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PAPER

Construction of Big Data Analysis Platform for College Students' Sports Training Driven by Wireless Communication Network

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ABSTRACT

College students' physical training is an important aspect of their studies and lives. In light of the existing issues with the accuracy of the physical training evaluation index for college students and other issues. Based on the theory of wireless communication networks, model definition and stability analysis methods are used to optimize the original model. The optimization model of a wireless communication network is obtained by considering the data output control theory, trained by college students. This model can analyze the big data of college students' physical training and construct the corresponding data platform. Through calculations, the rules for data changes under different indicators can be obtained. Finally, the accuracy of the optimized model is verified by comparing it with the original model. Related studies show that the variable parameters in the control system include model parameters, network upper limit, and corresponding control system parameters. On the whole, the model parameters exhibit a consistent trend of change, while the upper limit of the network displays a characteristic three-stage linear pattern. The control system first increases rapidly and then exhibits a gradual decline in exponential function type. The control system and the switching system can be switched using model calculations. The two different change curves exhibit obvious symmetry characteristics when influenced by the output times. It shows that the two change systems have opposite effects on the model, and the overall volatility is relatively high. The wireless communication network model can analyze and build a platform for collecting college students' sports training data. According to the model calculation, it can be seen that the changes in different indexes exhibit clear linear characteristics. Among them, the concepts of sports, personalized training, and basic training show linearly increasing changes. However, the training structure and content exhibit a typical linear decline. Finally, the advantages of the wireless communication network model are illustrated with the experimental data. This study can provide guidance and ideas for the construction of a data platform for college students' physical training.

KEYWORDS

wireless communication network, physical training, big data platform, stability, optimization model

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1 INTRODUCTION

Wireless communication networks are characterized by high accuracy and fast efficiency and have wide application prospects in many fields, such as cryptographic communication [1], simulation platforms [2], statistical analysis [3], and wireless communication [4]. The Internet of Things has a wide range of applications in the computer field. However, the wide application of the Internet of Things has been limited due to various problems with its display system. In order to enhance the application of the Internet of Things in the computer field, an analysis of its characteristics was conducted using wireless communication network technology, fuzzy theory, and neural network calculations [5]. Through calculation and analysis, the corresponding model optimization index can be obtained. This index allows for targeted representation of data, enabling the extraction of relevant data during the computing process of the Internet of Things. Finally, the wireless communication network optimization model was developed to calculate Internet of Things data, and an optimization scheme was obtained through analysis. Finally, the accuracy of the model was verified through experimentation. This study provides theoretical support for the application of wireless communication networks in the field of the Internet of Things. Antennas play a crucial role in the smart home industry. However, there are numerous shortcomings in the design and performance of existing antennas that need to be addressed through optimization models. Based on the theory of wireless communication networks, the convolutional neural network algorithm was utilized to perform intelligent analysis of the antenna, resulting in the acquisition of corresponding data analysis results. The data analysis algorithm was introduced to optimize the original data, and the results of the optimization were imported into the original model in order to establish the corresponding optimization model [6]. This model can provide guidance for the application of antennas in the field of smart homes, enabling the analysis of optimal antenna design and performance schemas. Finally, the data was used to verify the optimization model.

The above research mainly focuses on the driving and corresponding theories of wireless communication networks. However, there is a lack of research on wireless communication networks in college students' sports training. Aiming to address the current issues in college students' physical training, this paper utilizes the theory of wireless communication networks to optimize the original model through model definition, model calculation, and model output. Thus, the optimization model for wireless communication networks can be obtained. This model can provide theoretical guidance for analyzing and constructing data platforms for college students' sports training. The pattern of change in the data platform was further analyzed by calculating the relevant model indicators. Finally, the accuracy of the wireless communication network was demonstrated and confirmed by comparing the experimental data with both the original and optimized models.

2 ANALYSIS OF WIRELESS COMMUNICATION NETWORK CONTROL SYSTEM

Wireless communication refers to long-distance transmission between multiple nodes without the use of conductors or cables [7]. Wireless communication can be carried out by means of radio, Wi-Fi, etc.

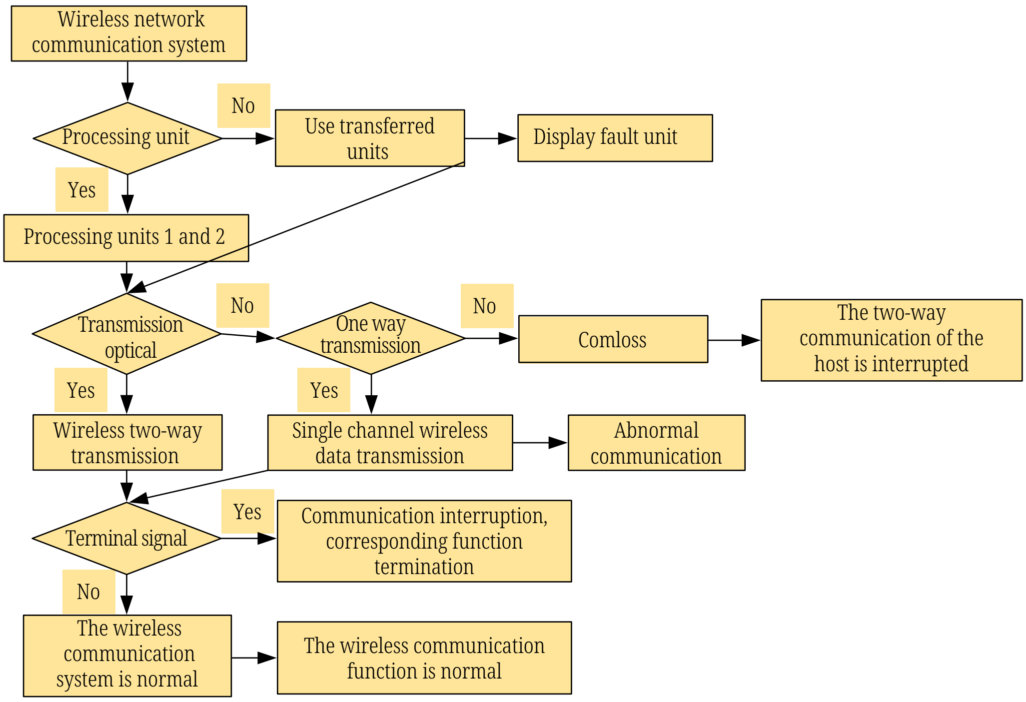

Fig. 1. Flow chart of wireless communication network driver system

Wireless communication networks play an important role in college students' physical training [8]. To elucidate the role and process of wireless communication networks in sports training data analysis and platform construction, a flow chart depicting the wireless communication network driver system (Figure 1) was obtained through summarization. As can be seen from the figure, the wireless network communication system should be analyzed first, and then the corresponding processing unit should be extracted. By evaluating the processing unit, if it does not meet the required processing specifications, the relevant processing unit should be transmitted in order to display the corresponding fault unit. If the processing units meet the requirements, the corresponding processing units 1 and 2 should be extracted and then imported into the optical fiber transmission system. In the process of optical fiber transmission, the corresponding optical fiber transmission, it is important to also perform assessment. If it does not meet the necessary transmission requirements, it should be imported into the singular transmission. If you do not meet the requirements, perform a communication interruption or double-click the host to interrupt communication. If the data meets the requirements for single-channel transmission, export the data using single-channel wireless transmission, and then assess the level of communication anomaly. If the optical fiber transmission meets the requirements, the wireless transmission network should be integrated into the terminal system, and further evaluation should be conducted within the terminal system. If the requirements are met, the wireless communication network will be interrupted, and the corresponding function will be terminated. If the terminal signal transmission requirements are not met, the wireless transmission system should be processed normally. Then, the corresponding command for the normal wireless communication function should be obtained, and the corresponding result should be output at the end.

2.1 The model definition

Considering the characteristics of wireless sensor network nodes, such as being inexpensive, having limited resources, low communication bandwidth, and a low data transmission rate, a large number of sensors, actuators, and controllers in large industrial systems are considered sensor network nodes [9]. The system can be implemented as a wireless network control system based on a wireless sensor network [10]. This system implementation can not only save on material costs but also increase the robustness and maintainability of the system [11].

Considering the wireless communication model, we are examining the wireless network control system described by the following discrete-time linear dynamic equation:

$$x(k+1) = Ax(k) + Bu(k) \tag{1}$$

$$y(k) = Cx(k) \tag{2}$$

Where: x(k) represents the state vector of the system, u(k) represents the control vector of the system, y(k) represents the output vector of the system, and A, B, and C are the matrix coefficients of the model.

Aiming to address the design problems that exist in sports and training, the following output feedback control is being considered, and the corresponding equation of the current data analysis platform is as follows:

$$u(k) = Ky(k) \tag{3}$$

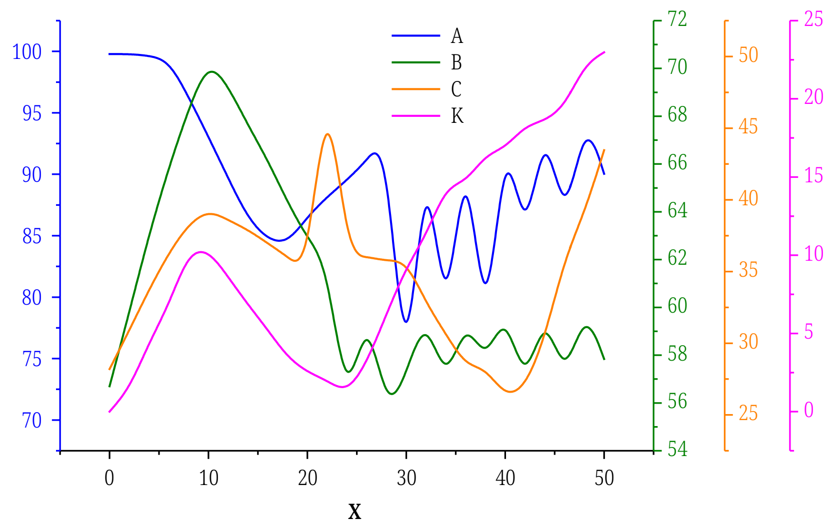

Fig. 2. Vector change law diagram

In the model definition, it is necessary to analyze the transmission control system of the wireless network. Through the analysis, it can be seen that there are several typical vectors in the wireless network transmission system that control the transmission system. These vectors can be mainly divided into A, B, C, and K.

In order to further illustrate the influence of these four vectors on the wireless network transmission control system, the variation law of the vectors shown in Figure 2 was obtained through analysis and calculation. It can be seen from the figure that the curves corresponding to the four different vectors exhibit distinct changing trends. With the increase of the independent variable X, the output curve corresponding to vector A initially shows a gradual decreasing trend, and its decreasing slope remains consistent, indicating that it follows a linear decreasing law. Then, when it reaches the local lowest point, it gradually increases and fluctuates, and the overall range of change is relatively small. It shows that vector A has relatively little influence on the wireless propagation system. As can be seen from the output curve corresponding to vector B, it initially exhibits a linear increase. However, once it reaches its peak value, the curve rapidly decreases with further increases in X. Then, further increasing the independent variable X will result in fluctuations in the output results of the corresponding B vector. The fluctuation range is relatively small, but the curve changes significantly in the first stage. It shows that vector B has a significant influence on NCS. The output curve corresponding to vector C can be seen as follows: With the increase of the independent variable X, the curve initially increases linearly, then decreases linearly, and finally rapidly increases to reach the highest value, exhibiting a U-shaped change. The overall fluctuation range of the curve is relatively small, exhibiting both linear and nonlinear characteristics, which can have varying effects on the network control system. As can be seen from the curve corresponding to vector D, the curve initially increases linearly with the increase of the independent variable X. However, it then gradually decreases until it reaches its lowest value at the highest point. With the further increase of the independent variable X, the curve exhibits a two-stage linear increase. The overall increase is quite noticeable, and it has a positive impact on the network communication system.

The delay introduced by packet transmission in wireless sensor networks is inserted in the feedback loop, and it mainly depends on the number of forwarding times or hops during the packet transmission process [12]. The controls command applied to the controlled object has the following form:

$$u(k) = KCx(k - rs(k)) \tag{4}$$

Where, rs(k) represents the time-varying delay in a closed-loop networked control system. Using the augmented vector method and considering all possible delays, we obtain the augmented state vector as follows:

$$\bar{x}(k) = [x^T(k), x^T(k-1) \cdots x^T(k-h)]^T \tag{5}$$

The open-loop control system described by the augmented state vector is always active.

$$\bar{x}(k+1) = \bar{A}\bar{x}(k) + \bar{B}u(k) \tag{6}$$

$$y(k) = \bar{C}_{rs} x(k)\bar{x}(k) \tag{7}$$

Where, $\bar{A}$, $\bar{B}$ and $\bar{C}$ are the corresponding matrices.

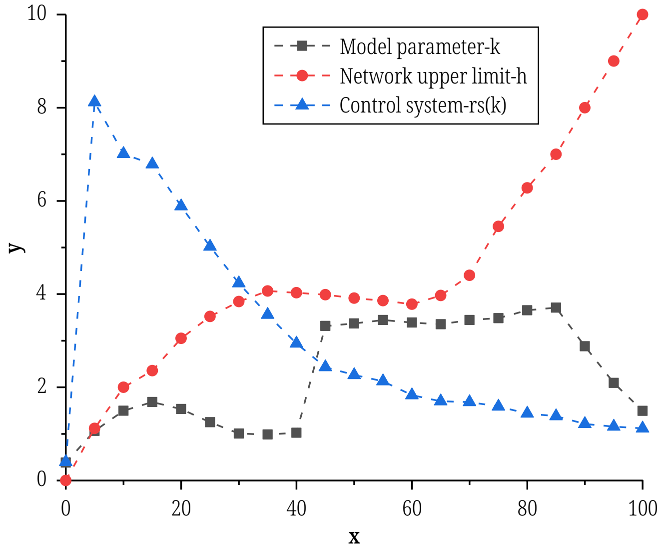

Fig. 3. Control system variable analysis diagram

Through analysis, it can be observed that the variables in the network control system exhibit different changing trends. These variables can be primarily categorized into model parameter variables, network upper limit variables, and control system variables. These three variables will have a specific impact on the control system unit. In order to further illustrate this influence and rule, the variable analysis diagram of the control system, as shown in Figure 3, is obtained through calculation and analysis. It can be seen from the figure that the output results corresponding to the three factors of model parameters, network online, and control system have different changing trends. Specifically, it can be observed that as the number of independent variables increases, the curve representing the model parameters initially rises and then falls, with a relatively narrow range of variation. With the increase of independent variables, the corresponding model parameter curve shows an increasing trend, and then the curve remains constant. Finally, the curve drops rapidly to reach the local minimum, and the overall fluctuation range is relatively small. As can be seen from the curve corresponding to the upper limit of the network, it initially increases linearly with the increase of the independent variable X. Then it reaches a local maximum value and remains stable before gradually increasing again. The curve exhibits typical linear characteristics, indicating that its impact on control system variables varies linearly. According to the curve corresponding to the control system parameters, it can be observed that it initially increases to its highest value and then rapidly decreases to the local lowest value before gradually declining further. The curve depicts a typical fluctuation trend, with a relatively wide range of variation.

2.2 Stability analysis of the model

Based on the research results of time-delay systems and networked control systems, it can be observed that network delays will degrade the system performance to some extent [13, 14]. At the same time, the complexity of wireless sensor networks and the variable additional delay introduced by multi-hop radio frequency communication make it challenging to analyze and synthesize control systems based on wireless sensor networks [15, 16]. The following closed-loop control system can be obtained through calculation:

$$\bar{x}(k+1) = (\bar{A} + \bar{B}K\bar{C}_{rs}(k))\bar{x}(k) \tag{8}$$

It is noted that the control system of the model is time-varying, and the closed-loop control system can be considered as a switching control system. The stabilization problem of the closed-loop control system is transformed into the stabilization problem of the switching system:

$$\begin{cases} \bar{x}(k+1) = Ai\bar{x}(k) \\ Ai = \bar{A} + \bar{B}K\bar{C}_{rs}(k) \end{cases} \tag{9}$$

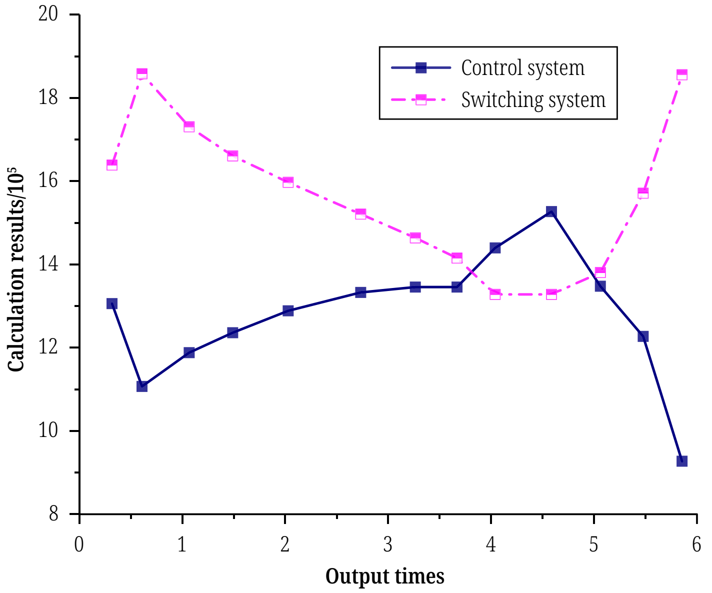

Fig. 4. Change diagrams for control systems and switching systems

The model's stability calculation results are acquired through analysis to elucidate the fluctuation pattern of the control unit within the wireless communication network propagation system. Through stability analysis, it can be observed that the control system and the switching system can mutually switch based on the output and calculation results. In order to further analyze the change rules of the two switching results, we obtained the change curves of the control system and the switching system, as shown in Figure 4, through analysis. As can be seen from the figure, the control system decreases rapidly at first and then gradually increases with the increase in output times. The increasing variables of the curve are essentially the same, indicating that its linear characteristics are evident. However, when the curve increases to its highest value and then rapidly decreases to its lowest value, the corresponding switching system exhibits the opposite change trend. The curve first increases to its highest value, then gradually decreases to its lowest value, and finally rapidly increases the volatility change. This indicates that the control system and the switching system exhibit contrasting changing trends, and their impacts on the calculation results also have opposite effects.

At any sampling time, the system can be further described as follows:

$$x(k+1) = \sum_{i=0}^{h} \xi iAix(k) \tag{10}$$

Where: ξi is the model transpose matrix.

By considering the switching system described by the equation, the following model functions are defined:

$$V(k,x(k)) = x^{T}(k)\left(\sum_{i=0}^{h} \xi i(k)Pi\right)x(k) \tag{11}$$

Where, Pi is the model symmetric matrix.

By utilizing the calculation results of the model and substituting the equation into the model function, it can be proven that the model function changes along any trajectory of the system [17, 18]. According to the principal stability theorem, the closed-loop system is asymptotically stable.

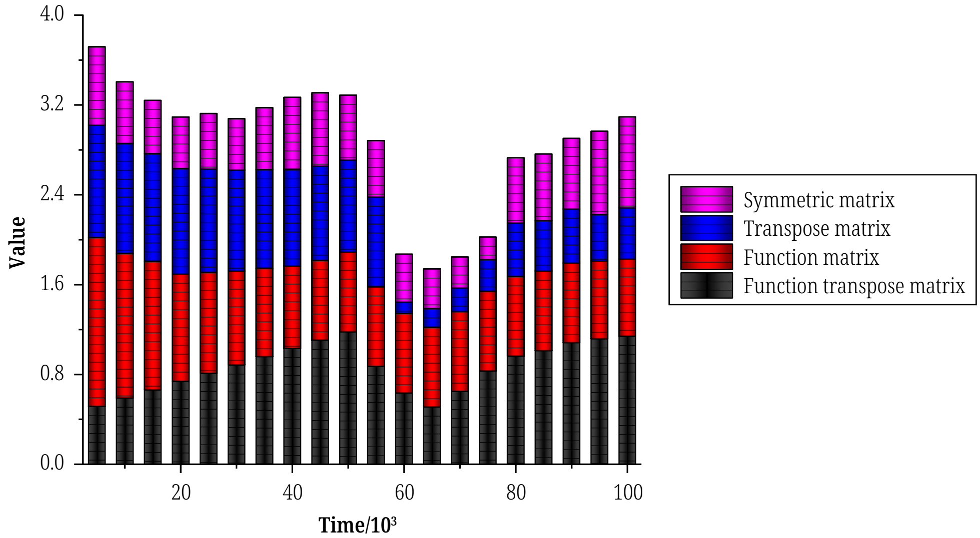

Fig. 5. Switching system calculation curve

In order to further explain the influence of various parameters on the model function of the system switching model. The calculation curve of the switching system, as shown in Figure 5, is obtained through calculations. Through the analysis, it can be seen that the influencing factors of the switching system mainly include symmetric matrices, transpose matrices, function matrices, and function transpose matrices. It can be observed from the figure that, as time increases, the symmetric matrix shows a trend of volatility change. It initially decreases, then increases, and finally decreases again. The overall fluctuation range is relatively large. As can be seen from the transposed matrix, the curve remains constant at first, then decreases slowly over time, and finally gradually increases. However, the range of the increase is relatively small. The data indicates that the overall trend is a linear decline. As can be seen from the corresponding output values of the function matrix, the curve initially decreases rapidly and then gradually stabilizes as it approaches the minimum value. The overall decline range is relatively large. It can be seen from the transpose matrix function that the curve increases linearly. When it reaches its peak, the curve rapidly declines to its lowest point as time progresses and then decreases once more.

But the second decline is non-linear. Through the above analysis, it is evident that the output results corresponding to the four different parameters exhibit varying trends. It is crucial to consider the combined influence of these parameters on the output results in order to obtain accurate values.

2.3 Model output control

In wireless sensor networks, packets may need to be forwarded multiple times before reaching the destination node. The corresponding model output control results are as follows:

$$u(k) = Ky(k - rs(k)) \tag{12}$$

In a closed-loop control system, various independent variables have a significant impact on the speed and stability of the system's response. According to the stability analysis mentioned above, in order to maintain the closed-loop stability of the system, all poles of the system must satisfy the following formula:

$$|eig(A + BKC)| \leq \frac{1}{\sigma(K)} \tag{13}$$

Where, $\sigma(K)$ is the stability parameter of the model, and the value determines the stability range of the system.

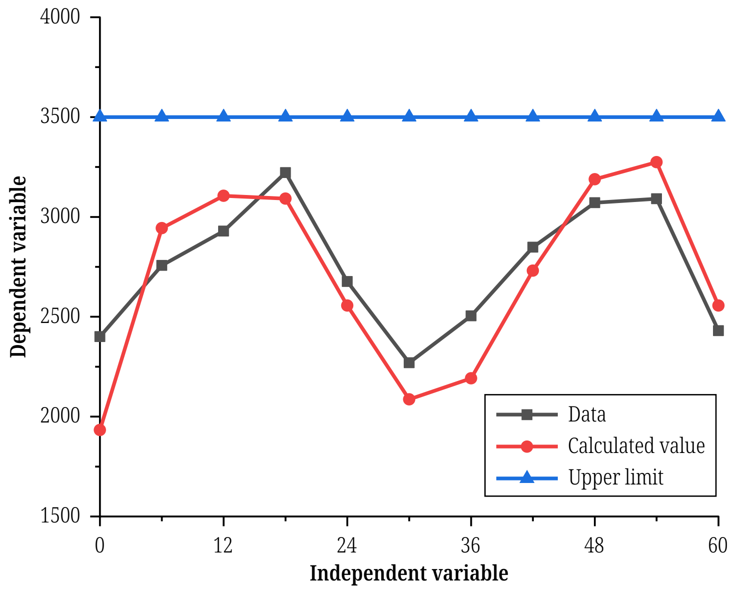

Fig. 6. Extreme value analysis of model output

The related content of the model output control is obtained by summarizing the output results in order to further explain the model definition and stability in wireless communication networks [19, 20]. By adopting this theory, the corresponding systematic changes can be calculated [21, 22]. In order to further explain the upper limit characteristics of the data and calculations in the system, the model output extreme values shown in Figure 6 were obtained through analysis. It can be observed from the curve in the figure that the corresponding data exhibits an

M-shaped trend, initially increasing, then decreasing, and then increasing again before finally decreasing. The increase in variables in the curve will cause the data to exhibit greater volatility. However, the corresponding calculated values exhibit the same changing trend, indicating that the calculated values effectively describe the overall fluctuation of the test data. The corresponding upper limit value is obtained through calculation, and the model's upper limit value is maintained at approximately 3500. This suggests that the upper limit value remains constant. This upper limit can reflect the data and calculation rules of the independent variables to some extent. The closest range of change will occur when the independent variable reaches approximately 20, while the largest difference will occur when the independent variable is around 28.

Through the modeling method of appeal analysis, the following wireless communication model can be obtained through simulation analysis:

$$x(k+1) = \begin{bmatrix} 1.8, 1.1, 0.2 \\ 1, \quad 0, \quad 0 \\ 0, \quad 1, \quad 0 \end{bmatrix} x(k) + \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix} u(k) \tag{14}$$

$$y(k) = [0.03,\ 0.04,\ 0.07]x(k) \tag{15}$$

3 CONSTRUCTION OF COLLEGE STUDENT SPORTS TRAINING DATA PLATFORM UNDER WIRELESS COMMUNICATION NETWORK

3.1 Big data index analysis of college students' physical training

As an important part of college students' lives and studies, physical training plays a crucial role in enhancing their physical and psychological well-being. However, there are many problems with college students' physical training. The main reasons for the problems include: (1) College students generally lack the habit of participating in sports. The formation of sports habits is a long-term process. After entering colleges and universities, despite having ample exercise time and well-equipped sports facilities, the tendency of modern college students to avoid sports creates a certain reluctance towards enhancing physical training among them. (2) Lack of basic sports skills among college students: Students have little to no habit of engaging in sports and are also lacking in fundamental sports skills and techniques. It also seriously affects the implementation of college students' active participation in sports training programs. (3) Safety has become a significant barrier to promoting physical training in colleges and universities. The physical constitution and athletic ability of contemporary college students are relatively poor. Physical training, especially intense physical training, will inevitably involve physical contact among participants. This poses a challenge to the goal of encouraging college students to fully engage in physical training.

In order to provide a more accurate explanation of these existing problems, an analysis index chart of college students' physical training was obtained through analysis, as shown in Figure 7. As can be seen from Figure 7, the analysis indicators of college students' physical training can be mainly divided into five aspects: basic training, sports concepts, diverse content, personalized training, and training structure. With the increase in the index, the corresponding data showed a trend of volatility, initially increasing and then decreasing. Through specific analysis, it can be observed that the index for basic training accounts for approximately 9.3%. In contrast, the proportion of sports concepts accounts for about 34.9%, and the proportion of rich content accounts for about 38%. The proportion of personalized training is the smallest, at only 8.4%, while the proportion of training structure is about 9.4%.

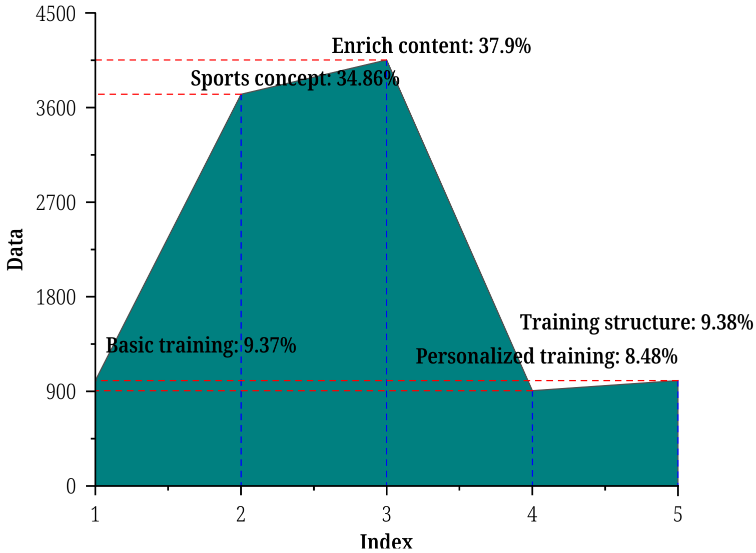

Fig. 7. Big data analysis diagram of college students' physical training

3.2 Analysis of college students' sports training data platform under wireless communication network

It is crucial to establish a data platform for college students' sports training using a wireless communication network in order to enhance the efficiency of their training [23, 24]. Based on the wireless communication network system, the model of a wireless communication system is obtained by considering the stability of the model and the corresponding output control. This model can effectively describe and explain the sports training platform for college students [25]. In order to enhance the analysis process of the wireless communication model, the flow chart depicting college students' physical training under the wireless communication network model is obtained through calculation and analysis, as illustrated in Figure 8. It can be observed from the figure that the training data of college students should be imported into the model's data processing module first. Then, the model's probe is used to analyze the changing characteristics of the data. The model probe can also analyze the data present in the signal generator and import it into the model probe for further analysis using a power amplifier. In order to obtain the crucial value for converting college student sports data, the signal is further processed by the model under probe. This value is then imported into the embedded control module. The Internet module of the model is analyzed through embedded control, and the corresponding wireless network is subsequently extracted. Then, the wireless network is divided into two parts: remote service and big data analysis. Through these two sections, key indicators can be provided for the development of a sports training data platform for college students, and the relevant indicators can be exported.

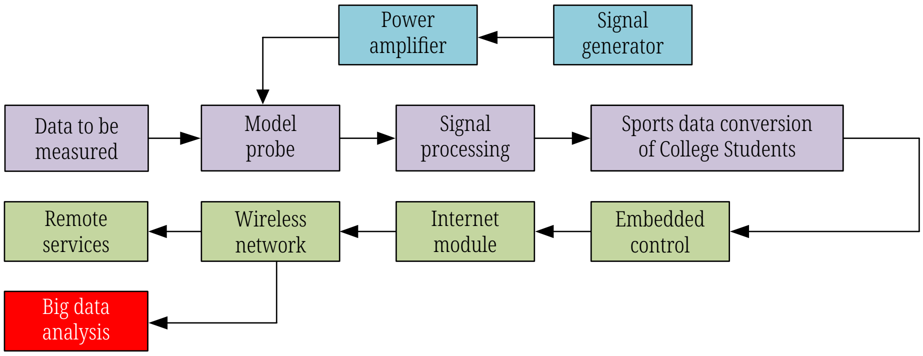

Fig. 8. A flowchart of the wireless communication network model of college students' physical training

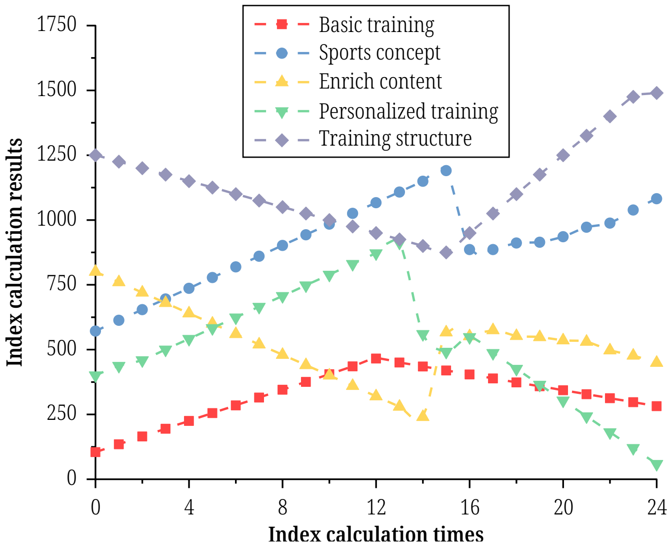

Fig. 9. Results of the calculation of the college students' sports data

Based on the wireless communication network model, the model outputs corresponding results while considering its stability. This allows for the analysis and calculation of college students' sports training platforms under the influence of the wireless network system. By importing the relevant data into the system, the calculation results for college students' sports data can be obtained, as depicted in Figure 9. Through the calculation results, it can be seen that the five basic indexes have different change trends. Specifically, it can be seen that basic training exhibits a two-stage linear change curve with an increase in calculation times. The calculation results initially show the highest value of linear increase and then gradually decline to the local lowest point. That means the linear slope in the first stage is higher than that in the second stage. It can be seen from the curve corresponding to the motion concept that as the number of calculations increases, the curve initially rises to its highest value. Due to a sudden spike in the data, the corresponding calculation result for the motion concept experiences a slight decrease, followed by a nonlinear increase. This curve exhibits comprehensive characteristics of both linearity and nonlinearity. Through the comprehensive content index, it is evident that the curve exhibits a linear decreasing trend as the number of calculations increases. When the curve reaches its lowest point, it rapidly rises for the same reason as the concept of motion and then decreases non-linearly. With the increase in the number of calculations, personalized training shows a linear trend. However, the curve then exhibits characteristics of both nonlinear and linear comprehensive decline, resulting in a significant overall decline range. The index corresponding to the training structure exhibits a V-shaped change with an increase in the number of calculations, and the slope of the second stage is higher than that of the first stage.

4 DISCUSSION

A wireless communication network model can be used to build and analyze a sports training data platform for college students. In order to further illustrate the accuracy of the calculation results, the model verification curve shown in Figure 10 was obtained through calculations. It can be observed from the curve that the original data exhibits fluctuations within a narrow range as the independent variables increase. Then, when the increment value reaches its highest point, the curve gradually declines with further increases in the independent variable. The corresponding original model can accurately provide the change trend of the test data, but it cannot describe the specific numerical changes. The optimized model curve can not only describe the changing trend and corresponding range of the data but also provide a better description and analysis of the specific data changes in the test curve. Through the above calculation, it can be seen that the college student sports training platform, which is based on a wireless communication network, has high accuracy in improving the analysis of training data.

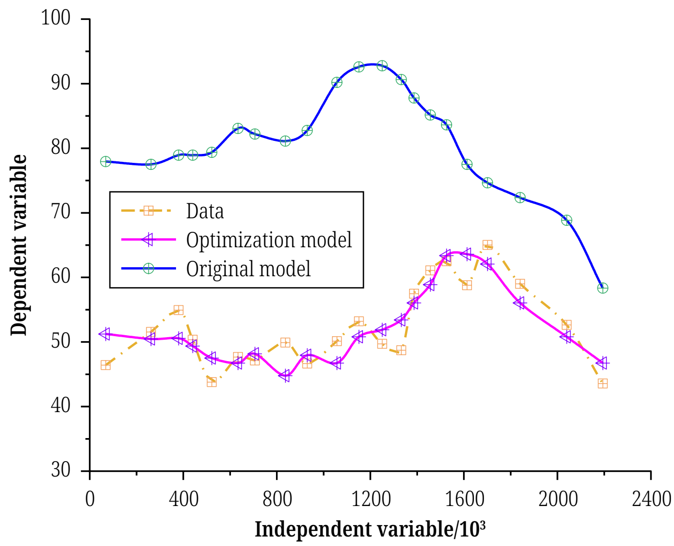

Fig. 10. Model validation and comparison curves

5 CONCLUSION

1. According to the vector change curve, it can be observed that the curves corresponding to vector A and vector B exhibit noticeable fluctuations, albeit within a relatively narrow range. The corresponding output results of vector C and vector K exhibit typical linear and nonlinear characteristics, with a relatively large variation range in the curve.
2. The switching system includes four factors: symmetric matrix, transpose matrix, function matrix, and function transpose matrix. The fluctuation range of the symmetric matrix and transpose matrix is small, indicating that they have little

influence on the switching system. However, the corresponding function matrix and its transpose exhibit clear linear changes, indicating that the function matrix has a positive impact on enhancing the accuracy of the switching system.

3. The data from the wireless network model shows a change in M-property, and its volatility is relatively obvious. The corresponding calculated value can effectively reflect the data changes of the model in the test, indicating the accuracy of the wireless communication network. And by examining the upper limit of the model, it becomes evident that the dependent variables exhibit varying change indices and calculated differences when subjected to different independent.

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