlation analysis of relevant data of construction drawing and application of intelligent multi-scheme. Shivegowda et al. [5] Use computer-aided design (CAD) to create products. Then, the concept is transformed into hardware. Wu and Tang [6] conducted a review of the BIM model during the construction drawing design phase analysis. The BIM mainly provides architectural design services during the professional construction drawing design stage of the model. The division of mechanical and electrical professional systems will not be considered from a construction perspective. Wu et al. [7] analyzed the research results of optimizing the layout design of floor tiles. The establishment of a deepening design model for this project plays a very important role in assisting in engineering quantity statistics and information query in future construction stages. However, in addition to refining the system, the BIM model for further design needs to be further reviewed for construction drawing design in the future. Xiao and Bhola [8] are using relevant software to conduct BIM collision checks, identifying collision points between different professions and importing a summary report of the collision points for easy modification or construction guidance in advance. The model established using BIM software can contain all information about components, such as size, number, price, and so on. The component list based on BIM software can directly export the usage status of materials, even if the quantity is used. Xu et al. [9] found that the traditional design method involves designing two-dimensional planes during the design phase. The collaborative design of BIM is a multi-dimensional and three-dimensional design, where designers from various professions work together using three-dimensional digital simulation. Real time interaction can be achieved between each other to achieve collision checking. Traditional two-dimensional design cannot achieve this, and the problems existing in two-dimensional design can be magnified in collaborative design, which must be eliminated through collaborative work. Zhang et al. [10] established a digital model of buildings by analyzing and processing various data of buildings, thereby achieving full lifecycle management of buildings. Information modeling methods can help the design process of green buildings become more efficient, accurate, and reliable, while also helping to optimize building design and reduce building energy consumption and pollutant emissions. A building that provides a healthy, comfortable, and safe space for people to use, while achieving a unified economic, social, and environmental benefits. Information modeling method is a data-based architectural design method that utilizes various available data to guide design. This includes various environmental parameters such as energy consumption of buildings, temperature, humidity, and lighting inside and outside the building, as well as the performance of building materials and equipment.

It can be seen that the multi-scene models commonly used in the application process of building construction drawing CAD system cannot efficiently complete the unique characterization of building construction projects, and different building model data need to be classified and value analysis, so there are many deficiencies in the efficiency and stability of the construction drawing CAD system. On the other hand, in the research on the combination of construction drawing CAD system with the Internet of Things technology, few research results of integration with Tabu search strategy multidimensional optimization algorithm and BIM technology appear, and there is a relatively lack of intelligent analysis and evaluation system. It is of great significance to develop the evaluation system of building construction strategy multidimensional optimization algorithm by IOT and BIM technology.

3 METHODOLOGY

3.1 Analysis Idea of Building Construction Drawing CAD System Based on Tabu Search Strategy Multidimensional Optimization Algorithm

As an advanced architectural design method, BIM technology has the characteristics of visualization, collaboration and simulation, which can help architects work together better and improve the design quality. BIM technology can be effectively applied to all links of construction projects through the integration and storage of construction project information. Through BIM technology, construction enterprises can monitor construction components and project quality on the construction site, and timely modify the BIM model according to the requirements of the construction process, so as to improve the construction quality. BIM technology applied in project construction can reduce project cost and improve project quality. The CAD can not only speed up the construction progress, save the construction period, but also effectively ensure the construction quality.

Tabu Search (TS) is also an optimization algorithm that simulates human intelligence. The algorithm generates a class of initial high-error results, and then combines the iterative strategy to optimize the initial solution and reduce the error, and finally obtains the optimal solution that meets the requirements. Tabu search strategy multidimensional optimization algorithm is mostly used to solve the efficiency of building construction drawing CAD system and optimal scheme allocation. Firstly, it is to quantitatively analyze the associated data of different building construction drawing

CAD system efficiency and evaluation, and form multiple association centers. Then, through the applicability analysis of different data sets, classification of different types of CAD data sets can be realized. The Tabu search strategy multidimensional optimization algorithm is shown in Figure 1. In the process of visualization analysis of CAD system projects of different types of building construction drawings, the data matching degree and internal relevance of different CAD projects will also be very different. Thus, the final analysis error can be reduced. In the process of classifying different data types involved in the CAD system of building construction drawings, free matching will be carried out according to dimensions such as intrinsic "value relation" and "feature clustering". By combining BIM technology in the architecture of the Internet of Things, adopting Tabu search strategy multidimensional optimization algorithm, the corresponding CAD drawings in the construction process can be visually analyzed and freely classified, and then the optimal matching scheme can be obtained according to the actual building needs. Figure 1 shows the thinking process of multidimensional optimization algorithm of Tabu search strategy.

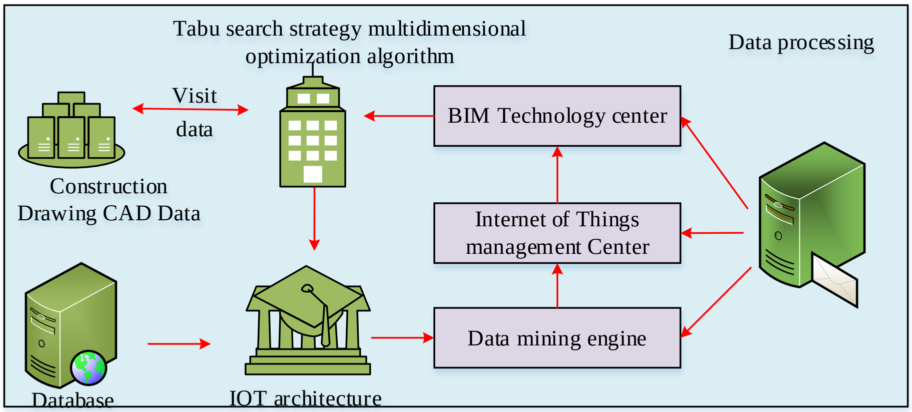

Figure 1: The thinking process of Tabu search strategy multidimensional optimization algorithm.

3.2 Efficiency Evaluation Model of Building Construction Drawing CAD System Based on Tabu Search Strategy Multidimensional Optimization Algorithm

BIM technology is applied to the planning and optimization of construction project CAD, and its advantages are as follows: First, the modeling can provide the construction project information related to the construction project and present it in the form of 3D, providing intuitive and accurate information for the construction project. Secondly, BIM modeling technology is used to realize the effective utilization of different types of data resources. Thirdly, BIM technology is introduced into CAD, so that the BIM technology in CAD can effectively process the information in CAD, so as to make the information processing in CAD more perfect. Therefore, CAD are carried out in this study, so as to make better use of BIM technology in construction drawing CAD. Firstly, the whole BIM architecture is analyzed, and then the operation of the system is optimized. Finally, combined with Tabu search strategy multidimensional optimization algorithm, intelligent grouping and simulation analysis were carried out on CAD data of different types of building construction drawings. The simulation results are shown in Figure 2.

In Figure 2, the corresponding efficiency, reliability and stability of CAD data of construction drawings with different tabu search strategies are quite different in the evaluation. This is because in different types of Internet of Things data analysis networks and BIM data grids, multidimensional differences of their data sets to realize the classification processing of different CAD drawings.

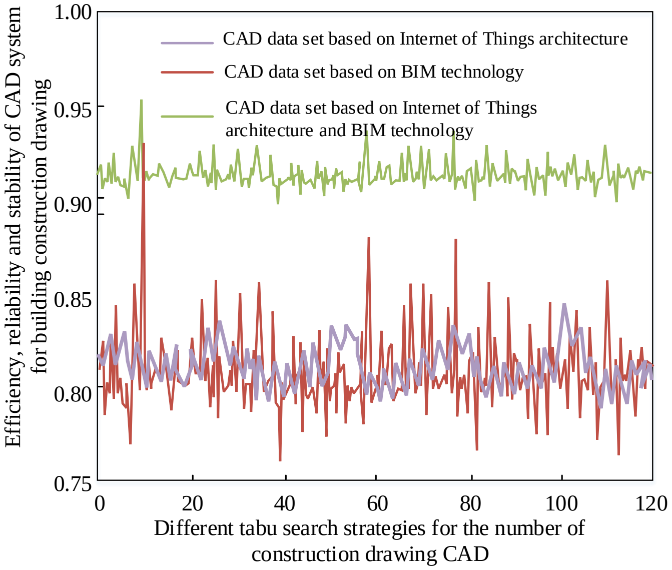

Figure 2: Simulation results of efficiency evaluation model for Internet of Things architecture and BIM technology.

The corresponding evaluation function $A(x)$ and efficiency function $B(x)$ can be expressed as:

$$A(x)=\sqrt{\sum_{i=1}^{n}\left(\frac{x_i^2+x_{i-1}^2}{2}\right)} \tag{1}$$

$$B(x)=\frac{\sqrt{x_{i-2}^2+2}+\sqrt{x_i^2-1}}{2\sqrt{x_i^2+x_{i-2}^2}} \tag{2}$$

In order to achieve the best operation of BIM technology in the architectural engineering drawing CAD system, it is necessary to optimize the construction mode of BIM. Therefore, this study firstly takes into account the universality and maintainability of BIM in the process of building BIM, so as to avoid repeated construction and lower work efficiency caused by inaccurate construction mode. Secondly, in the establishment of the model, the unification of the adopted technical specifications and technical specifications is ensured. Thirdly, in order to ensure that the establishment method of BIM model meets the relevant specification requirements, and modify and improve the BIM model according to the existing industrial standards, so as to ensure the safety of BIM application in construction projects. Finally, this study determined the key points in each step through a comprehensive analysis of the BIM model, so as to improve the effectiveness of the application of BIM technology. For different CAD data sets corresponding to BIM characteristic dimension data, the solution expression $L(x)$ is

$$L(x)=\frac{\lim_{x\to 0}\sqrt{\frac{\sqrt{B(x)^2+A(x)}}{\sqrt{B(x)^2-A(x)}}}}{A(x)+B(x)} \tag{3}$$

In the formula, x represents different CAD characteristic values, and the corresponding BIM value function $C(x)$ is:

$$C(x)=\frac{B(x_k)+Kx_k}{A(x_k)-Kx_k} \tag{4}$$

Where, x_k represents the position parameters of different types of CAD data sets. Different types of CAD arrays are unified and standardized, and the strategy formula is:

$$C'(x)=\frac{KB^2(x_k)+x_k}{KA^2(x_k)-x_k}+\sqrt{\frac{B^2(x_k)+Kx_k}{A^2(x_k)-Kx_k}} \tag{5}$$

In the CAD system of building construction drawing, grouping of CAD clusters can be realized by classifying and vector converting different types of CAD drawings and using different set vector subsets in clusters. The expression is:

$$D(x_k)=\frac{C(x_k)^2+B(x_k)^2}{\sqrt{B(x_k)+A(x_{k-1})}}+\frac{\sqrt{C(x_k)^2+B(x_k)^2}}{B(x_k)+A(x_{k-1})} \tag{6}$$

Where, x represents different CAD characteristic values. The results of the corresponding undifferentiated discrete CAD data set in the experimental process are shown in Figure 3.

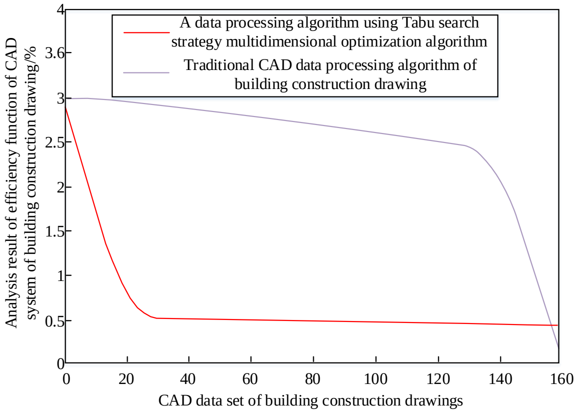

Figure 3: The results of the corresponding undifferentiated discrete CAD data set.

Based on these results, there are differences in the result of the difference in the maximum value of the CAD set. Therefore, it can be seen that the classification effect and stability of the undifferentiated discrete CAD data set are relatively high. A-positive-feedback is generated, and then the process of efficiency evaluation and accuracy of architectural construction drawing CAD system can be quantified.

The standard error value of CAD system efficiency of the building construction drawing is set as 3%, and the results are shown in Figure 4. As can be seen from Figure 4, in the process of efficiency evaluation of building construction drawing CAD system, the corresponding value degree strategies are quite different under the application of BIM technology, because when efficiency analysis is carried out for different types of data sets, dimension analysis and correlation comparison should be carried out according to the types of data sets.

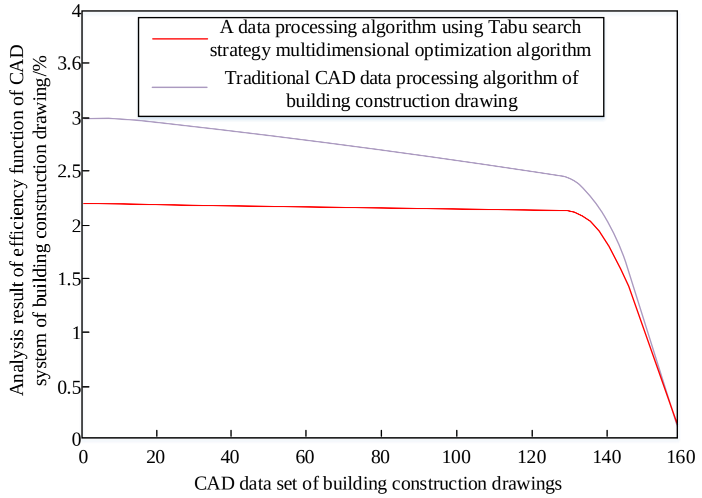

Figure 4: The simulation analysis result of the efficiency of CAD system of corresponding building construction drawing.

The corresponding taboo error function can be expressed as:

$$r(x)=\left|1-\sqrt{\frac{A(x)\sqrt{x}+B(x)x}{A(x)+B(x)}}\right| \tag{7}$$

The corresponding solution condition and evaluation function is:

$$\frac{[A(x)+x]}{x\sqrt[3]{A(x)}-x\sqrt[3]{B(x)}}\geq\frac{x[A(x)-B(x)]}{x\sqrt[3]{A(x)}+x\sqrt[3]{B(x)}} \tag{8}$$

$$T(x)=\frac{\sqrt[3]{A(x)}+\sqrt[3]{B(x)}}{x+A(x)} \tag{9}$$

It is also necessary to increase the taboo classification conditions under the Internet of Things architecture:

$$\frac{[A(x-1)+x]}{\sqrt[3]{A(x-1)}-x\sqrt[3]{B(x+1)}}\geq\frac{[A(x)-B(x)]}{xA(x)+B(x-1)} \tag{10}$$

The set vector quantization analysis function $\alpha(f,x)$ at this time is:

$$\alpha(f,x)=\frac{\sqrt{fx+(Kx-\sum_{i=1}^{n}x_i)}}{fA(x)+B(x)} \tag{11}$$

In the formula, f represents value network types under different iot architectures, and K represents threshold coefficient.

At this time, under the Internet of Things architecture and BIM technology, the corresponding value function $H'(x)$ is:

$$H'(x)=\frac{\sqrt{\left|\sum_{i=1}^{n}Ax_i(x_i\times x)+B(x_i\times x)\right|}}{A(x)B(x)+\alpha(f,x)} \tag{12}$$

$$H''(x)=\frac{\sqrt{\left|\sum_{i=1}^{n}Ax_i(x_i\times x)+B(x_i\times x)\right|}}{H'(x-1)} \tag{13}$$

$$H'''(x)=\frac{\sqrt{\left|\sum_{i=1}^{n}Ax_i(x_i\times x)+B(x_i\times x)\right|}}{xH''(x-1)} \tag{14}$$

The corresponding conjunctive error function of construction drawing CAD system is:

$$r'(x)=\frac{\left|1-\dfrac{A(x)\sqrt{x}+B(x)x}{A(x)+B(x)}\right|}{1+A(x)+B(x)} \tag{15}$$

In the formula, x represents different CAD characteristic values, and the corresponding analysis results under the Internet of Things architecture are shown in Figure 5.

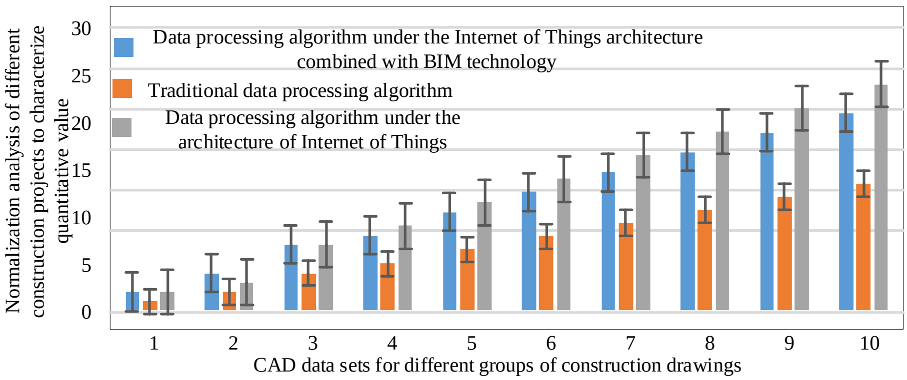

Figure 5: Corresponding analysis results under the internet of things architecture.

In Figure 5, the normalization analysis of different construction projects, the CAD system of building construction drawing corresponds to different types of CAD data sets, which is because the correlation is very different after the analysis of Tabu search strategy multidimensional optimization algorithm and BIM technology. Therefore, the standardized factor under the corresponding Internet of Things architecture has good stability.

4 RESULT ANALYSIS AND DISCUSSION

4.1 Verification Experiment of Construction Drawing CAD System Based on Tabu Search Strategy Multidimensional Optimization Algorithm

In the process of experiment, different types of building construction drawing CAD data sets are randomly grouped, and according to their different data vector sets, the same initial state and experimental state are set, and different BIM technology feature identification methods and data operation stability strategies are adopted to carry out experimental analysis on the group. Figure 6 shows the preliminary experimental results.

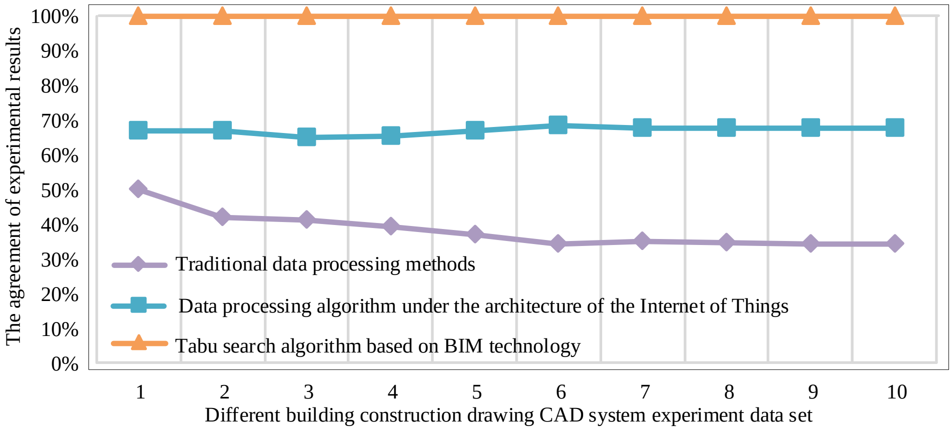

Figure 6: Preliminary experiment results.

In Figure 6, it can be found that different data sets of CAD system for construction drawings are available. Under the condition of the combination of the Internet of Things architecture and BIM technology, the results of Tabu search strategy multidimensional optimization algorithm are highly variable and consistent in the process of reliability and stability analysis of CAD data, and such results are also in line with the experimental expectations. This is because under the condition of adopting the Internet of Things architecture and BIM technology, the corresponding CAD system of building construction drawing can effectively deal with the internal relevance of different types of existing data sets according to their characteristics, which can effectively improve the utilization rate of CAD data sets. On the other hand, this is because it is a different data set for a project CAD. On the basis of BIM technology, this project intends to study the reliability and stability of CAD data by using multi-dimensional optimized "disable - search" algorithm, and the research results meet the experimental requirements. The fundamental reason is that BIM based architectural design CAD can effectively analyze the internal relationship of various data according to the characteristics of various types of existing data, so as to improve the use efficiency of CAD data.

4.2 Experimental Results and Analysis

In this paper, a CAD system of architecture layout is put forward which is based on Fuzzy Information Processing Arithmetic. The results of the test stability are presented in Figure 7. From Figure 7, when studying a variety of CAD datasets, a test group that adopts a prohibited search policy has a minimum error level and a maximum effectiveness assessment. The reason for this is that when BIM is integrated into IOT, the IOT architecture adopts the prohibition search algorithm, and the related data stabilization and the precision of the error function will be greatly different. Thus, when analyzing later CAD datasets, there is a significant difference between the respective functional models. Thus, the precision of the assessment can be increased.

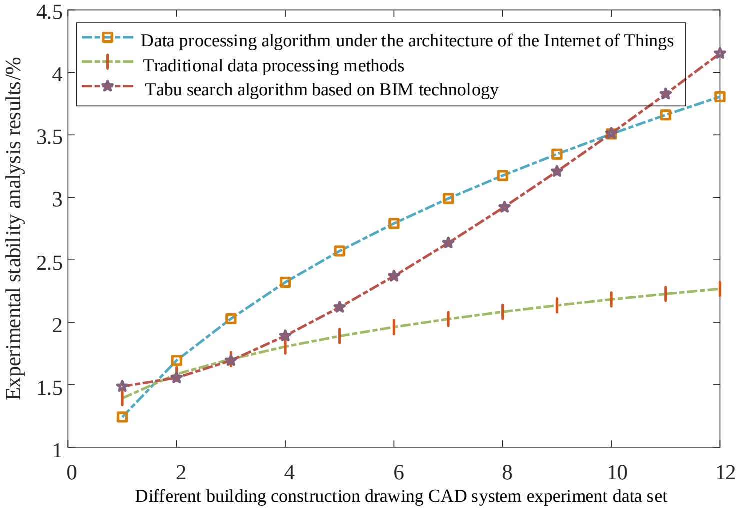

Figure 7: Corresponding experimental stability analysis results.

5 CONCLUSION

At present, in the process of efficiency evaluation and analysis of building construction drawing CAD system, because of the automatic analysis method of construction data, there are problems of unstable evaluation credibility and low analysis efficiency. This paper studies the building construction drawing CAD system and optimization method based on BIM technology. First, combined with the Internet of Things architecture, the efficiency evaluation model of construction drawing CAD system based on Tabu search strategy multidimensional optimization algorithm was established. Secondly, combined with BIM technology, different types of building construction drawing CAD drawing data clusters are established, the efficient analysis of building construction drawing CAD system is realized. Finally, the accuracy and applicability of the CAD system analysis model of building construction drawing are evaluated quantitatively. The results show that the CAD system of construction drawing based on Tabu search strategy multidimensional optimization algorithm can quickly use the Internet of Things technology, and according to the characteristics and data types of different construction projects, combined with BIM technology scheme, choose the CAD drawing construction scheme that best meets the construction requirements. To realize the multi-value dimension and data feature extraction of different types of construction projects. However, since this paper only focuses on the evaluation strategy of the CAD system of building construction drawing, without considering its internal relevance. The subsequent work can be further studied from the application range of the CAD system of building construction drawing and the differentiation of data sets of different CAD types.

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