Biomechanical Characteristics of Taekwondo Athletes' Horizontal Kick Technique Based on Machine Learning Algorithm

Manman Shi
Leshan Normal University, Leshan, Sichuan, China

Abstract: Taekwondo competitors frequently use the horizontal kick, because it is quick and simple to demonstrate, and it helps them place higher in the competition. This paper investigates artificial neural networks in machine learning algorithms to extract reliable information from the complex competition training process. This essay examines the biomechanical aspects of taekwondo practitioners' horizontal kicks and offers insightful conclusions. A general introduction to machine learning algorithms is given in this article. It combines machine learning algorithms with the biomechanical characteristics analysis of taekwondo athletes' horizontal kick technical movements to analyze the biomechanical aspects of the sport's athletes' horizontal kick technical movements. According to this paper's experimental methodology, the accuracy recognition rates of using neural networks to distinguish between the three stages of taekwondo horizontal kick technical movements are all above 75%, which is within the acceptable range. In contrast to the experimental procedure and measurement data using traditional biomechanical characteristics analysis, the experimental results in this paper demonstrate that the biomechanical characteristics of taekwondo athletes' horizontal kick technical movements based on machine learning algorithms are more abundant.

Keywords: Horizontal Kick Technique, Biomechanical Features, Machine Learning, Artificial Neural Network (ANN)

1. Introduction

The arrival of the data age has greatly facilitated the current life. Machine learning algorithm is a comprehensive tool, involving introductory science, statistics and other disciplines. It is widely used, and it is the core of artificial intelligence. Machine learning algorithms mainly use induction and synthesis. It can acquire new knowledge by simulating human behavior, thereby improving the existing knowledge framework and improving performance.

The horizontal kick is a relatively simple and high scoring skill in Taekwondo. Therefore, it is also a common skill movement that is widely used in taekwondo competitions. There are many scholars who analyze the horizontal kick technique and movement of Taekwondo, and there are many methods used, and some are based on biomechanical characteristics. Biomechanics is the use of mechanical principles to study mechanical problems in living organisms. It includes all aspects of living organisms, from wholes to systems and organs, but few scholars have analyzed them from machine learning algorithms. This paper is based on the machine learning algorithm to analyze the biomechanical characteristics of taekwondo athletes' horizontal kick technical movements. It discusses some physical performance of taekwondo athletes when they use the horizontal kick technique, so as to effectively help athletes understand their own sports conditions. It really improves tactics and enhances its own capabilities. In this paper, artificial neural network algorithm in machine learning algorithm is used to analyze the biomechanical characteristics of taekwondo horizontal kick technique. The purpose is to expand the research methods in this direction, and to provide an effective method for the analysis of the horizontal kick technique of taekwondo athletes.

In this paper, artificial neural network algorithm is used as an analysis method to study the biomechanical characteristics of taekwondo athletes' horizontal kick technique. By using algorithms to analyze relevant data, it can obtain more scientific analysis conclusions. The innovation of this paper is to analyze the biomechanical characteristics of athlete's

horizontal kick technique based on machine learning algorithm.

2. Related Work

The analysis of the biomechanical characteristics of athletes has always been a popular link in the direction of biological research, and many studies have been carried out on it. Among them, Alp M believed that the traditional warm-up exercise generally refers to aerobic running. He believed that long-distance athletes need to perform static stretching training or dynamic stretching exercises suitable for the site to maintain physical stability. He also concluded that athletes accustomed to this state of movement are less susceptible to stretching-induced strength deficits based on research on professional taekwondo athletes [1]. The aim of Simunic's research was to investigate the association between running. Through experiments, he concluded that the contraction time of the vastus lateralis and the running speed were significantly different due to the influence of gender, and the contraction time of the biceps femoris was closely related to the running speed [2]. Lampen N thought the need to develop a deep neural network based on biomechanical developments. It is used to rapidly predict soft tissue deformation so that orthognathic surgery can be performed accurately [3]. Iryna R proposed that taekwondo athletes need psychological support during the training process during the four-year Olympic training cycle [4]. Busco K proposed that the maximum force of the punch is closely related to the maximum joint torque by comparing the muscle strength and explosive force of kicks and punches in experimental taekwondo athletes [5]. These scholars have analyzed the biological characteristics of athletes more, and some scholars have analyzed part of the physical state of taekwondo athletes. However, the analysis methods are relatively traditional and time-consuming, which are obviously affected by sample changes. It does not conduct experiments with large data volumes such as machine learning algorithms.

The use of machine learning algorithms is very wide, so there are many research projects on them. Aktan S studied the efficiency of using 8 machine learning algorithms including CRT in financial distress. He believed that most of the algorithms are better than the CRT algorithm in terms of classification accuracy and AUROC application [6]. The Yedukondalay RV study explored the feasibility of time-frequency methods in classifying happy and sad emotional states using electrodermal activity signals. The findings suggest that the protocol is useful in diagnosing clinical conditions associated with both happy and sad emotional states [7]. Whyte A applied two machine learning algorithms, Support Vector Machine-SVM and Random Forest-RF, to study the highly vulnerable iSimangaliso Wetland Park. He concluded that two-part image segmentation can efficiently create object features for the entire study area. He also believed that overall data accuracy improvements can be observed when the datasets are combined fully synergistically [8]. The experimental results of Alanis show that in the application of artificial neural network, its advance prediction of one step ahead and n steps ahead is stable [9]. Isik E believed that the fuzzy inference system based on artificial neural network and mobile adaptive network is used for modeling. It can effectively predict meteorological data, thereby improving the design of thermal systems [10]. These scholars have discussed the role of machine learning algorithms in some fields, and the research results are also very optimistic, but there are few analyses of the biomechanics of athletes' physical movements. The fields of application of machine learning algorithms are not broad enough.

3. Related Methods of Taekwondo Horizontal Kick Action Based on Machine Learning Algorithm

3.1 Biomechanical Characteristics of Taekwondo Horizontal Kick

(1) Taekwondo horizontal kick technical movements

Taekwondo is a combat sport. It mainly uses hands and feet for confrontation, which has now become the official event of the Olympic Games [11]. Taekwondo is mainly based on leg movement, with boxing as an auxiliary. It emphasizes breathing and pays attention to the performance of momentum. Its pursuit of speed and power is a boon to the mind and body. It is also a healthy exercise with ornamental significance, as shown in Figure 1.

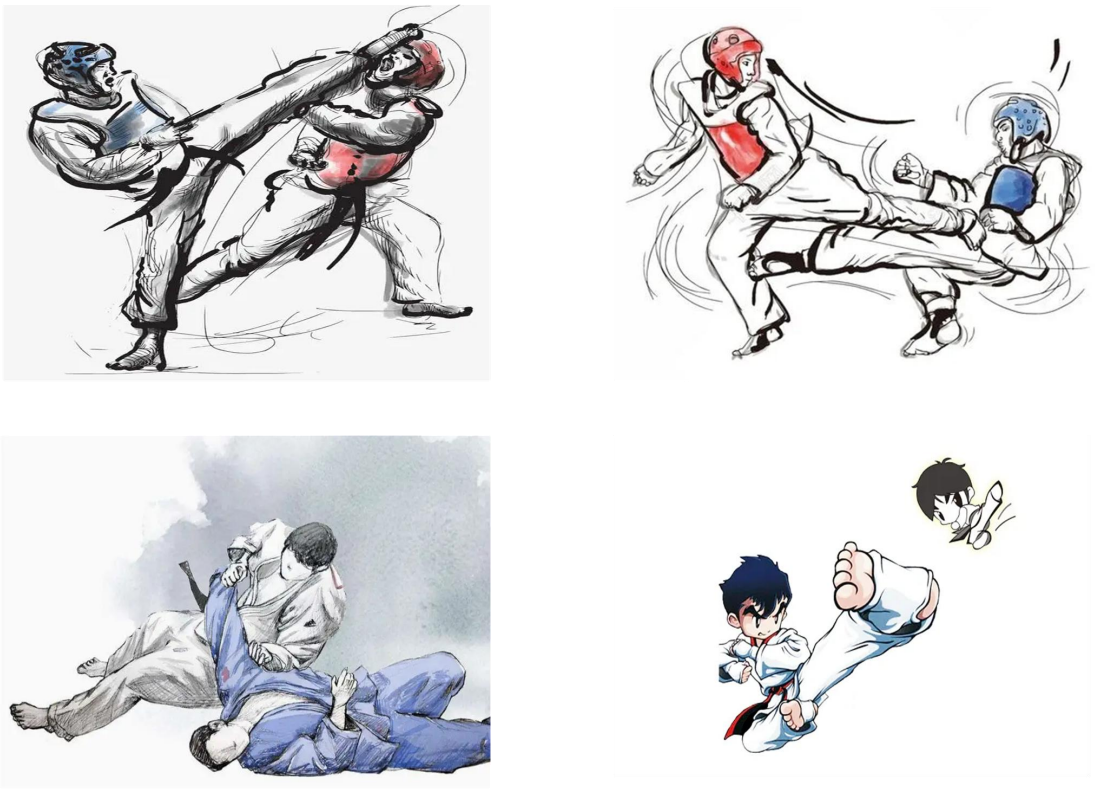

Figure 1. Cartoon of a Typical Taekwondo Confrontation Competition

Taekwondo horizontal kick is a common action in Taekwondo, and it is also one of the main actions used in competitions [12]. The main parts of the horizontal kick attack are the chest and abdomen. According to the actual combat situation, the horizontal kick also includes many variants, such as front leg horizontal kick and whirlwind kick. Taekwondo athletes must practice diligently on the basis of mastering the essentials of movements in order to have a solid technical foundation. The daily practice status of taekwondo athletes is shown in Figure 2:

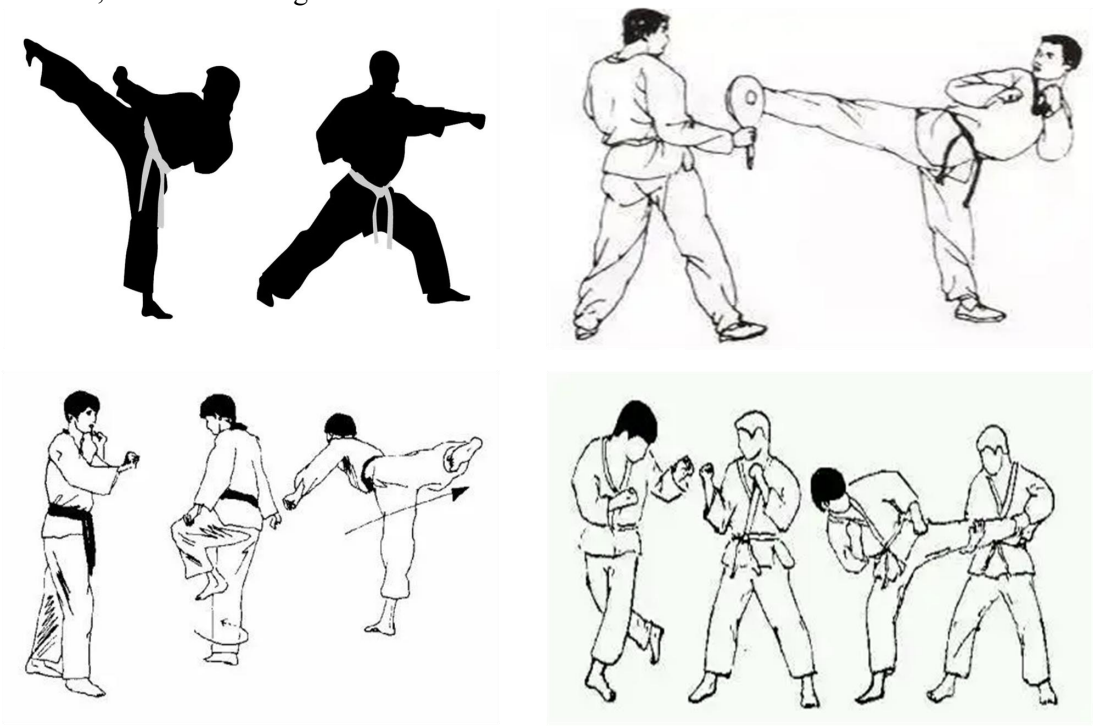

Figure 2. Daily Practice State Diagram of Taekwondo Athletes

(2) Biomechanical characteristics of taekwondo horizontal kick technique

Biomechanics is a science that studies the laws of human motion and is an important component of sports science. Biomechanics includes biorheology and respiratory system dynamics. The biggest difference between it and other mechanics is that the research object is an organism [13]. The study of the biomechanical characteristics of taekwondo horizontal kick technical movements is mainly reflected in the analysis of some muscle states and skeletal states of athletes during taekwondo movement. It improves the training state of taekwondo athletes according to the analysis results, so as to provide a certain degree of help for the improvement of the athletes' ability.

3.2 Biomechanical Method of Taekwondo Horizontal Kick Action Based on Machine Learning Algorithm

(1) Machine Learning (ML)

Machine Learning (ML) is a discipline that involves several fields such as probability theory. It mainly improves the performance of the system with the help of the intelligent computing power of the computer. It also produces a suitable algorithmic model[14]. Among them, the process of machine automatic learning is the process of algorithm model. The earliest idea of machine learning is to imitate human thinking patterns, as shown in Figure 3 [15].

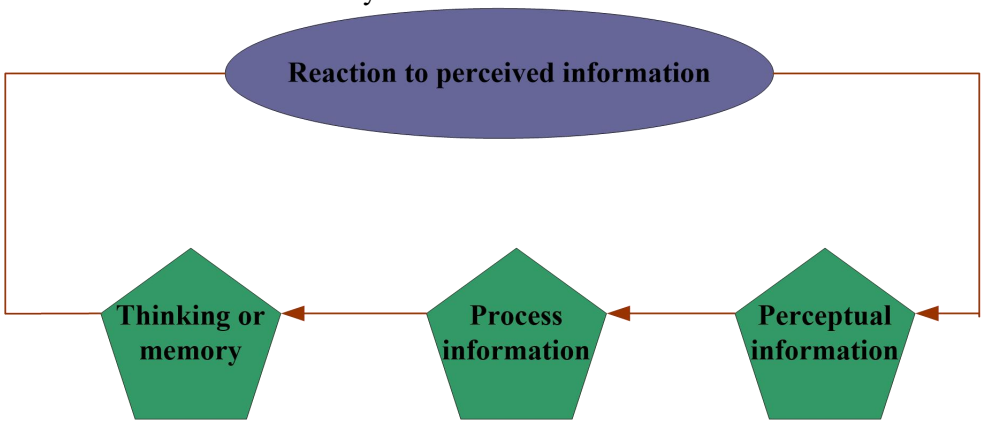

Figure 3. Cognitive Processes in the Human Brain

(2) Artificial Neural Network Algorithm (ANN)

Artificial Neural Networks (ANN) are simulations of basic and abstract features in the human brain. It can convert complex nonlinear problems into easy-to-understand forms[16].

In general, an artificial neural network is composed of a type of independent artificial neurons connected [17]. Among them, each independent artificial neuron cell body is composed of an input end, an artificial nerve cell body and an output end. It generates an output value by inputting a real value and then processing it, as shown in Figure 4:

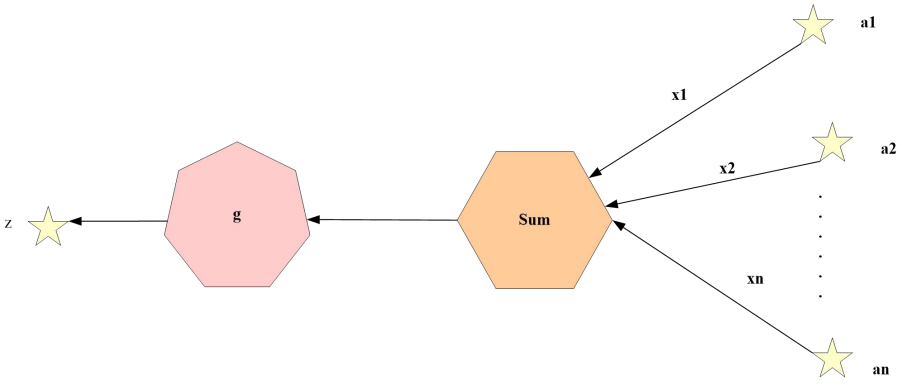

Figure 4. Schematic Diagram of a Simple Artificial Neuron

In Figure 4, $a1, a2, ...an$ is the condition of the input end, and after the artificial nerve cell body is processed, the result of the output end is finally obtained.

The process of artificial neural network mainly adopts the method of gradient descent, which is the basis of backpropagation [18].

Gradient descent method:

That is, the perceptron acts as a simple artificial neuron with only two outputs, as shown in Figure 5, showing a perceptron with k real inputs $x_1, x_2, ..., x_k$ [19].

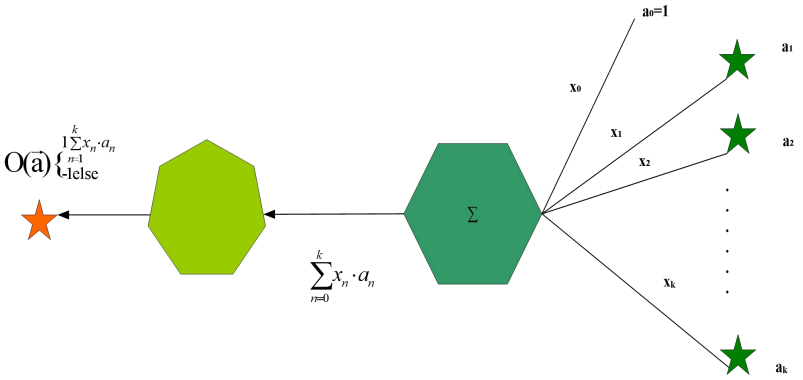

Figure 5. Simple Perceptron Neuron Model

In Figure 5, each input a_n corresponds to a weight x_n, in addition, there is a bias term x_0. Therefore, it is necessary to calculate the linear combination formed by the weights corresponding to the k input values, plus the bias term, as shown in formula (1):

$$S = \sum_{n=1}^{k} x_n \cdot a_n + x_0 \tag{1}$$

In formula (1), let $a_0 = 1$, then it can be expressed as formula (2):

$$S = \sum_{n=1}^{k} x_n \cdot a_n = \vec{x} \cdot \vec{a} \tag{2}$$

In formula (2), the input vector $\vec{a} = (1, a_1, a_2, ..., a_k)$, the weight vector is $\vec{x} = (x_0, x_1, x_2, ..., x_k)$, the output formula (3) of the perceptron is the result of thresholding.

$$O(\vec{a}) = \begin{cases} 1 \sum_{n=1}^{k} x_n \cdot a_n \\ -1 \text{else} \end{cases} \tag{3}$$

It can be seen from Figure 5 that each weight x_n input to the $\sum$ summation unit connection indicates the value of a_n in the line. $\sum$ represents the process of doing integration, -1 and 1 in the perceptron represent the two states of the neuron. It can be seen from formula (3) that when the problem is put into the k-dimensional space, the perceptron can achieve the goal of classifying samples in the hyperplane $\vec{x} \cdot \vec{a} = 0$. Among them, the output value of one side of the hyperplane is 1, and the other side is -1. The process of sample testing is to adjust the weight of $x_0, x_1, x_2, ..., x_k$, so that the final output of the sensor is 1 or -1. However, the range of this kind of sensor is relatively fixed, which limits the ability of classification and processing to a certain extent. By generalizing it to a linear unit, the resulting sensor is shown in Figure 6:

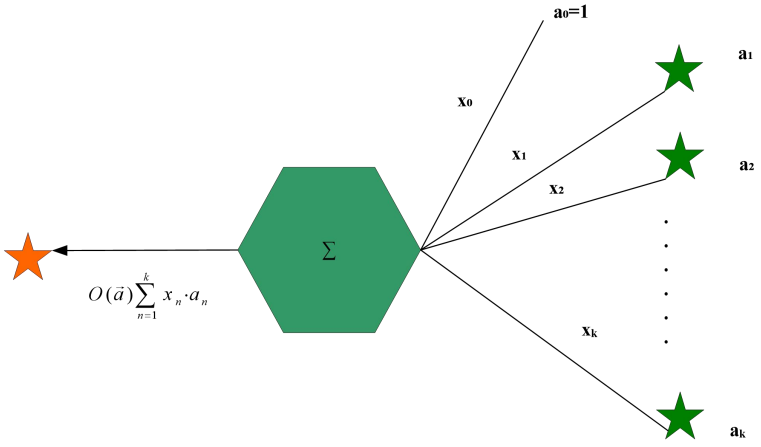

Figure 6. Simple Linear Unit Neuron Model

The output value of the model in Figure 6 is a linear combination formed by its k input values based on the weights, plus the bias term x_0, as shown in formula (4):

$$O(\vec{a}) = \sum_{n=1}^{k} x_n \cdot a_n + x_0 \tag{4}$$

In formula (4), let $a_0 = 1$, then it can be expressed as formula (5):

$$O(\vec{a}) = \sum_{n=1}^{k} x_n \cdot a_n = \vec{x} \cdot \vec{a} \tag{5}$$

In formula (5), the input vector $\vec{a} = (1, a_1, a_2 ..... a_k)$ and the weight vector $\vec{x} = (x_0, x_1, ...x_k)$ are used for training purposes similar to those of the perceptron. The main purpose is to continuously adjust the weight of $x_0, x_1, ...x_k$, so that the linear unit can achieve the purpose of accurate classification.

The derivation of the linear unit weight learning rule is for the purpose of learning. This requires defining a value to measure the error between the output of the artificial neural network and the true value under the weight $\vec{x}$. The common rule-based squared error criterion [20] is shown in formula (6):

$$E(\vec{x}) = \frac{1}{2} \sum_{g \in G} (t_g - o_g)^2 \tag{6}$$

In formula (6), G is the sample set; t_g is the target output value of the sample g , and the output is the real value. o_g is the actual value of the output after the sample has passed through the linear unit. $E(\vec{x})$ represents the difference between the actual value and the output value plus 0.5 times the final result of the summed value after the square operation. Therefore, it can be concluded that the result o_g depends only on the weight vector $\vec{x}$.

In order to determine the value of the weight vector $\vec{x}$, the gradient direction is obtained by calculating the partial derivative by borrowing the concept of gradient in advanced mathematics. Here it is set as $\nabla E(\vec{x})$, and the expression is as in formula (7):

$$\nabla E(\vec{x}) = [\frac{\partial E}{\partial x_0}, \frac{\partial E}{\partial x_1}, ... \frac{\partial E}{\partial x_k}], \tag{7}$$

The direction in which the value of formula E decreases the fastest in this paper uses a negative gradient, thus obtaining formula (8):

$$\bar{x} \leftarrow \bar{x} + \Delta \bar{x} \tag{8}$$

In formula (8), $\Delta \bar{x}$ is expressed in the form of formula (9):

$$\Delta \bar{x} = -\mu \nabla E(\vec{x}) \tag{9}$$

μ is the learning rate, which represents a constant; $\bar{x}$ represents the current search point, and $\Delta \bar{x}$ represents a displacement in the direction of the fastest descent. formulas (8) and (9) can be written in the form of components, as follows:

$$\bar{x}_n \leftarrow \bar{x}_n + \Delta \bar{x}_n \tag{10}$$

$$\Delta \bar{x}_n = -\mu \frac{\partial E}{\partial x_n} \tag{11}$$

According to the above formula, it can be concluded that the direction of the fastest decline can be achieved by proportionally changing each x_n in $\bar{x}$, and then calculate $\frac{\partial E}{\partial x_n}$, as shown in formula (12).

$$\frac{\partial E}{\partial x_n} = \frac{\partial}{\partial x_n} [\frac{1}{2} \sum_{g \in G} (t_g - o_g)^2] == \sum_{g \in G} (t_g - o_g)(-a_{ng}) \tag{12}$$

In formula (12), a_{ng} represents a component a_n in the sample g calculated by the eternal training training. In formula (7), a sample is set so that the target output value is constant and the partial derivative is 0, as in formula (13):

$$\frac{\partial t_g}{\partial x_n} = 0 \tag{13}$$

The output o_g is a function of x_n , for linear units, as in formula (14):

$$o_g = \sum_{n=0}^{k} x_n a_{ng} \tag{14}$$

When calculating that o_g is the partial derivative of x_n , the remaining components of x_n in x can be treated as constants, so that (15) is obtained:

$$\frac{\partial t_g}{\partial x_n} = a_{ng} \tag{15}$$

Through the above three formulas, the updated weight formula of gradient descent can be obtained, such as formula (16):

$$\Delta \bar{x}_n = \mu \sum_{g \in G} (t_g - o_g) a_{ng} \tag{16}$$

To sum up, this method is suitable for

calculating the weight update status according to the independent sample error increment. The modified weight update formula is as follows (17):

$$\Delta x_n = \mu(t-o)a_n \tag{17}$$

This method can be regarded as a function $E_g(\vec{x})$ that defines different errors for any independent sample g, as shown in formula (18):

$$E_g(\vec{x}) = \frac{1}{2}(t_g - o_g)^2 \tag{18}$$

4. Experiment and Biomechanical Characteristics of Taekwondo Horizontal Kick Technique

4.1 Scheme Design of Biomechanical Characteristics of Taekwondo Horizontal Kick Technique

Taekwondo's horizontal kick involves three technical phases: raising the knee and turning the hip, kicking and hitting, and closing the leg [21]. This paper defines one of them, the stage of raising the knee and turning the hip, as the action that begins when the leg is lifted off the ground by a lateral kick and ends when the knee joint angle reaches its minimum value. This paper defines the kicking step as the point at which the taekwondo practitioner completes the behaviour of raising the knee and turning the hip, stopping the angle of the knee joint of the leg from the smallest to the largest. The stage of leg retraction is described in this paper as occurring when the athlete has finished kicking and hitting, allowing the calf to relax until the leg touches the ground while the angle of the knee joint reaches its maximum value.

Now, the top three male and female players in an Asian country's urban competition, namely the champion, the second runner-up and the third runner-up, are used for the design of the biometric analysis in this paper. Among them, A, B, C are male athlete, X, Y, Z are female athlete, and their basic personal information is shown in Table 1.

Table 1. Specific Conditions of Athletes

Name	Gender	Height	Weight	Age	Training years
A	Male	183cm	63kg	19	6
B	Male	186cm	60kg	21	6
C	Male	178cm	58kg	20	7
X	Female	170cm	56kg	19	5
Y	Female	180cm	66kg	18	4
Z	Female	174cm	61kg	18	5

As shown in Table 1, the subjects of this experiment are three outstanding male taekwondo athletes and three outstanding female taekwondo athletes. The overall age is about 19 years old, and the average training period is about 5-6 years.

(1) Time characteristics of each stage

Taekwondo athletes perform horizontal kicks faster and score higher. Therefore, by analyzing the time of different taekwondo athletes completing the horizontal kick in different sports stages, the proportion of time distribution in each stage can be observed, which has practical significance for evaluating the rationality of athletes' time mastering rhythm and technical application. Table 2 shows the parameters such as segmented time and total time spent by the experimental subjects in different stages when performing the horizontal kick technique.

Table 2. Time Characteristics of Each Stage of Horizontal Kick Technical Action (Unit: s)

Name	Knee raise and hip turn	Kick	Retract the legs	total time
A	0.21	0.09	0.27	0.57
B	0.19	0.09	0.26	0.54
C	0.19	0.09	0.25	0.53
X	0.23	0.09	0.25	0.57
Y	0.21	0.09	0.26	0.56
Z	0.23	0.09	0.27	0.59
Mean	0.21±0.02	0.09±0.00	0.26±0.01	0.56±0.03
proporti	0.38	0.16	0.46	100

(2) Angle characteristics of joints at each stage

According to the observation of the research subjects in the experiment, all 6 test subjects have the right leg as the attacking leg. This article takes the moment when the right leg leaves the ground as the starting time, and divides the horizontal kick technique into three time periods: raising the knee and turning the hip, kicking and closing the leg. Table 3 shows the angle changes of the hip, knee and ankle joints in the right swinging kick of the six taekwondo athletes.

(3) Characteristics of speed change at each stage

Taekwondo athletes will go through three stages of raising the knee and turning the hip, kicking the leg and closing the leg in the horizontal kick technique. The different values of joint velocity at different stages reflect the

kinematic characteristics of athletes. Now this paper converts the hip joint change characteristics of the test object into a comparative line chart of male and female athletes, as shown in Figure 7.

Table 3. Statistics of the Hip, Knee and Ankle Angle Characteristics Of The Swing Leg of the Right Leg

Name	Hip joint			Knee joint			Ankle joint		
	Start	Kick	Retract the legs	Start	Kick	Retract the legs	Start	Kick	Retract the legs
A	173.5	101.4	111.2	152.8	132.8	154.2	134.5	146.1	150.9
B	169.5	100.8	106.5	159.3	135.4	158.9	158.6	143.8	159.8
C	168.6	112.5	115.5	155.4	124.6	146.3	127.4	143.9	148.4
X	172.4	132.4	134.5	143.5	138.1	159.1	126.5	152.4	153.4
Y	163.5	99.7	105.3	156.4	131.5	150.4	132.5	152.3	160.1
Z	164.8	95.4	99.4	157.2	119.6	142.1	133.4	157.2	152.3
Mean	168.7	107.0	112.1	154.1	130.3	151.8	135.5	149.3	154.2

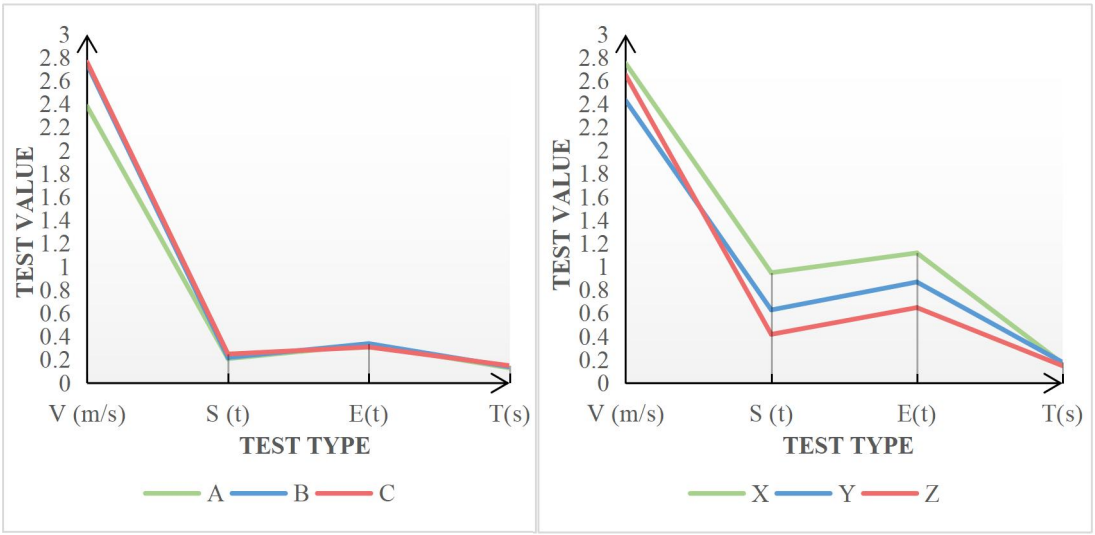

Figure 7. Comparison of Hip Changes in Male and Female Athletes

When a taekwondo athlete performs a horizontal kick and kicks the right leg, the knee joint changes from flexion to extension. Now, the six athletes are observed by gender to compare T1 and T2. Then the speed change characteristics of the knee joint of the right swing leg in the kicking stage are shown in Figure 8:

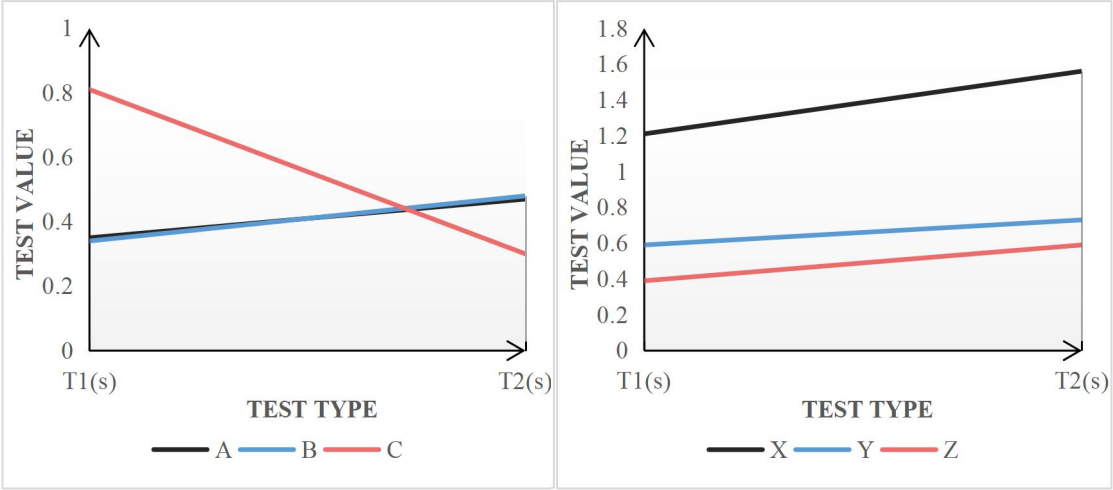

Figure 8. Comparison of Changes in Knee Joint Velocity Between Male and Female Athletes

The movement of the ankle joint is the end link in the kicking process, and the key link is the change of speed. The specific data are shown in Table 4.

Table 4. Characteristics of Changes in Ankle Joint Velocity During Kicking and Striking

Name	V_1(m/s)	T_1(s)	V_2(m/s)	T_2(s)	T_2-T_1
A	9.33	0.98	2.32	1.12	0.14
B	9.24	1.21	2.13	1.32	0.11
C	9.56	1.35	1.98	1.55	0.20
X	9.58	1.02	2.66	1.21	0.19
Y	9.39	1.12	2.34	1.34	0.22
Z	9.41	1.59	2.47	1.75	0.16
Mean	9.42	1.21	2.32	1.38	0.17

4.2 Biomechanical Characteristics of Taekwondo Horizontal Kick Technique

Since Taekwondo itself is a popular competitive sport, there are many athletes and enthusiasts participating in this sport, but Taekwondo itself originated in Asia. Therefore, the research object of this paper is to refer to the athletes of an Asian Taekwondo city competition. It selected the top three male athletes and the top three female athletes respectively. Table 1 is the basic information of the experimental subjects. The average age of these athletes is 19 years old, and the average training period is 5 years.

According to the observation in Table 2, when the athletes complete the horizontal kick technical action, the time proportion of each link is 38% in the starting stage of raising the knee and turning the hip, 16% in the stage of raising the leg and hitting, and 45% in the stage of closing the leg. According to the score of most horizontal kick technical movements, in the starting phase, the shorter the time spent raising the knee and turning the hip, the less time is left for the opponent to react. Therefore, the faster the athlete raises the knee and turns the hip during the competition, the better the sports effect can be achieved, and the easier it is to gain the initiative of the competition. In the stage of kicking and hitting, the athletes controlled the time to 0.09 seconds, indicating that the athletes paid great attention to the time of their kicking and hitting. The speed is fast, the center of gravity is easily unstable, and it is easy to reduce the strike force. The speed is slow, which can improve the striking power, but it is easy to be detected by the opponent and misses the best time to attack. It requires athletes and coaches to constantly explore in their usual training and daily teaching. In the leg retraction stage, the speed of the leg retraction affects the athlete's tendency to further attack. According to the training principles of taekwondo, athletes must shorten the time to close their legs and return to the defense in time to have a greater advantage in the game.

According to Table 3, in the attacking process with the right leg as the attacking leg, the change trend of the angle of the hip joint is: increase - decrease - increase again.It's all about increasing the hitting power more effectively.

It can be seen from Table 4 that Taekwondo athletes increase their speed in the starting phase, which lays the foundation for the subsequent joint speed. The athlete's speed of starting and turning the hip is faster, the action omen is small, the action is concealed, and it is not easy to be detected by the opponent. Therefore, in daily training, the athlete's various techniques and speed exercises should be strengthened to improve the hitting power of the legs.

When a taekwondo athlete performs the kick solution, the knee is flexed and then extended. This requires that the athlete's leg swing must be fast, so that the speed and power of the kick are in place. It can be seen from Table 4 and Table 5 that when the maximum velocity V1 of the knee joint appears, it is after the peak of the hip joint. It shows that the process of performing the horizontal kick technical action of Taekwondo is to rotate the hip joint while driving the knee joint to complete the overall action. As shown in Figure 8, the comparison between T2 and T1 shows that the athlete's leg swing speed gradually decreases, but the difference is not very obvious.

The movement of the ankle joint is the final link in the entire kick and strike process. According to Table 4, the speed of the athlete for the second time is significantly lower than that for the first time, and the average value of the two times is not particularly large. It shows that in kicking, time control is very important. In the process of horizontal kick technical action, paying attention to speed cannot effectively bring threats to the opponent. If the time is too long, it is easy to expose its own flaws.

4.3 Biomechanical Feature Model of Taekwondo Horizontal Kick Technique Based on Machine Learning Algorithm

The analysis model based on artificial neural

network designed in this paper is divided into three layers, namely input layer, output layer and hidden layer [22]. There are three neurons in the input layer, which represent the three stages of taekwondo horizontal kick technical movements. There is one neuron in the hidden layer, which is used for computation. The output layer has three neurons, representing action classification. Usually, as the number of hidden layers increases, the weights of the neural network will increase, and the training process will be faster and more efficient, but on the other hand, overfitting will occur [23]. Based on the above considerations, the neural network model established in this paper is a single layer, and the structure diagram is as follows:

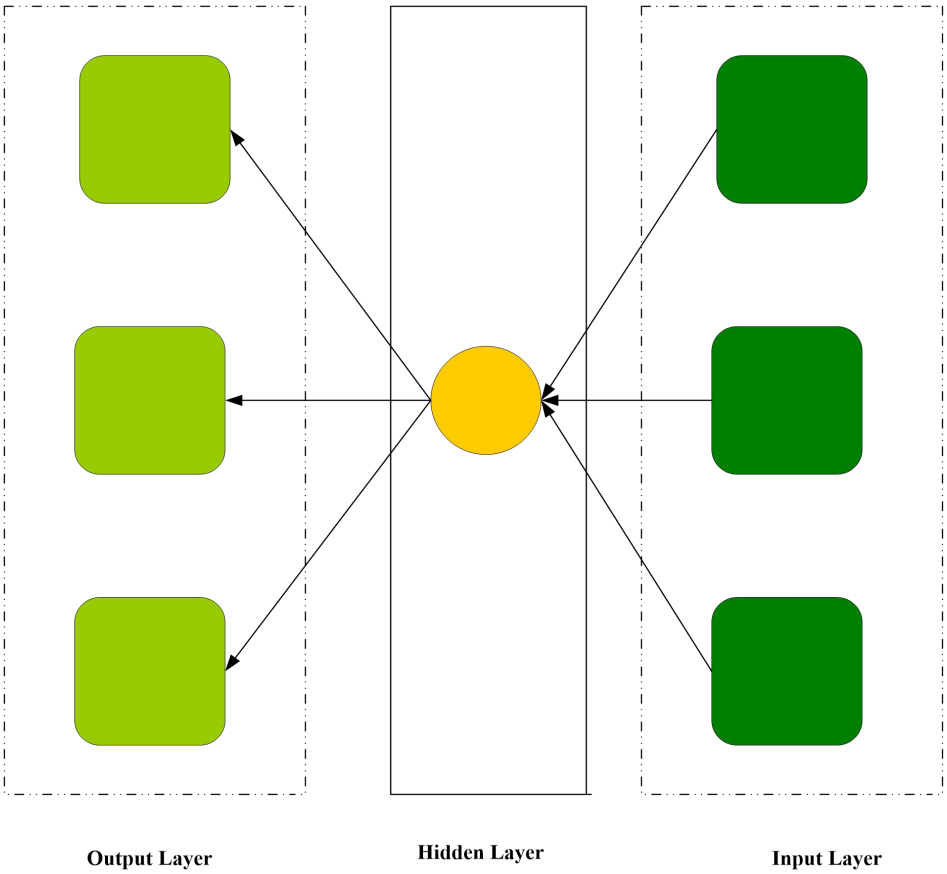

Figure 9. Neural Network Analysis Model Structure Diagram

As shown in Figure 9, each layer of neurons will feed back the result to the next layer, and obtain the final result in the output layer. According to the training process of the neural network algorithm in 3.2, this paper selects 5-10 pictures of the three stages of the horizontal kick action of the six athletes for testing. As shown in Table 5, the recognition rate reaches more than 75%, and the result is good. Therefore, the model meets the prediction requirements of this paper.

Table 5. Results after Three Stages Were Measured Separately

Action	Number of experimental images	Accurately identify the quantity	Recognition rate
Knee raise and hip turn	45	34	75.6%
Kick	53	42	79%
Retract the legs	60	46	76.7%

5. Discussion

This paper is devoted to the study of machine learning algorithm technology based on artificial neural network algorithm, and it is applied to the analysis of biomechanical characteristics of taekwondo horizontal kick technique. This is not only a further expansion of the application of machine learning algorithms, but also a new attempt to analyze the biomechanical characteristics of taekwondo

athletes' horizontal kick technical movements.By analyzing the biomechanical characteristics of some taekwondo athletes' lateral kicks, the research potential of artificial neural network algorithm, a complex measurement system tool, in biomechanical characteristics is explored. In addition, on the basis of in-depth research on the existing machine learning algorithms in the world, it improves the artificial neural network algorithm. Combining it with the biomechanical characteristics of the horizontal kick technical movement makes the new algorithm suitable for analyzing the biomechanical characteristics of the horizontal kick movement. For the research of machine learning algorithm, this paper starts from the basic artificial neural network algorithm and analyzes the operation mode of the algorithm. This paper makes improvements, which successfully combines the improved artificial neural network algorithm with the analysis of the biomechanical characteristics of the lateral kick action to obtain the optimal solution of the problem [24]. This paper uses the improved model to get the final result in the experimental analysis stage, and analyzes it in terms of practical significance. The results obtained are in line with reality.

Through the analysis of this case, it shows that the analysis of biomechanical characteristics of taekwondo athletes' horizontal kick technique based on machine learning algorithm is more scientific than the results obtained by traditional methods. Measurers can use artificial neural networks for analysis or other algorithms for biomechanical analysis. At the same time, the algorithm can be optimized and combined, which can greatly improve the accuracy of monitoring. In the specific experimental process, the researchers choose the appropriate algorithm to optimize the combination according to the actual situation, so as to obtain the best results.

This article analyzes the body data of a Taekwondo athlete in a city competition in an Asian country. It first obtained the relevant data of six athletes in the competition through data investigation, and used artificial neural network algorithm to analyze the athletes' athletic qualities. Through data comparison and further calculation of the algorithm, this paper concludes that it is more advantageous to use the machine learning algorithm to analyze the biomechanical characteristics of taekwondo athletes' horizontal kick technical movements. The data also makes more realistic conclusions.

6. Conclusion

Through the research and analysis of this case, this paper draws the following conclusions: In general, the biometric analysis of the horizontal kick technique of taekwondo athletes generally uses thermal measurement tools for data collection. This paper is based on the perspective of machine learning algorithm to perform biometric analysis of horizontal kick technical movements. Through experiments, it can be seen that the biomechanical characteristics of taekwondo horizontal kick technical movements are three stages: raising the knee and turning the hip, kicking and hitting and retracting the leg. They account for 38%, 16%, and 46% respectively, and the artificial neural network is used to measure, and the accurate value reaches more than 75%. In the process of taekwondo confrontation, the horizontal kick technique is used more frequently, which is easy to cause knee injury. Therefore, taekwondo athletes need to exercise their physique well and understand the techniques of protecting the knee joint, so as to perform stably on the field. In order to increase an athlete's advantage on the field, the athlete needs to increase the rotation effect in the taekwondo competition. It includes increasing the muscle torque and reducing the rotational inertia. To sum up, in Taekwondo competition, athletes should make full use of the mechanical characteristics of muscles, pay attention to the law of center of gravity movement, and use them flexibly.

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