Research Article

The Characteristics and Physical Fitness Characteristics of Track and Field Sprint Events Based on Discrete Dynamic Modeling of Complex Systems

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Sprint is not only the oldest sport in track and field but also one of the most competitive sports today. This paper studies the characteristics of sprint and the physical characteristics of sports human body. Using the characteristics of genetic programming combined with system structure estimation and parameter estimation, this paper expounds the application of genetic programming in discrete dynamic modeling of complex systems. A model evaluation method based on error estimation is proposed. Based on the analysis of big data, the intelligent control model of track and field sprinters' training progress is designed, and the simulation experiment is carried out through the simulation environment. This paper analyzes their physical quality, discusses the contents and methods of sprint training, and provides a reference for coaches engaged in sprint training. The intelligent training schedule model of track and field sprinters from the perspective of big data analysis has outstanding practical value. It can quickly and accurately formulate training plans, solve data fluctuations under the trend of big data segmentation, and realize intelligent operation. Its fluency and accuracy are very high, which is worthy of vigorous promotion and application.

1. Introduction

Track and field is the foundation of all sports. As the earliest born sports in the world, it has an ancient and long historical process. Among them, sprint is the most noticeable basic event in track and field events. Up to now, the world record of 100 meters has reached a relatively high level, but the step-by-step improvement of competition results in recent years shows that the world sprint competition level is showing a trend of continuous progress. How to conform to the development trend of track and field in the world and how to occupy a position in the fierce international competition will become the direction of thinking and efforts of sports researchers, coaches, and athletes in China. Studies have shown that the selection of 100-meter sprinters is different from that of other track and field athletes, and anthropometric indicators do not necessarily play a decisive role. Besides physical morphological indicators, age, physical function, comprehensive physical quality, and special indicators are also very important. Comprehensive selection system can significantly improve the effectiveness of selection and the reliability of prediction potential [1, 2].

Track and field sprint is a periodic sport with the characteristics of speed and strength. During the whole project, the function of the human body mechanism is mainly anaerobic function. In recent years, China's 100-meter sprint performance has been greatly improved, but these are far from enough. Compared with the world's top sports level, the sprint performance gap between China and foreign countries is still relatively large, and the results are relatively backward, which is mainly reflected in the gap between the sprint technology and the world's excellent level [3]. In all kinds of world sprint competition stages, the difference between Chinese domestic elite sprinters and foreign high-level athletes in the early stage of the 100-meter movement is not big, sometimes they can lead slightly, and basically they can keep pace with each other. However, in the middle and second half stages, Chinese sprinters will be

slowly left behind, and finally, the distance will widen sharply, eventually forming an irreversible disadvantage [4, 5].

From the perspective of Petri net, this paper makes discrete dynamic modeling of complex system, introduces time periodic network, and analyzes the time performance of the system with the help of mathematical tools. The innovative contributions include using the characteristics of genetic programming combined with system structure estimation and parameter estimation; this paper expounds the application of genetic programming in discrete dynamic modeling of complex systems and puts forward a model evaluation method based on error estimation. The performance of the system has been greatly improved in terms of time controllability and rational allocation of resources. This paper discusses the contents and methods of sprint training, which provides a reference for coaches engaged in sprint training. The intelligent training schedule model of track and field sprinters from the perspective of big data analysis has outstanding practical value. It can quickly and accurately formulate training plans, solve data fluctuations under the trend of big data segmentation, and realize intelligent operation.

In this paper, the intelligent control model of track and field sprinters' training progress is designed, and the simulation experiment is carried out on the use environment. This paper analyzes the constitution of athletes' physical quality, probes into the contents and methods of sprint training, and provides a reference for coaches engaged in sprint training. The research is divided into five parts. The first part describes the research background. The second part cites some research literature. The third part expounds the research methods, including discrete dynamic modeling of complex systems and track and field sprinter training based on big data analysis. The fourth part is the result analysis and discussion and analyzes the prediction value and prediction error of the model. Finally, the fifth part summarizes the full text.

2. Related Work

Discrete event dynamic system presents a new topic for the study of dynamic system theory and forms a new branch and frontier direction in system and control science [6]. The monitoring theory based on automata/formal language proposed by Saavedra et al. is relatively complete, which can transplant the main concepts of modern control theory. Logical predicates are used to express the current state estimation, rule sets are used to express control, and logical predicates "enable" the control function, while the dynamic characteristics and state estimation of controlled objects are described by axiom sets, and automatic theorem proof is used to realize the control strategy [7]. Sylejmani et al. studied the "most economical" modeling problem with a hierarchical state machine. It avoids combinatorial explosion through state aggregation in modeling [8]. Lian et al. proposed a subsystem compound algebra. They applied the finite recursive process model to the monitoring problem and expressed the interaction between the object and the

monitor by the synchronous composite operator, so they also put forward the decentralized control problem in an algebraic way [9].

Ouyang et al. pointed out that there are significant differences in the starting reaction time of athletes of different genders in 100-meter running, and the starting reaction time of athletes is related to genetic factors [10]. Chai et al. pointed out that the starting reaction time will change with different levels of athletes. The higher the sports level of athletes, the shorter the starting reaction time [11]. The main reason for the different starting reaction time of athletes of different levels is the reaction action time of athletes. Widianawati et al. pointed out that one of the main factors to improve the performance of 100-meter running is the maximum speed of athletes in 100-meter running. The authors think that although the maximum speed is an important factor affecting athletes' performance, the maximum speed cannot represent the performance and level of world elite athletes [12]. Ahn et al. pointed out that the maximum speed of athletes can be analyzed by some physiological factors, and the main influence is the percentage and area of fast muscle fibers [13]. A large part of the reasons for the great difference in performance between Chinese sprinters and foreign sprinters are the differences in sprint techniques. Sohn et al. pointed out that after a lot of investigation and analysis, if the speed of athletes' swinging legs is improved and accelerated, it will lead to the improvement of athletes' pedaling and buffering efficiency in sports [14], and the effect of accelerating the speed of sports is remarkable. Kim et al. divided the single step into five stages, namely, landing, buffering, pushing and stretching [15], leaving the ground, and flying, and studied and analyzed athletes by observing and replaying each single-step research video when studying athletes.

3. Research Method

3.1. Discrete Dynamic Modeling of Complex Systems

3.1.1. Description of Discrete Dynamic System. In the fields of engineering technology, economy, natural science, and social science, there are many complex systems and nonlinear phenomena that change with time such as price fluctuations, urban expansion, changes in weather, and population growth. People usually need to establish a reasonable dynamic system model (dynamic model) according to the observation data of the dynamic system, which provides a basis for system analysis, design, and prediction of the future state of the system. Discrete dynamic system model is a very important model. Discrete system refers to all systems that are discontinuous in time and space. Dynamic system refers to the system whose state changes with time or evolves with time according to the deterministic law. A discrete system is a dynamic system with discrete characteristics.

Let a dynamic system be described by n related state variables, and observe the system in discrete time step. The observed data from $0 \sim t$ time step are as follows:

$$X = \begin{bmatrix} x_1(0) & x_2(0) & \cdots & x_n(0) \\ x_1(1) & x_2(1) & \cdots & x_n(1) \\ \vdots & \vdots & \ddots & \vdots \\ x_1(t) & x_2(t) & \cdots & x_n(t) \end{bmatrix}. \tag{1}$$

Among them, the relationship between state variables can be expressed as the following dynamic equations, and $x_i(t)$ represents the state value of the ith state variable in time step t.

$$\begin{cases} x_1(t+1) = f_1[x_1(t), x_2(t), \ldots, x_n(t), t], \\ x_2(t+1) = f_2[x_1(t), x_2(t), \ldots, x_n(t), t], \\ \ldots \\ x_n(t+1) = f_n[x_1(t), x_2(t), \ldots, x_n(t), t]. \end{cases} \tag{2}$$

Make

$$X(t) = [x_1(t), x_2(t), \ldots, x_n(t)]^T, \tag{3}$$

$$F(X^T, t) = [f_1(X^T, t), f_2(X^T, t), \ldots, f_n(X^T, t)]. \tag{4}$$

The above formula is transformed into

$$X(t+1) = F[X^T(t), t]. \tag{5}$$

Discrete dynamic modeling of a complex system is to find F in formula (4) to minimize formula (5).

$$\sum_{t=0}^{m} \sum_{i=1}^{n} [x_i(t) - x_i^*(t)]^2, \tag{6}$$

where $x_i(t)$ is the observed value on t time step; $x_i^*(t)$ is the predicted value on t time step.

In the process of establishing the model, it is very difficult to determine the dynamic equations describing the evolution of the system. The traditional modeling method assumes the structure of a set of dynamic equations in advance by intuition or experience and then uses the numerical method to determine the parameters in the assumed equations. However, its rationality, poor accuracy, and cumbersome calculation process limit the application of traditional methods. It is very difficult to determine the structure of equations for nonlinear multidimensional and high-order complex system modeling. Genetic programming (GP) is developed on the basis of a genetic algorithm. It can combine structure estimation with parameter estimation and can be used without complete model structure information. Using observation data to establish system dynamic model solves the shortcomings of genetic algorithm, which cannot describe hierarchy and lack of dynamic variability, and provides a new idea and method for complex system modeling.

3.1.2. Petri Net Method. After more than 30 years of development, Petri net theory has become a general net theory with a strict mathematical foundation and various abstract levels. At present, it not only is used as a means of formal description, performance evaluation, and aided design of various computer systems but also has many successful applications in the fields of engineering technology, chemistry, economy, and law. Particularly, the research on modeling, analysis, and control synthesis of discrete event dynamic system based on the Petri net method is one of the research hotspots in the field of system and control science. Many people have done a lot of work in this field and obtained a series of significant research results [16, 17].

(1) Properties of Petri Nets. The operation of the Petri net can simulate the actual system, and its behavior is mainly described by its properties.

Let t_1, t_2 be two transitions in the network N and M be an identifier of N, so that $M[t_1 >$ and $M[t_2$.

If $M[t_1 > M_1 \longrightarrow M_1[t_2 >$ and $M[t_2 > M_2 \longrightarrow M_2[t_1 >$, it is said that t_1 and t_2 are concurrent under MM.

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Concurrency is not equal to "occurring at the same time," nor can it be understood as "occurring in any order"; it refers to the independent occurrence of changes. Concurrency can improve the efficiency of the system, and conflicts are undesirable (Figure 1).

The synchronization distance between the two transitions t_1, t_2 of the network is

$$\max_{\sigma} |\overline{\sigma}(t_1) - \overline{\sigma}(t_2)|, \tag{7}$$

where σ can be any priming sequence starting from $M \in R(N, M_0)$ and $\sigma(t_i)$ is the number of times that transition $t_i (i = 1, 2)$ appears in σ.

Synchronization distance is a quantitative description of the relationship between two groups of events. It is used to describe the basic phenomena such as conflict and concurrency between events so as to study the rhythm coordination of some production processes. The purpose of designing and controlling the system is to make the system meet certain behavior requirements, and the behavior of the system is the embodiment of these properties of Petri nets.

(2) Analysis Technology of Petri Net. The Petri net model only gives the static structure and characteristics of the system, and the dynamic behavior of the system is reflected in the running process of the Petri net. Therefore, it is often hoped that the actual system can be mastered and controlled by analyzing the model properly. Existing Petri net analysis methods can be generally divided into four categories: reachable tree method, invariant method, Petri net language, and structure analysis method (Figure 2).

(1) Reachable tree method

This is the most intuitive method, which represents all reachable states of Petri nets in tree form. In this way, deadlock, boundedness, and other properties can be easily verified, some single-run states can also be found in the reachability tree, and the enabling transition of their parent nodes can be controlled.
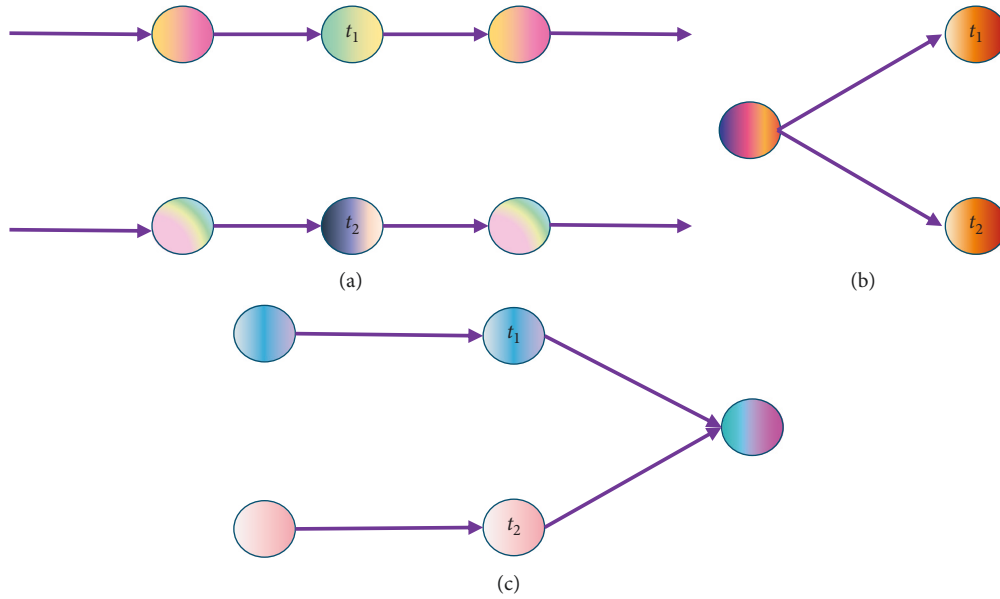
FIGURE 1: Conflict form, (a) concurrent conflict, (b) consumption conflict, and (c) capacity conflict.
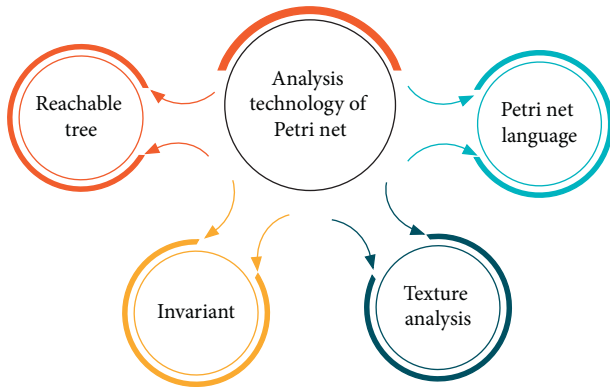

FIGURE 2: Analysis technology of Petri net.

structure exist in Petri net structure, we can study the necessary conditions for deadlock in the Petri net.

(4) Peri net language

This method is similar to the formal language method of automata, which marks each transition of the Petri net to correspond to a symbol in the alphabet so that the possible transition sequence in the net corresponds to a language. This method is suitable for qualitative research in theory, but its operability is poor in practical application.

3.1.3. Modeling Method Based on Domain Model Library. To support the modeling of complex discrete event dynamic systems, we provide a set of rules and guidelines to support the modeling by system method [18]. In the process of modeling, the system analysis method combining top-down and bottom-up is used; that is, the system is decomposed layer by layer, and reusable components are used. The modeling process guided by this method includes a series of continuous steps, as shown in Figure 3.

The idea of genetic programming comes from a genetic algorithm: randomly generate an initial population suitable for the given problem environment, that is, search space, each individual in the population is a tree structure, and calculate the fitness value of each individual. Genetic operators (replication, crossover, mutation, etc.) are selected to iteratively optimize the population until the optimal solution or approximate optimal solution is found in a certain generation [19].

Individuals are expressed by a generalized hierarchical computer program, which consists of a set of functions F and a set of terminators T [20]. In function modeling, in general, the functions in the function set are binary or unary mathematical functions:
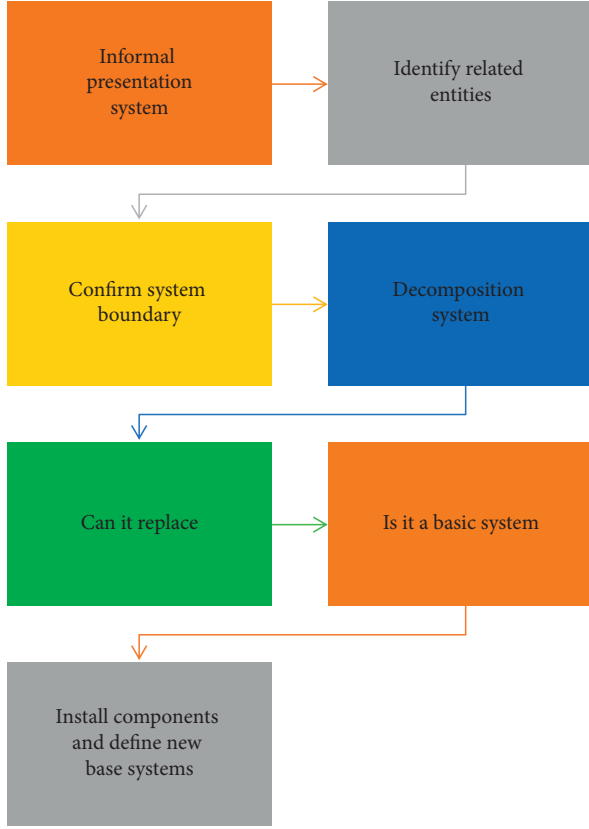
(2) Invariant method

This method deals with the system completely by algebraic computation and assumes that the base net of Petri net is pure; that is, $\forall p, p \cap p = \varphi$. T invariant shows that after several changes corresponding to it occur, the logo will be restored to the state where they started to occur. It reflects the possible transition sequence that makes the state return and can be used to study the performance such as periodicity; P invariant reflects weighted conservation of Token total in some positions, which can be used to study mutual exclusion behavior, deadlock analysis, and error detection.

(3) Structural analysis method

Many performances of Petri nets are determined by their structure. The structural analysis method is to study the performance of the system by analyzing the structure of Petri nets effectively. For example, by analyzing whether deadlock structure and trap

FIGURE 3: Modeling steps based on domain model.

$$F = \{+, -, \times, \div, \ \sin \ , \ \cos \ \cdots\}. \tag{8}$$

Terminator set consists of constants and variables, where x_i represents the ith variable. In discrete dynamic systems, x_i represents the ith system state variable, and c is marked as a constant.

$$T = \{c, x_1, x_2, \ldots, x_n\}. \tag{9}$$

And the solution to be expressed is composed of F, T. For example, the Lotka–Volterra equation can be described as follows [21]:

$$\begin{cases} x_1(t+1) = x_1(t) + ax_1(t) + bx_1(t)x_2(t), \\ x_2(t+1) = x_2(t) + cx_1(t)x_2(t) - dx_2(t), \end{cases} \tag{10}$$

where x_1, x_2 are the system state variables; a, b, c, d are constant.

The solution of the system can be expressed by expression binary tree [22]. Each system state variable corresponds to an expression binary tree, and the whole system is represented by n expression binary trees. Lotka–Volterra equation needs two expressions to represent an individual, as shown in Figure 4.

Using pure variance to evaluate complex nonlinear dynamic systems with chaotic characteristics obviously cannot reflect the true quality of the model. In this paper, an error estimation method is proposed; that is, the effective prediction time step of the model is used for evaluation.
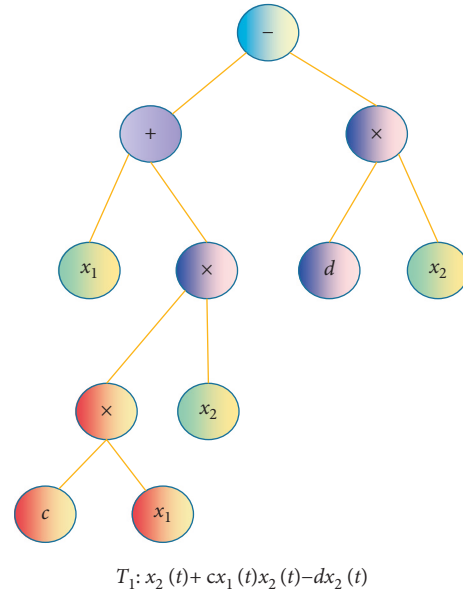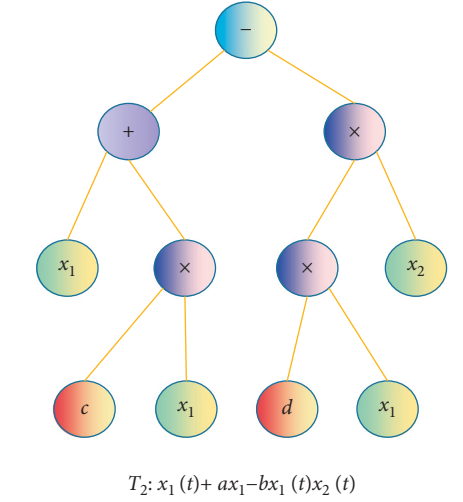

$T_2: x_1(t) + ax_1 - bx_1(t)x_2(t)$

$T_1: x_2(t) + cx_1(t)x_2(t) - dx_2(t)$

FIGURE 4: Expression binary tree.

Define the j-step predicted value $X^*(t, j) \, (0 \le t \le n)$ at t time XX; then

$$\begin{cases} X^*(t, j+1) = F[X^{*T}(t, j), t + j], \\ X^*(t, 0) = X(t), \quad 0 \le j < n - t. \end{cases} \tag{11}$$

The maximum error e_{ip} predicted by x_i in step p is defined as

$$e_{ip} = \max \left\{ \left| \frac{[x_i^*(t, p) - x_i(t, p)]}{x_i^*(t, p)} \right| \Big| 0 \le t, t + p \le n, 0 < p, p < i \le n \right\}. \tag{12}$$

For the state variable x_i, the allowable error is e, and then the time step of the system described by formula (13) within the control error e is

$$p = \max\{p | e_{ip} \le e\}. \tag{13}$$

Evaluating the discrete dynamic system model by using p value not only reflects the error of the model but also reflects the dynamic characteristics of the model. The

significance of p value is a predictable time step in the range of specification error. When the experimental data are determined, the size of p value depends on the quality of the model.

3.2. Training of Track and Field Sprinters Based on Big Data Analysis. With the advent of big data era, big data analysis technology collects and processes data and information resources based on advanced software systems, which highlights its unique advantages; namely, it covers massive data, has high timeliness and practical value, strong accuracy, and timeliness, and diversifies output results, so it is favored in intelligent planning of training schedule. The big data model is realized based on massive data collection and analysis, so data collection is an essential part of building an intelligent model in athlete training. According to athletes' training situation, two major technical links can be selected for data collection, namely, identity system and interface [23]. The flow of big data collection is shown in Figure 5.

Okumura–Hata intelligent model is widely used in the field of big data analysis. Its main feature is that it can resist interference efficiently and ensure the accuracy and stability of model design. Okumura–Hata intelligent model can be used to build models based on collected data and comprehensively explain and analyze data characteristics.

Okumura–Hata intelligent model divides data based on Okumura coordinate system diagram and constructs characteristic data relationship through normal distribution of curve function. In order to realize the intelligent analysis of training progress data, the Okumura–Hata intelligent model is constructed. Firstly, the intelligent extreme value specific analysis is carried out for the data; namely,

$$\frac{Q(k)}{N(k)M(k)} = s_c \left[\frac{Q(k)}{N(k)M(k)} \right]^a \left[\frac{K(k)}{N(k)M(k)} \right]^{1-a-k} \\ - \delta_h \left[\frac{G(E)}{N(T)} + \gamma \frac{Q(k)}{N(k)M(k)} \right], \tag{14}$$

where $Q(k)$ is data range, $N(k)$ is base height, $M(k)$ is working frequency, $K(k)$ is data model dynamics after loss index correction, δ_h is transmission distance, and γ is quantitative constant.

Particular feedback data $H[a]$ of Okumura–Hata intelligent model is as follows:

$$H[a] = \frac{\partial^2 \Omega}{\partial v^2} = \sum_{i=1}^{n} e_k w_i \xi_{ij} \partial l_i^{-1} \left\{ \sin\left[\xi_i^{-1/2} \right] \cos[\xi] \right\} e^{\xi 2_i/2}. \tag{15}$$

Here, v^2 is the time-delay parameter of athletes' training sports characteristics, Ω is the effective use value of data, and e_k is the labeling operator.

The specific feedback data of the Okumura–Hata intelligent model is the key link to further realizing the intelligent planning of athletes' training progress. Through the above process, the model construction can be preliminarily completed [24].
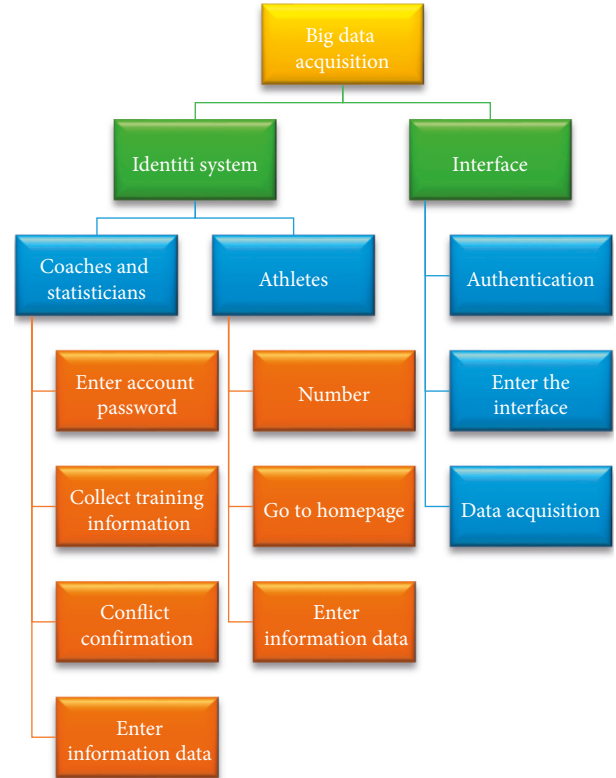

FIGURE 5: Big data collection process.

4. Result Analysis and Discussion

4.1. Model Realization. In order to ensure the effectiveness of the intelligent model experiment of track and field sprinters' training progress, as well as the stability and accuracy of the experimental process, the experimental data need to be set reasonably. This paper takes track and field sprinters as the experimental object and takes the training of simulated track and field sprinters as the experimental sample. Thirdly, the model is tested by loading software to eliminate the environmental factors affecting the perspective of big data analysis. The software evaluates the accuracy of data acquisition according to yuh index and uses pol parameters to evaluate the applicability of the model. The experimental results are shown in Figure 6.

It can be seen from Figure 6 that the data intensity of intelligent modeling of track and field sprinters' training progress from the perspective of big data analysis is high, which can reflect the degree of data basis. The more the data basis, the more accurate the modeling result [25].

4.2. Prediction Value and Prediction Error of the Model. In order to verify the effectiveness of this algorithm, this paper takes the evolution data of the Lotka–Volterra equation as the experimental data. The experimental research adopts genetic programming to model the system. The parameters are population size 100, crossover 15, and variation 25. After 40,000 generations of evolution and 30 times of calculation, the optimal solution is obtained.
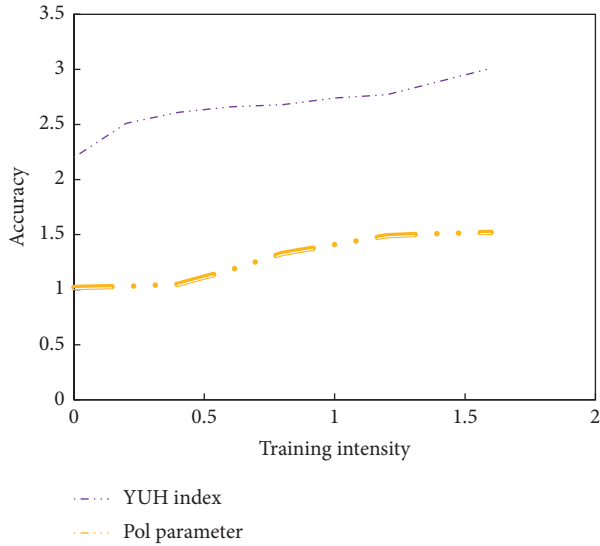
FIGURE 6: Test experimental results.

FIGURE 7: Prediction value and prediction error of the model.

Figure 7 calculates the predicted value of x_1, x_2 from the first generation and draws the measured value and predicted value of x_1, x_2 and the relative error curve between them. It can be seen that the curves of the predicted value and the measured value of x_1, x_2 almost coincide. It is shown that genetic programming can be used in discrete dynamic modeling of complex systems in the absence of system structure information, and satisfactory results can be obtained. For discrete dynamic systems, this modeling method is general.

4.3. Fuzzy Reliability Analysis of System. Fault tree analysis is a kind of system reliability analysis method with strong logic and intuitive expression. It is widely used in qualitative and quantitative reliability modeling and analysis of complex engineering systems. The fault tree model uses a graphical expression to describe the component failure events and their combinations that lead to system failure through logic gates such as and gate or gate and voting gate, and its mathematical description is given by the structure function [26, 27]. Systematic error is characterized by its regularity. The causes of systematic error can generally be determined and eliminated through experiment and analysis. Because there are many kinds and models of testing instruments, the use environment is often very different, and there are many factors that produce a systematic error. Therefore, the characteristics of systematic error, that is, the change law, are often inconsistent [28]. In the process of system reliability analysis, the normal working or failure state of components is regarded as certain [29]. That is to say, parts are either in a working state or in a failure state, and the probability of parts being in these two states is certain. However, this is not always the case in practical engineering systems, and the state and probability of systems and components often have fuzziness caused by various factors.

Under a fixed horizontal cut set, the system reliability curve is shown in Figure 8. The data lines in the figure,
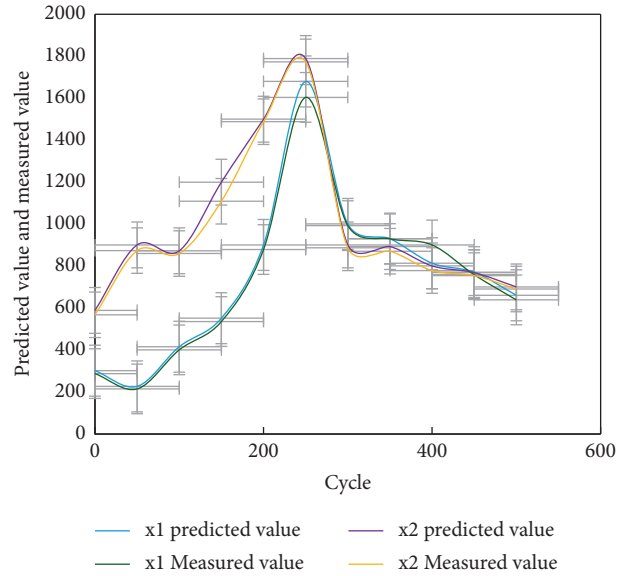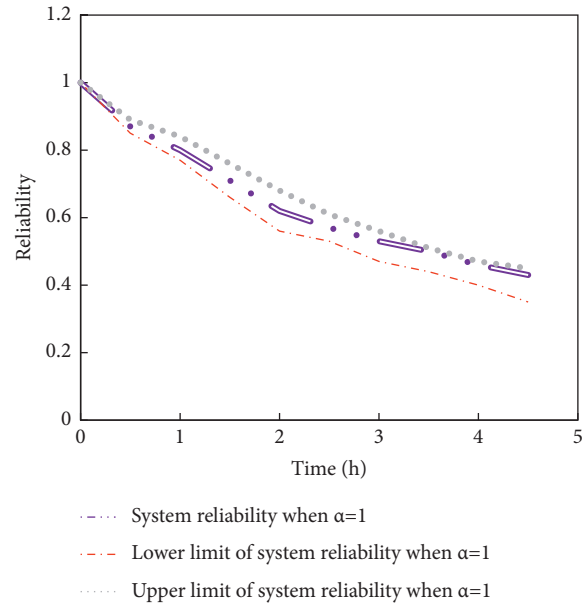

FIGURE 8: Fuzzy reliability of system when $\alpha = 1$ and $\alpha = 0$ are cut horizontally.

respectively, represent the fuzzy reliability curves of the system at a cut-off level $\alpha = 1$ and the curves of the upper and lower limits of fuzzy reliability at $\alpha = 0$.

Figure 8 shows that this method is an effective method for system reliability analysis, which can accurately model and quantitatively evaluate the reliability of systems with dynamic failure characteristics and uncertain failure rate.

4.4. Analysis of the Characteristics of Sprint Events and Physical Fitness

4.4.1. Analysis of the Whole Speed Curve Model of 100-Meter Running. Because of its own characteristics, the time from the start to the end of the 100-meter race is fleeting, so it is

difficult for those who study the 100-meter race to form a specific concept of the whole speed change, and it is even more difficult to allocate the 100-meter race segments reasonably. Studying and analyzing the curve of the whole 100-meter race change is one of the main methods to study the 100-meter movement and analyze various data at present. Different athletes have different sports achievements, and the level of each athlete is not always the same.

If scientific researchers want to obtain a scientific movement speed curve, they must reasonably allocate the whole speed and different speed stages to keep the speed movement of each 100-meter athlete relatively stable, and only when the speed change curve is relatively smooth, the fluctuation is small [30]. From a large number of papers, the author found that the speed change curve models of the world's top elite men's 100 m athletes are mainly in the form of "dam-type" curve model and "bimodal" curve model [31]. In order to show the change characteristics of the 100 m speed curve model of track and field sprinters in track and field championships more directly, this paper draws the 100 m speed curve models of preliminaries, semifinals, and finals in the competition, respectively (Figure 9).

From the situation shown in Figure 9, the change trend of 100-meter speed of track and field sprinters approaches the characteristics of the "bimodal" curve model.

4.4.2. Technical Indicators of Step Size and Step Frequency.
For the 100-meter sprinter, the step length and step frequency determine the speed and directly affect the final result. Step length refers to the distance of each step, and step frequency is the number of steps per unit time when the human body moves. How to coordinate the ratio of step length and step frequency is the key to improving sprint performance. However, in the actual training process, there are conflicting aspects between the step length and the step frequency, which often makes it difficult to achieve the maximum benefit from the mutual promotion.

The research on stride length and stride frequency will also become a long-term topic in 100-meter sprint. This study compares the technical indicators of the best performance of Athlete 1 with those of Athlete 2 and Athlete 3 competing in the same field to reveal their technical characteristics and gaps. The results are shown in Figure 10.

According to the analysis results, there are some obvious differences in step size among Athletes 1, 2, and 3. The average step size of Athletes 1 and 3 is 2.43 m and 2.06 m, respectively. It is obvious that the step size of Athlete 3 is larger than that of Athlete 1, and the lowest step size index of Athlete 1 among the three is 1.19. By comparison, Athlete 3 has the slowest response to start among the three, and the stride frequency is relatively slow, but the result is the best. This phenomenon can explain that the influence of stride length is greater than the stride frequency to some extent for the 100-meter result. It also suggests that we should pay more attention to improving the stride length to the greatest extent on the basis of keeping a certain stride frequency in sprint training.
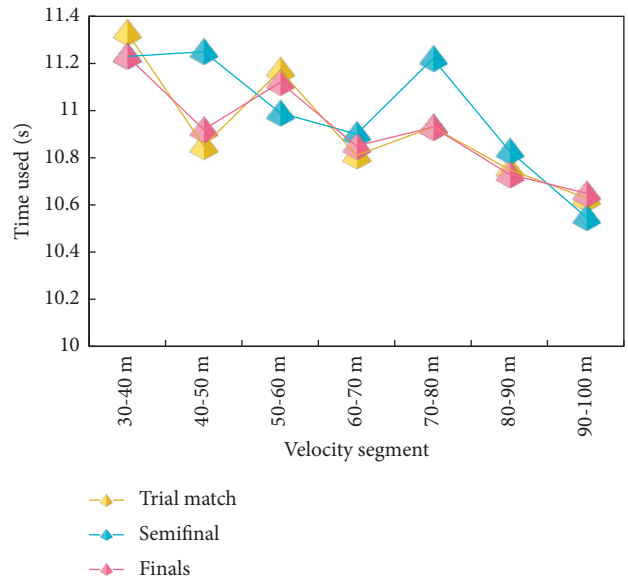

Figure 9: 30–100 m speed change curve of track and field sprinters in preliminaries, semifinals, and finals.
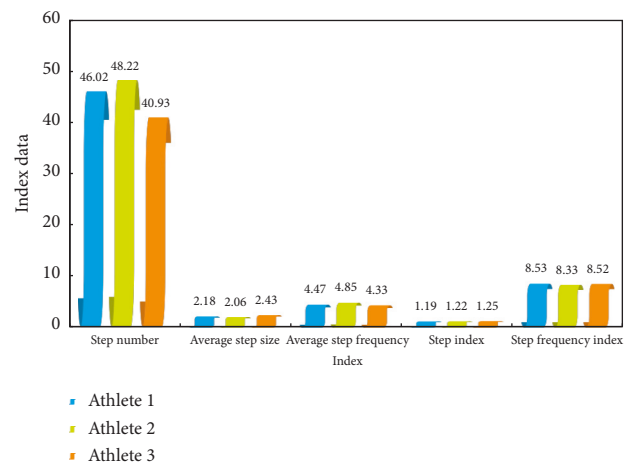

Figure 10: Comparison of step frequency data of Athletes 1, 2, and 3 steps.

Through comparative analysis, it is known that the step frequency index of Athlete 1 is maintained at a high level, while the step index is low, so there is room for improvement. Because of individual differences, stride length and stride frequency have different personal characteristics. It is suggested that Athlete 1 should pay more attention to the backward pedaling technique related to stride length on the basis of keeping stride frequency stable and further improve the space of stride length by strengthening special physical training so as to improve sports performance.

4.4.3. Analysis of Physical Function of Athlete.
The 100-meter sprint is completed in about 10 seconds, and the energy supply capabilities of phosphagen, glycolysis, and aerobic oxidation systems of Athlete 1 are indispensable. This paper selects some physiological and biochemical

aspects of winter training during the preparation for the competition of Athletic Sprint Athlete 1 as the research object, and the statistical results are shown in Figure 11.

HGB can buffer the acid-base balance of the human body. When the energy released by sugar metabolism is insufficient, the metabolism of protein will be strengthened, and HGB will have a downward trend at the beginning of large-scale sports. There are certain individual differences in this index, so it is particularly important to establish athletes' own comparative evaluation criteria. The average HGB level is 140.92 g/L, within the normal range, the body has a good ability to carry transport samples and carbon dioxide during training, and the 100-meter sprint event is strong and easy to produce acidic substances. The overall HGB level of Athlete 1 is high, which is beneficial to the adjustment of acid-base balance in the body.

Studies have shown that sports training can cause BUN to rise, and after adaptive training, the functional status will rise, and the morning value of BUN will decrease. Athletes' BUN is affected by the intensity and amount of training, but the amount of exercise is sensitive to it. Modern training function monitoring is widely used, and it is an important index to evaluate training load and function recovery. During the winter training period, BUN of Athletes 1 showed an upward trend, which was related to the training cycle. With the continuous winter training, the amount of training increased, the body gradually adapted, and BUN was adjusted to a lower level after the end.

During the winter training, the athletes' indexes changed periodically within a reasonable range and adapted to the training content. After the winter training, T and HGB were improved, and their physical functions were further improved. BUN index showed that there was no symptom of excessive fatigue at the end of the winter training, and they were suitable for competition. Athletes' physical function can provide theoretical support for other 100-meter sprinters in China in order to achieve their own best training state.

4.4.4. Running Posture Analysis.

In the process of running, there are two aspects of calculating the time of a single step, that is, the leg support time and the flight time after the athlete runs; that is, the two add up to a single step time. Therefore, athletes' single-step time is closely related to the two. Figure 12 shows the variation characteristics of knee angle data of supporting legs during the supporting period of Athlete 2 running on the whole journey.

It can be seen from Figure 12 that the knee angle of the supporting leg during the preliminary competition when Athlete 2 ran to support during the preliminary competition was between 149.5° and 137.5°, and the difference was 12°. In the semifinals, the knee angle of the supporting leg varies from 151.6° to 138.9° during the running support, with a difference of 12.7°. In the middle of the final run, the knee angle of the supporting leg changed from 149.8° to 137.1°, and the difference was 12.7°.

From the above characteristics of athletes' knee angles, it is not difficult to find that when sprinting forward, the
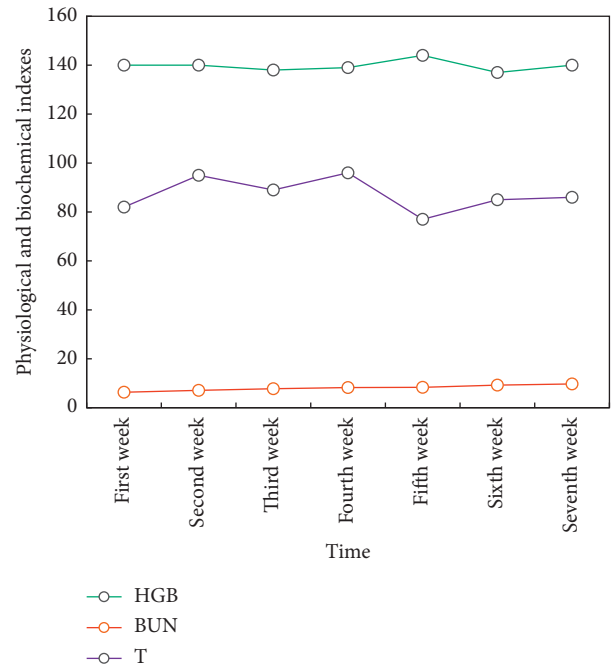

Figure 11: Some physiological and biochemical indexes of track and field sprinter 1 during winter training during preparation for competition. HGB refers to hemoglobin in mmol/L; BUN refers to blood urea nitrogen in mmol/L; T refers to serum testosterone in nmol/L.
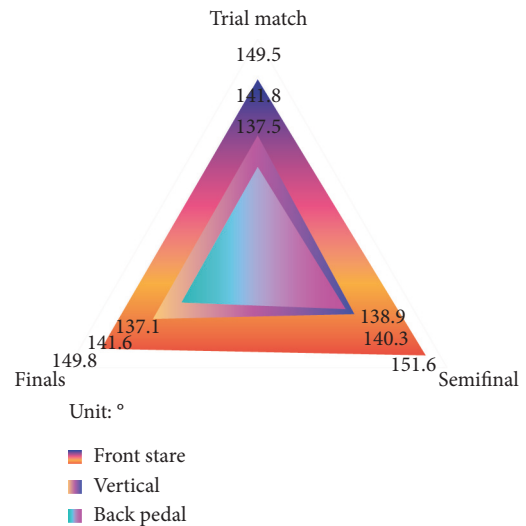

Figure 12: Variation characteristics of knee angle data of supporting legs during the supporting period in the whole journey.

working principle of supporting leg muscle contraction is from "centrifugal contraction to centripetal contraction," which is also the main source of strength for sprinters to run forward. In this process, there are more exposed sites combined with the transverse bridge; then, the energy needed for muscle contraction will be more, and the energy released will be higher, thus paving the way for the next muscle contraction warrior. The larger the angle of the supporting legs at the moment when the backpedal is off the

ground is, the more the effective control of the ups and downs of the body can be made so that the strength required by the more intensive horizontal acceleration can be obtained, and the angle between the strength and the acceleration direction can be reduced; otherwise, it will increase, thus wasting more physical strength.

5. Conclusion

Track and field sprinters need the ability to run the whole course continuously at high speed under the condition of plenty of oxygen deficiency. In various competitions, the phenomenon of short step length, slow frequency, and technical deformation caused by late deceleration is the manifestation of its lack of speed endurance. Through training, athletes can keep the highest speed for as long as possible and minimize the decline of the highest speed. The main reason for the speed decrease is the fatigue of the central nervous system caused by high-frequency stimulation. Through research, this paper puts forward the key steps of genetic programming modeling for discrete dynamic systems, including modeling and evaluation methods, and makes an empirical study by using the evolution data of the Lotka–Volterra equation. The results show that genetic programming can be used for discrete dynamic modeling of complex systems in the absence of system structure information, and satisfactory results can be obtained. For discrete dynamic systems, this modeling method is general. The intelligent model of track and field sprinters' training progress from the perspective of big data analysis has outstanding practical value, which can make training plans quickly and accurately, solve the data fluctuation phenomenon in the trend of big data division, and then realize intelligent operation. Moreover, the fluency and accuracy are very high, and it is worth popularizing and applying vigorously. However, the research of this paper lacks accurate control analysis of system structure information under complex conditions. Therefore, some data will produce some errors in practical application, which makes the practical application of the model inaccurate. It needs to be improved in future development.

Data Availability

The data used to support the findings of this study are included within the paper.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Acknowledgments

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