Big Data Stepwise Regression Correction Method for Forearm Wrong Posture in Track and Field

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Abstract. The current large data correction method for track and field forearm wrong posture has not considered the forearm posture detection results and restricts the arm posture detection, resulting in the wrong forearm posture and the low accuracy of the big data for correcting forearm posture. For this reason, a track and field forearm is proposed Stepwise regression correction method for wrong posture big data. Make full use of the information detection characteristics of the physical factors of the stepwise regression, and assume the time series of the forearm posture to detect the motion posture of the forearm in the track and field; calculate the misjudgment probability of detecting the forearm motion posture, form the misjudgment probability matrix, and analyze it according to the matrix. As a result, the forearm posture big data misjudgment probability matrix constraint is obtained; the stepwise regression method is used to realize the big data detection and classification of the forearm wrong posture, judge whether the forearm posture is wrong, calculate the peak value of the forearm posture error, and correct the big data of wrong forearm posture. The experimental results show that the error posture big data correction accuracy of this method is higher.

Keyword: Stepwise regression · Track and field sports · Wrong forearm posture · Correction

1 Introduction

Track and field sports are one of the main contents of current sports. Correct and beautiful track and field movements can greatly improve students' strength, agility, flexibility and other qualities, physical coordination, sense of rhythm, and shaping a beautiful body shape. The benefits of [1]. Therefore, track and field sports are an important part of sports. However, due to the mutual influence and mutual restriction of personal habits, physical fitness and other factors, in the process of track and field sports, it is inevitable that various redundant or wrong actions will occur. If the wrong action cannot be found in the budding state in time To be corrected, the wrong power stereotype will be formed over time, which will not only affect the mastery of the correct movement technique

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of track and field sports, but also may lead to injury accidents [2]. Therefore, in track and field sports, it is particularly important to check and correct wrong movements. Therefore, both at home and abroad are actively studying ways to correct track and field wrong postures. In China, there are many documents on track and field analysis and error correction, but most of them are divided into two types. One is to analyze and correct only a certain movement of track and field sports, but does not consider the connection with the overall movement, and cannot grasp the root cause of the error. The second is the listing and description of various wrong actions, not only did not analyze and discuss the cause of the error and corrective methods in detail, but also did not sort and analyze the wrong actions [3]. In foreign countries, for the correction of wrong actions in track and field exercises, it is necessary to choose a reasonable error correction method in accordance with the law of formation of track and field skills [4]. Relevant scholars have made some progress in this issue.

In reference [2], a simulation of manipulator grasping attitude control based on synovial error feedback is proposed. The multi-sensor fusion information acquisition method is used to measure and fuse the manipulator attitude parameter information, and the constraint parameter model and control objective function of manipulator attitude control are established. The experimental results show that the method has high control accuracy in the robot arm attitude control, and improves the robot arm grip. But the error capture time is not good.In reference [3], a general dual robot arm posture detection method based on three-dimensional positioning is proposed. The robot positioning accuracy of the target workpiece under a single camera is measured by three-dimensional positioning method, and the relevant features in the image information are interacted, which can quickly and efficiently separate the target object from the background. This method has efficient recognition ability, However, the positioning error of this method is obviously large.

In view of the above problems, this paper introduces the stepwise regression method to correct the big data of forearm wrong posture in track and field. From the psychological factors, environmental factors, physical factors and other aspects of technical error correction are analyzed and studied effectively, which can effectively improve the correction effect of forearm error posture in track and field.

2 Big Data Correction Method of Wrong Forearm Posture in Track and Field

2.1 Big Data Detection of Forearm Posture Based on Stepwise Regression

In track and field sports, the forearm posture time series $Y(t)$, (where t represents time), is composed of forearms, elbows and wrists. In order to make full use of the big data of forearm posture, the information on the change law of the factors generated in track and field sports is gradually used. Formula regression method separates its period term and trend term, and predicts the forearm motion posture [5]. Therefore, the separated random term can be regarded as a stationary time series. Let the periodic term be $T(t)$, the trend term is $P(t)$, the random term is $R(t)$, the number of dominant factors of the periodic term is I, the order of the detection model is P, and the number of periodic terms is The number is i, the regression coefficients of the periodic term are A_0 and A_i, the number of dominant test periodic waves is k, the length is l, and the test periodic waves of length l are $f_{il}(t)$, the regression coefficients of the trend term are B_0 and B_i, and the constructor of the time t is $g_i(t)$, the regression coefficient of the random term is ϕ_i, and the mean value of the random term is μ, then:

$$\begin{aligned} Y(t) &= T(t) + P(t) + R(t) \\ T(t) &= A_0 + \sum_{i=1}^{I} A_i \sum_{l=1}^{k} a_{il} f_{il}(t) \\ P(t) &= B_0 + \sum_{i=1} B_i g_i(t) \\ R(t) &= \mu + \sum_{i=1}^{P} \phi_i [R(t-i) - \mu] \end{aligned} \tag{1}$$

In the formula, a_{il} represents the coefficient of the test periodic wave $f_{il}(t)$ [6]. At this time, substituting the forearm posture time series $\{Y_1(t), Y_2(t), \cdots, Y_n(t)\}$ (where n is the number of forearm posture factors) obtained by Eq. (1) into the stepwise regression to obtain the predicted value of the forearm posture factor $Q(t)$, then:

$$Q(t) = b_0 + \sum_{i=1}^{n} b_i Y_i(t) \tag{2}$$

In the formula, b_0 and b_i are time series coefficients. At this time, according to the formula (2), the forearm posture is recognized and the forearm posture is recognized to determine whether there is an error in the big data of the forearm movement posture during the track and field exercise.

2.2 Determine the Constraint Conditions for Correcting the Big Data Misjudgment of the Forearm Posture

Misjudgment Probability Matrix

In the process of detecting and recognizing the forearm posture, due to problems such as the angle and direction of the forearm movement, there will be a certain probability of misjudgment when recognizing whether there is an error in the forearm posture and correcting it [7]. Therefore, based on formula (2), the detected forearm motion posture in track and field is calculated and the probability of misjudgment exists when correcting the wrong posture of the forearm. Let i represent the correct detection of the forearm posture, j represent the large data detection error of the forearm posture, use p_{ij} to represent the probability that the detection result is i and the actual result is j, c_{ij} represents the actual result is i, and the actual result is the number of j. Then there are:

$$p_{ij} = \frac{c_{ij}}{\sum_{j=0}^{3} c_{ij}} \tag{3}$$

In the formula, the values of i and j are 00, 01, 02, 03. At this time, using formula (3), after taking all values of i and j, the misjudgment probability matrix can be established, as shown in Table 1.

Table 1. Misjudgment probability matrix

Actual class	Forecast			
	00	01	02	03
00	0.731	0.003	0.006	0.008
01	0.128	0.797	0.002	0.07
02	0.030	0.109	0.980	0.05
03	0.111	0.091	0.012	0.872

In the misjudgment probability matrix shown in Table 1, when the predicted value calculated by Eq. (3) is 00, the probability of forearm posture detection error 00, 01, 02, 03, 04 is 0.731, 0.128, 0.030, 0.111. The misjudgment probability matrix established at this time lays the foundation for the error correction algorithm.

Forearm Posture Big Data Misjudgment Probability Matrix Constraint
In the process of correcting the wrong forearm posture, there will be 04, 05, and 06 types of forearm posture recognition results with a correct rate of more than 96%. Therefore, on the basis of the misjudgment probability matrix, the forearm posture misjudgment probability matrix is constrained. Based on the probability value of the misrecognition

Table 2. Correspondence between i, j and the new category

Test results	Ranges	New category
00	[1,73]	00
	[73,86]	01
	[86,89]	02
	[89,100]	03
01	[1,80]	01
	[80,91]	02
	[91,100]	03
02	[1,98]	02
	[98,100]	03
03	[1, 7]	01
	[7, 13]	02
	[13,100]	03

probability matrix, 100 integers are divided into different areas from 1 to 100. At this time, the correspondence between the three is shown in Table 2.

At this time, suppose that in track and field sports, the forearm movement posture identified in (2) is Type m, and $m \in \{0, 1, 2, 3\}$. And use x_m to represent the random integer whose recognition result is m, and the value range of x_m is in $[1, 2, \cdots, 100]$. Suppose the new category after the calculation process in Table 2 is y_m and $y_m \in \{0, 1, 2, 3\}$. At this time, the piecewise function x_m is established according to Table 2, then:

$$f(x_m) = \begin{cases} 00, 1 \le x_{00} \le 73 \\ 01, 74 \le x_{00} \le 86, 1 \le x_{01} \le 80, 1 \le x_{03} \le 7 \\ 02, 87 \le x_{00} \le 89, 81 \le x_{01} \le 91, 1 \le x_{02} \le 98, 8 \le x_{03} \le 13 \\ 09, 90 \le x_{00} \le 100, 92 \le x_{01} \le 100, 99 \le x_{02} \le 100, 14 \le x_{03} \le 100 \end{cases} \quad (4)$$

At this time, (4) is the constraint condition of the misjudgment probability matrix. Combining the above content, the constraint flow of the forearm posture misjudgment probability matrix can be established, as shown in Fig. 1.

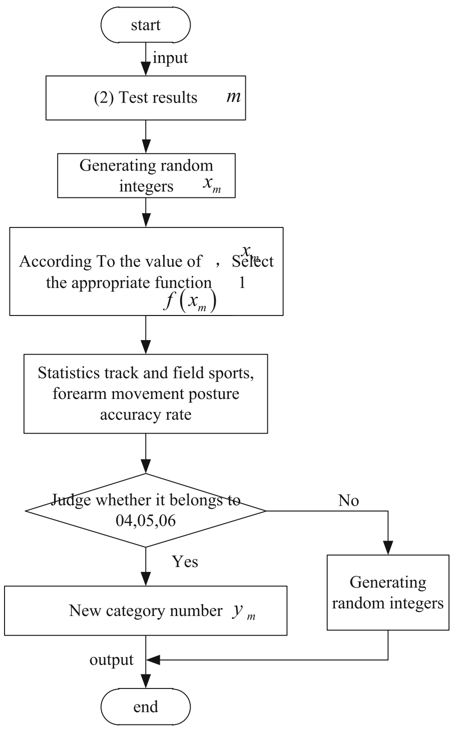


Fig. 1. Flow chart of the constraint of the probability matrix

At this time, under the above constraints, the wrong posture of the forearm movement in the track and field movement detected by the formula (2) is corrected.

2.3 Big Data Correction Algorithm for Wrong Forearm Posture

For the existing forearm movement posture in the track and field detected by Eq. (2), the output result of Fig. 1 is mapped to the [0, 1] interval, that is, the classification result is expressed in the form of probability. Suppose the last layer of fully connected data of the forearm posture of track and field is extracted, the one-dimensional matrix V represents this set of data, V_i represents the value of the i element in V, and the value range of i is determined by the number of tags in the model [8]. The big data of the forearm posture of track and field sports proposed this time has a total of n tags, so the value of i ranges from 1 to n. W_i represents the weight parameter in the maximum flexibility. Suppose the maximum flexibility is S_i and Z_i, then the maximum flexibility is S_i and Z_i as:

$$\begin{aligned} S_i &= \frac{e^{Z_i}}{\sum_{i=1}^{n} e^{Z_i}}, i = 1, 2, \cdots, n \\ Z_i &= \sum V_i * W_i \end{aligned} \tag{5}$$

In the formula, e represents an increasing function. Since the classification result of the maximum flexible maximum is to select the class with the maximum probability, that is, the i maximum S_i corresponds. It can be seen from the formula (5) that S_i and Z_i have a corresponding relationship. Because the value on the denominator is constant, and e represents an increasing function, the size of the Z_i value determines the final classification result, and the i corresponding to the largest Z_i is the final classification result of the forearm posture. as shown in picture 2.

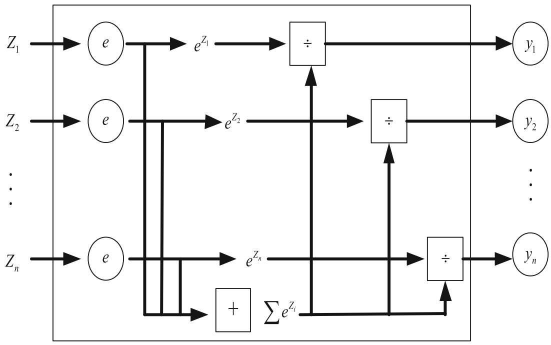


Fig. 2. Final classification of forearm posture big data

Under the condition of correcting the probability constraint of forearm posture misjudgment, the same forearm motion posture data set is divided into correct class and wrong class. Based on the above analysis, the value of Z depends on V. Therefore, before classifying the forearm motion posture data set, the characteristic value V of the n fully connected layer is used to express the distribution law with a curve fitting function.

Observing the curve distribution of the two recognition results of the same type of gesture, it is found that there is a common feature dimension in V that has a large impact factor on the recognition result, so it is defined as a misrecognition feature matrix. The reason why the big data of the same type of forearm movement posture error based on the stepwise regression recognition process is that the value of the misrecognition feature matrix is too small, that is, the process of detecting the misrecognition feature matrix is to explore the error mechanism of the misrecognition gesture [9]. Therefore, suppose that the correct m forearm pictures identified by stepwise regression constitute set A, and the u forearm pictures identified incorrectly by stepwise regression constitute set B. And extract the eigenvaluesof the n fully connected layer, save it to the matrix V, and define the total number of features as h. When inputting any track and field sports, the forearm motion postures k and s, where $k \in A$, $s \in B$; the eigenvalues of the n fully connected layer, extract k and s respectively, and save them in the matrix V; respectively calculate k and s and input them to the flexible The value on Z of the maximum value function; arrange the data from small to large, and use a curve to describe the changing trend of Z, find out the characteristics that change drastically and the corresponding original dimension, and form the dimension of the set C; start traversing from C_1, Until C_h ends the loop, the frequency and frequency of each dimension are counted; the frequency is greater than 90% and the dimension is saved to the matrix Q, and the misidentified feature matrix Q is output, and the end.

Based on Eq. (5) and the classification results of the forearm motion posture in Fig. 2, in order to retain the position information of the forearm features and the relationship between the feature points, the data of each row in the matrix is represented by three-dimensional coordinates. Then there are:

$$z = griddata(x, y, z, X, Y, V) \tag{6}$$

Formula represents the big data fitting process of forearm motion posture [10–13]. (6) In the formula, $z = f(x, y)$, the surface is fitted with an irregular data vector x, y, z, and $griddata()$ means that the interpolation of the surface z at the point (X, Y) will be returned, and the surface always passes through these data points x, y, z. The input parameter (X, Y) is usually a regular grid. X, Y is a matrix of one-dimensional constant row vectors.

At this point, you can correct the wrong forearm posture in track and field, that is, enter the stepwise regression recognition category number; extract the current forearm motion posture and the characteristic value in the track and field; calculate the current forearm motion posture, the three-dimensional in the track and field Curved surface peak; when the three-dimensional curved surface peaks are within the normal swing range of the forearm; when the three-dimensional curved surface peaks are within the normal swing range of the forearm; output the original forearm swing posture. When the peak value of the three-dimensional curved surface is not in the normal swing range of the forearm, the above calculation process is used to correct the forearm movement posture and output the correction result of the forearm error posture. At this point, the correction of the wrong posture of the forearm is completed.

3 Experimental Demonstration Analysis

To verify the method for correcting the wrong forearm posture of track and field sports, two commonly used large two-dimensional forearm posture databases of track and field athletes were selected as the test objects of this experimental method to correct the wrong forearm posture of the track and field athletes. The proposed method for correcting forearm wrong posture in track and field sports is regarded as experimental group A, and the two methods for correcting forearm wrong posture in track and field sports mentioned in the introduction are regarded as experimental group B and experimental group C, respectively. The actual data of the track and field athlete's wrong forearm posture movement data set is known. The three methods for correcting forearm posture in track and field sports are used to detect the forearm posture of the selected track and field athletes this time, and the detected wrong posture is corrected. The three methods for correcting forearm posture in track and field sports are compared. When detecting the forearm posture, The accuracy of the detection result; the error generated from the correct posture when correcting the posture of the forearm.

3.1 Experiment Preparation

In order to fully measure the performance of the proposed algorithm, two commonly used large-scale two-dimensional track and field athletes' forearm posture movement databases were selected as the test objects of this experimental method. The first is the BU-3DFE data released by American researchers, which is currently the most comprehensive database containing forearm posture movements. In addition, the original scan data in it also contains other very complex interferences, such as clothes, hair, expressions, hand gestures, etc. It obtains a variety of forearm movement postures generated by 100 participants in track and field. Each forearm movement posture is divided into 4 different degrees. Therefore, each individual has 25 corresponding three-dimensional forearm movements. Posture, a total of 2500 two-dimensional forearm motion posture images. The second database is the GavabDB three-dimensional forearm movement posture database, which contains 61 objects in the same track and field sports and 412 three-dimensional forearm movement posture pictures. In the two databases, under the same track and field sports, there are different forearm motion postures, which include various interferences other than the forearm motion, such as clothes, hair, and shoulders. For this experiment, a computer with Linux PC, Intel Dual 2.3 GHz processor, 2G memory and GeForce 8600 graphics card was selected.

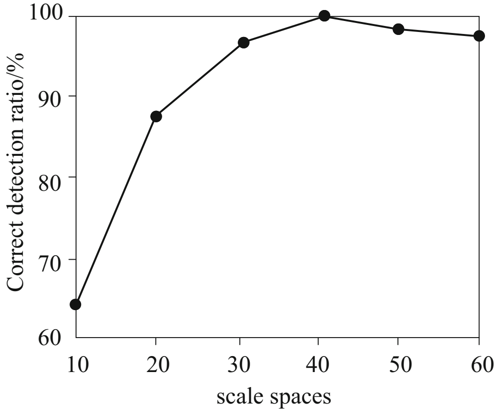
The parameters of this exercise posture correction experiment include the number of scale spaces n, the forearm movement feature threshold T, and the forearm movement area feature threshold R. For the selection of the values of these three parameters, the GavabDB database is used to determine. When the number of scale spaces n is less than 10, as shown in Fig. 3, many relatively sharp parts will correspond to a relatively large forearm motion posture, which will result in many forearm candidate points, that is, the distinguishing ability of features is not strong enough at this time. However, when the number of scale spaces gradually increases, the original three-dimensional surface will gradually become smoother, and the features of the forearm part will become larger than other areas, that is, the ability to distinguish features of the forearm becomes more and more obvious at this time. Generally speaking, when the number of scale spaces n is greater than 40, as shown in a in Fig. 3, the forearm movement characteristic threshold T gradually becomes relatively stable. Here we tested the accuracy of forearm motion detection in different scale spaces, and the results are shown in Fig. 3 a.

Based on the above analysis of the number of scale spaces n, the number of scale spaces n is selected as 40. The selection of the forearm movement characteristic threshold T is based on the analysis of the number n of the scale space as described above. When the number of scale spaces n is about 40, the forearm area gradually corresponds to the maximum threshold T, so the forearm features of all points are sorted from large to small, and the first N_T points are selected for the next clustering process. The selection of the N_T value depends on the resolution of the forearm motion posture, that is, the number of discrete forearm posture points. When the forearm posture has about 15,000 points, a stable and accurate result will be obtained when N_T is selected between 30 and 50. The relationship between the accurate detection rate and N_T is shown in b in Fig. 3. The feature threshold R of the forearm movement area will be selected in a similar way to the forearm movement feature threshold T. When the value of N_R is generally between 100 and 150, good posture correction results can be obtained. The c in Fig. 3 shows the relationship between the average angle error of the attitude correction and N_R. To sum up, it is the value of the three parameters selected in this experiment: the number of scale spaces n, the forearm movement feature threshold T, and the forearm movement area feature threshold R.

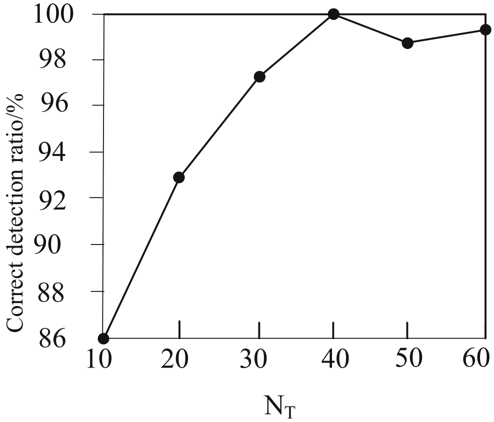
3.2 The First Set of Experimental Results

In the two three-dimensional motion forearm posture data of GavabDB and BU-3DFE, forearm posture detection and segmentation are performed. Based on the determination of this experiment, the three parameters of the experimental scale space number n, forearm movement characteristic threshold T and forearm movement area characteristic threshold R are determined, and the result of forearm posture detection is verified by artificial visual observation. Among them, the GavabDB database contains 412 forearm movement postures, and the BU-3DFE database contains 2500 forearm movement postures. The detection results of the wrong forearm posture are shown in Table 3.

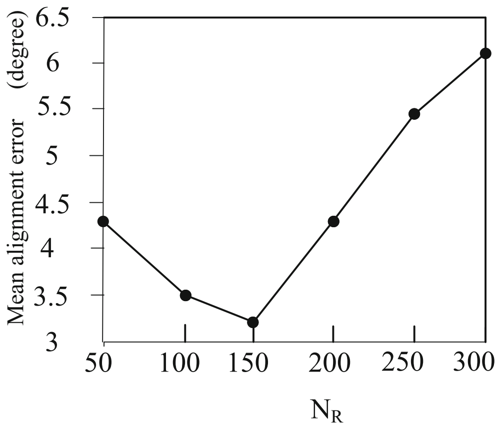
It can be seen from Table 3 that the experimental group A has extremely high accuracy in detecting the forearm posture in the GavabDB database, and there is only one error point in the number of forearm movement postures detected. For the BU-3DFE database, because the database, The number of forearm postures is huge, but the number of errors in the detected forearm postures is only 30; and the experimental group B has a higher accuracy rate of forearm posture detection in the GavabDB database than that of the BU-3DFE database. The number of detection data is affected, but the number of detected forearm motion postures and the number of errors are much higher than that of experimental group A; experimental group C's accuracy of forearm posture detection in the GavabDB database is lower than that of the BU-3DFE database. Compared with experimental group B, it is more suitable for multiple database detection, but the number of detected forearm movement postures and the number of errors are much higher than experimental group A. It can be seen that the method for correcting forearm posture



(a) Number of scale spaces



(b)Forearm motion characteristic threshold



(c) Characteristic threshold of forearm motion area

Fig. 3. Determination of different parameters

Table 3. Accurate detection rate on the two databases

Method	Database	Number of detections	Accurate detection rate
Experiment Group A	GavabDB	411	99.8%
	BU-3DFE	2470	98.8%
Experiment Group B	GavabDB	369	89.6%
	BU-3DFE	2107	84.28%
Experiment Group C	GavabDB	351	85.0%
	BU-3DFE	2205	88.2%

errors in track and field sports in this study can more accurately detect forearm posture errors in track and field sports.

3.3 The Second Set of Experimental Results

On the basis of the first set of experiments, conduct the second set of experiments. Using the first set of experiments, the wrong posture in the forearm movement was detected, and three wrong posture correction methods were used to correct the wrong posture of the forearm. A total of 2881 successfully detected three-dimensional forearm postures from the two data are used to measure the error. It is found that the average error of elbow detection is 2.31mm, and the average angle error of forearm line positioning is 3.52°. The angular errors in the x-axis and y-axis directions of the forearm posture correction are 2.41° and 2.68°, respectively. At this time, according to the above detection results, three sets of correction methods are calculated to correct the angle of the wrong forearm posture and the error between the correct forearm posture angle. The corresponding error distribution diagram is shown in Fig. 4.

According to the analysis of Fig. 4, when the current number of arms is two, the forearm positioning error of experimental group A is 120 mm, that of experimental group B is 760 mm, and that of experimental group C is 660 mm; When the current number of arms is 8, the forearm positioning error of experimental group A is 60 mm, the forearm positioning error of experimental group B is 590 mm, and the forearm positioning error of experimental group C is 250 mm. Among them, experimental group A is the method of this paper, which shows that the forearm positioning error of this method is significantly smaller than other methods.It can be seen from Fig. 4 that the angle error of the wrong forearm posture generated in the two databases in the experiment group B and experiment group C is significantly higher than that in the experiment group A after correction. It can be seen that the method for correcting the wrong forearm posture in track and field sports this time has a higher correction rate for the wrong posture of the forearm.

Based on the above two sets of experiments, it can be seen that the large data correction method of forearm wrong posture in track and field sports in this study can quickly detect the large data of wrong forearm posture in track and field sports. After the big data of wrong posture is corrected, and The accuracy of correction is high.

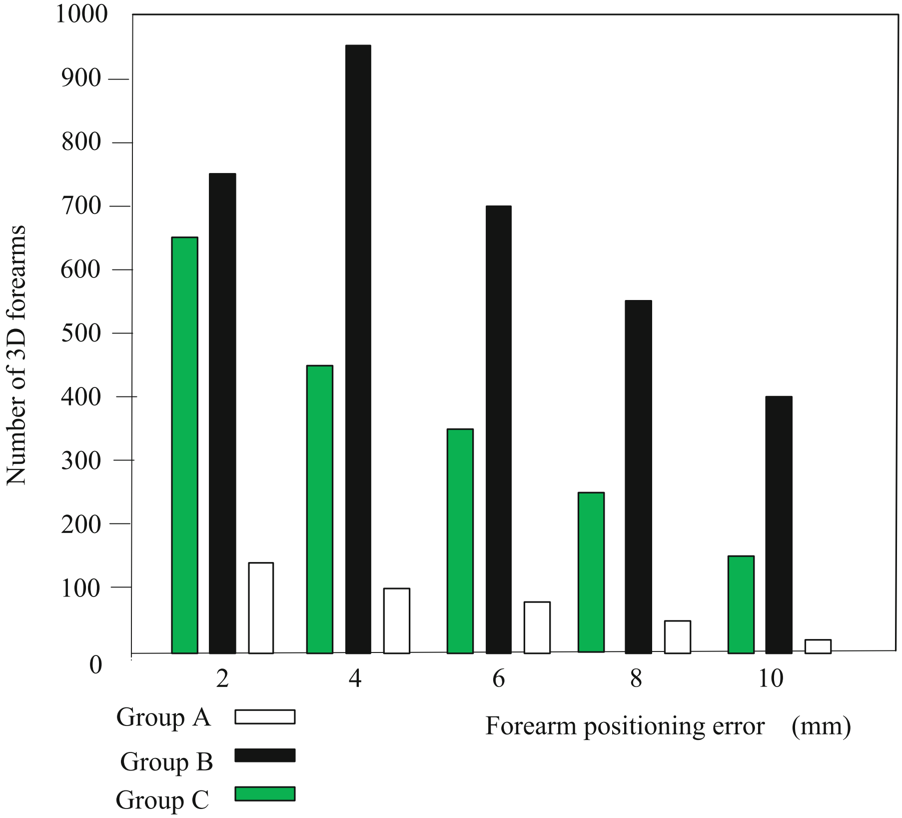


Fig. 4. Corresponding error distribution diagram

4 Concluding Remarks

Research on the big data correction method of forearm wrong posture in track and field, and make full use of the information detection characteristics of physical factors of stepwise regression to predict the posture of forearm in track and field. However, the large data correction method of forearm wrong posture in track and field in this study has not considered the presentation form of forearm movement posture. In different presentation forms, the big data of forearm wrong posture will affect the correction process. Therefore, in future research, the presentation form of forearm posture in track and field sports should be considered, and the big data correction method of forearm wrong posture should be analyzed in depth.

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