

# Rationality evaluation of batting action of table tennis players based on support vector machine model

Yong Wang<sup>1</sup>

## Abstract

With the rapid development of Internet technology and the continuous progress of society, machine learning, an artificial intelligence science, plays an increasingly important role in social production, scientific research and daily life. As a classic algorithm in machine learning, support vector machine has developed rapidly based on its unique advantages in small sample, nonlinear and high-dimensional pattern recognition. Table tennis is a sport with fast speed, strong rotation and high requirements for landing. The five elements of "strength, speed, rotation, landing and arc" constitute the basis of table tennis. In the training of young people, basic skills training should be done solidly. Therefore, this paper conducts corresponding research and analysis on table tennis hitting action based on support vector machine model. This paper combines the support vector machine model to study and analyze it. After the research in this paper, it can be seen that the vector machine model can have a certain impact on the table tennis action, and the impact is as high as 67.45%. The research in this paper lays a foundation for future research on table tennis strokes.

**Keywords:** Support vector machine model; juvenile table tennis player hitting action; Ball-hitting motion orientation model.

## 1. Introduction

The study of effective multi-attribute decision-making methods has important theoretical significance and practical value. After years of research and exploration, people have proposed a variety of decision-making methods. The key process to solve the multi-attribute decision-making problem is to obtain the decision maker's preference structure information, multi-attribute decision-making Utility function is a commonly used method to solve such problems. With the increasing technical level of table tennis, the qualitative leap and the increase in quantity, the requirements for the standardization, accuracy and detail of the batting action are getting higher and higher. Only with a precise batting action structure, can you achieve a higher hit rate and return your ideal batting quality, angle, speed, power and rhythm. Support vector machine is a data classification, pattern recognition and regression analysis model under supervised learning mode.

It has strong mathematical foundation and theoretical support. At present, support vector machine classification technology has been widely used in machine learning, pattern recognition, pattern classification, computer vision, industrial engineering applications, aviation applications and other fields, and its classification effect is considerable. For example, in the field of text detection and recognition, for text documents, mainly for handwritten text, it can realize text keywords and special meaning phrases. It has specific analysis and research for different languages; in the field of human body part recognition, it can effectively identify palms, ears, faces and facial expressions (Wang et al., 2008). Support vector

machine has strong learning ability and generalization performance, can better solve problems such as small samples, high dimensionality, nonlinearity, local minima, etc., and can effectively perform classification, regression, density estimation, etc. Because of these advantages, Support vector machine has become a research hotspot in the field of machine learning. At present, support vector machine has been successfully applied to three-dimensional object recognition, time series analysis, automatic text classification, remote sensing image analysis, face detection, handwritten digit recognition, protein structure prediction, etc. in many ways. Machine learning has achieved great success in recent years. As the core of artificial intelligence and neural computing, it has played a leading role in the development of science and technology. Its application has spread to various branches of artificial intelligence, such as expert systems, automatic reasoning, natural language understanding, pattern recognition, computer vision, intelligent robots and other fields (Song & Li, 2007). Although table tennis did not originate from China, due to China's outstanding achievements in the field of table tennis, table tennis is also known as China's national ball and has always been a first-class existence in the table tennis field. Table tennis is a sport with fast speed, strong rotation and high requirements for landing. The five elements of "strength, speed, rotation, landing and arc" constitute the basis of table tennis. Under the background of big data ecology, with the explosive growth of heterogeneous and heterogeneous scientific and technological documents, the complex and diverse data tests the ability of scientific researchers to acquire knowledge at different levels such as high capacity, diversity and high growth rate,

<sup>1</sup> College of physical education, Weifang University, Shandong Weifang, 261061, China.

\* Corresponding author: Yong Wang, E-mail: 20111013@wfu.edu.cn

and also provides countries and regions. challenges in the formulation and implementation of science and technology policies. A support vector machine is a machine learning method based on the principle of structural risk minimization. Its algorithm is a convex quadratic optimization problem, so that the solution found by the algorithm is a global optimal solution, which can better solve practical problems such as small samples, nonlinearity, dimensionality disaster, and local minimum, and overcomes the convergence of neural network algorithms. It is slow and easy to fall into local minima. It has good promotion ability and has been widely used in pattern recognition, data mining, remote sensing image analysis and network security. According to the needs of the national table tennis team, the training mode of table tennis players has been changed from specialization to "combination of sports and education", so that the cultural special projects of young athletes can develop in an all-round way, so as to prepare more outstanding talents with both political integrity and ability for the national team. (Ding & Qi, 2012). The Chinese table tennis team is very strong and has always been in the leading position in the world. However, in recent years, table tennis players have been injured. The direct pursuit of our country directly poses a threat to our country's table tennis team. In the game of table tennis players, whether each ball can be scored and whether or not the game can be won is directly related to the quality of the player's hitting.

In this paper, the corresponding research methods are used to study and analyze it. In the research of support vector model, the corresponding model and algorithm formula are established to analyze and study it. In the study of table tennis players, a corresponding data graph is established to study and analyze them.

The blaze new trails of this Sheet:

In the article, the support vector model is combined to carry out the corresponding research and analysis on table tennis players.

In this paper, the batting action is studied by vector machine model.

## 2. Related work

At present, the international community has carried out extensive research on the detection of scientific research frontiers and achieved rich results, but there are still certain shortcomings: for example, the use of traditional citation analysis and other bibliometric methods cannot overcome the time-lag defect, and the frontiers in the future There are many problems such as insufficient time series analysis and forecasting.

Therefore, effectively mining the forward-looking topic information in the text content and constructing a forecasting model for the development trend of the frontier topics become the key to the next research. There are many table tennis techniques and different styles of play, but they all have one thing in common in the action structure, that is, each complete action is

composed of three stages: lead-in action, hitting action and swing-reduction action. Generally speaking, the action structure refers to the process of completing the action. Each hitting action must go through the steps of selecting position, leading the racket, swinging the racket, touching the ball, following the swing and restoring. The structure of the batting action, different batting action structures will have different effects on the batting effect. In view of the limitations of a single support vector machine, targeted optimization of the support vector machine is the best solution. The structure of multi-attribute utility functions is complex, and it is generally difficult to set their values. Therefore, when the decision maker's preference structure satisfies certain constraints (such as the independence of attributes, the utility function of each attribute is linear, etc.), Decomposes multi-attribute utility functions into additive, multiplicative, or quasi-additive forms of single-attribute utility functions.

In the study, Lu N, Wu B L, Liu Y believed that the core part of the human body is the key link connecting the upper and lower limbs, and it is the premise of ensuring body balance and power transmission. The strength of this area directly affects the hitting effect (Lu, 2011). Table tennis is a net-parting confrontation sport that requires athletes to maintain a stable center of gravity and body balance during fast movements. A series of reforms by the ITTF since 2000 have had an impact on the speed, strength and rotation of the ball. To maintain the stability of the center of gravity and the trunk during quick offense and defense transitions, players need to use their core strength to ensure that. The power in the core area is in the middle of the whole chain of the body, which directly affects the transmission of power when hitting the ball. Peng X, Wang believes that in track and field, whether it is running, jumping or throwing, the starting point of force is not in the limbs of the body, but in the core area of the body. Most events in track and field are completed in an unstable state, and strong core strength can control the rotation of the body to maintain the stability of the body of track and field athletes (Peng & Wang, 2009). Wei Z, Yi Z, Sun J put forward a new test, the enhancement of the athlete's physical strength can improve the ball speed and speed of hitting the ball, and the improvement of physical fitness and body stability can enhance the accuracy of the hitting point (Zhong et al., 2018). Core strength training is a new type of training method in contemporary physical training. Since the research by scholars, its positive role in table tennis has been continuously highlighted. WangZhen, ShaoYuan-Hai, WuTie-Ru. Put forward targeted guidance to improve and perfect the daily technical movement training of table tennis players (Wang et al., 2013). However, there may be some differences between the batting action under the experimental conditions and the batting action in the actual game. In addition to the individual differences of different table tennis players, the

applicability of the targeted guidance proposed in this paper still needs to be Further correction and improvement in actual training. Wang W J, Guo H S proposed a direct multi-task Support Vector Machine. This method is similar to the multi-task support vector machine idea. The classifiers share a common representation among tasks, and each task will have a bias. At the same time, in order to eliminate the defect of Support Vector Machine's sensitivity to outliers, we propose a prime and biplane support vector quantization by weighting the distance from the class center to the hyperplane, and then extend the CTSVM to multi-tasking in the same way. We obtain our multi-task qualitative and biplane SVM (Wang & Guo, 2009) under the learning framework. Hai L I, Chun-Lai L I, Hou D Y proposed a non-parallel plane closest classifier called the generalized eigenvalue closest support vector machine (LI et al., 2010). Its principle is that each hyperplane is as close as possible to the sample points of one class and as far as possible from the sample points of another class, and then by solving two generalized eigenvalue decomposition problems, the eigenvector corresponding to the smallest eigenvalue is obtained as Two nonparallel classification hyperplanes.

### 3. Support Vector Model Research and Analysis

#### 3.1 Introduction and Research of Support Vector Model

Learning from reality is a very important ability of human beings. By analyzing known facts and summarizing laws, and then predicting facts that have not happened, this ability is called generalization ability. The generalization ability is also involved in machine learning problems. Researchers expect that the methods they propose can find the inherent relationship of the data by learning from the known data, so as to predict unknown things or factors. This is also the main content of the research in the field of machine learning. Data-based machine learning is an important aspect of modern intelligent technology. Research starts from observation data samples to find rules, and uses these rules to predict future data or unobservable data, including pattern recognition, neural networks, etc. Existing machine learning One of the common theoretical foundations of the methods is the asymptotic theory of statistics when the number of samples tends to infinity.

The existing learning methods are mostly based on this assumption. The purpose of machine learning is to estimate the dependence between the input and output of a system based on the given training samples, so that it can make as accurate predictions as possible for the unknown output. Support vector machine is a new machine learning method proposed by statistical learning theory. It is based on the principle of structural

risk minimization. It is the youngest content in statistical learning theory. It has strong learning ability and generalization performance. It can better solve the problems of small samples, high dimensionality, nonlinearity and local minima, and can effectively perform classification, regression and density estimation. The proposal of support vector machine is based on statistical learning theory and structural risk minimization criterion. Statistical learning theory avoids the limitation of sample size of classification model, and structural risk minimization criterion avoids model problems during model training (Liu et al., 2015; Wang & Zheng, 2015). In the background, the promotion of support vector machine technology and its ability to discriminate are strong. As shown in Figures 1 and 2.

The asymptotic theory of statistics, which deals with the behavior of statistical estimators as the number of samples tends to infinity, serves as a common theoretical foundation for many existing machine learning methods. These methods often rely on the assumption of having a large number of samples to make accurate predictions. Support Vector Machine (SVM) is a machine learning method introduced based on statistical learning theory and structural risk minimization. It is a relatively newer concept in statistical learning theory. SVM has shown strong learning ability and generalization performance, making it effective in solving problems related to small sample sizes, high dimensionality, nonlinearity, and local minima. SVM can be used for classification, regression, and density estimation tasks.

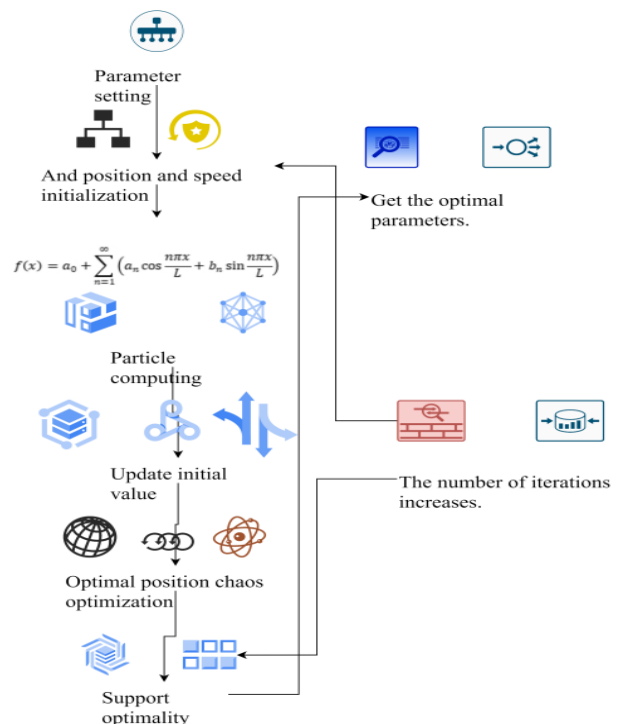


Figure 1 Support vector model parameter optimization process diagram

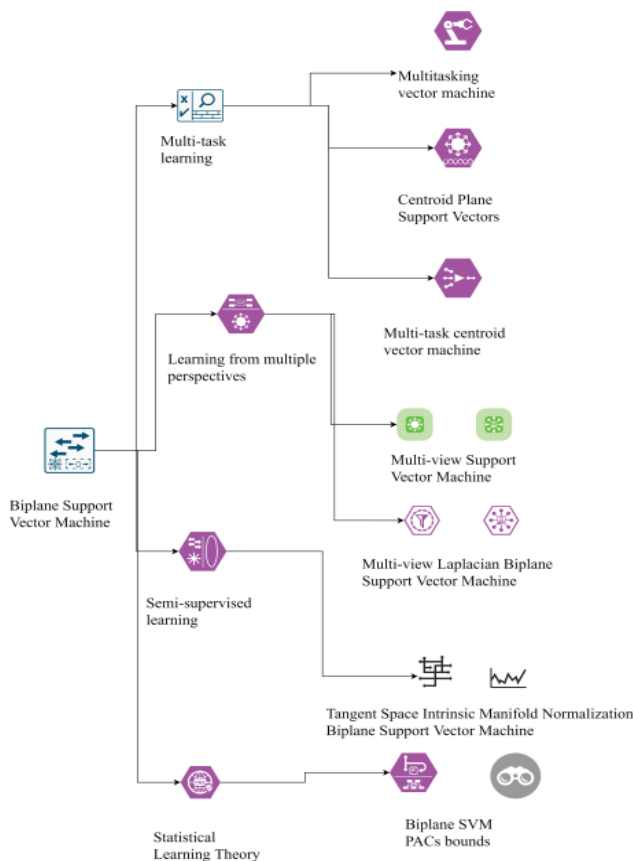


Figure 2 Support Vector Machine Model Diagram

### 3.2 Research on Support Vector Model Algorithm

Separation error minimization is one of the basic problems of machine learning. The original model of separation error minimization is analyzed, and it is found that its non-differentiability leads to computational difficulties. This chapter uses the maximal drop function to transform it into a differentiable convex programming, and then obtain the approximate optimal solution of the original problem. In the classification problem, the objective function is to minimize the two-norm of the weights, and at the same time, keep the points in each training set as far as possible from the support vectors on the side of their own categories. In the regression problem, the original objective function can continue to be maintained, but for the constraints, it cannot be like the classification problem, because the regression problem does not have categories. For regression problems, the goal of learning is to fit each point in the training set as closely as possible to a model. The original support vector machine problem is a slack variable, and its significance is to introduce outliers in the support vector. If classification is using a hyperplane to separate two sets of data, regression is fitting a hyperplane to known data. Since the same is to find an optimal hyperplane, the objective function is the same, but the constraints are different. With the massive growth of data at this stage, along with the complex structure in the data such as chaos, nonlinearity and other

characteristics, the complex data structure and a large amount of data make the computational cost significantly increase, and the development of support vector machines has encountered a bottleneck.

With the reduction of the dimension of the input data, the execution time of the classification is shortened, and the precision and recall parameters of the classification algorithm are also reduced with the number of classification errors. The support vector machine using the PCA method is more accurate. However, dimensionality reduction methods such as principal component analysis are not easy to have a reasonable realistic explanation for the new input variables after dimensionality reduction. In addition, researchers must manually set or adjust the threshold for cumulative interpretable variance (Cong et al., 2017; Shi & Zhu, 2012). In the basis of support vector, linear classifier and logistic regression are the basis, which can be studied and analyzed according to its data points, as shown in formula (1).

$$w^T X + b = 0 \tag{1}$$

According to the method research of linear classifier, the classical method is logistic regression, and its logistic regression formula is shown in formula (2).

$$g(\theta^T x) = \frac{1}{1 + e^{-\theta^x}} \tag{2}$$

The probability of the logistic function value is shown in formulas (3) and (4).

$$P(y = 1 | \theta) = g(\theta^T X) \tag{3}$$

$$P(y = 1 | \theta) = 1 - g(\theta^T X) \tag{4}$$

When its constant and partial derivative are constant values, it is shown in formulas (5) and (6).

$$\frac{\partial L}{\partial W} = 0 \Rightarrow w = \sum_{i=1}^m \alpha_i y_i x_i \tag{5}$$

$$\frac{\partial L}{\partial b} = 0 \Rightarrow \sum_{j=1}^n \alpha_j y_j = 0 \tag{6}$$

Support vector machine is a machine learning method based on the principle of structural risk minimization. Others can make full use of limited sample learning to obtain decision functions with high generalization ability. Then the discriminant functions in the case of two types of linear separability are shown in formulas (7) and (8).

$$f(x) = w \bullet \varphi(x) + b(1) \tag{7}$$

$$f(x) = w \bullet \varphi(x) + b = 0 \tag{8}$$

Assuming that there is a decision plane, it is shown in formulas (9) and (10).

$$f(x) = w \bullet \varphi(x) + b > 0, y_i = +1 \tag{9}$$

$$f(x) = w \bullet \varphi(x) + b < 0, y_i = -1 \tag{10}$$

Since there are many parameters that can be determined subjectively in the support vector machine,



such as which variables are selected as the input set and the selection of search space and hyperparameters, these parameters will affect the running results of the model. In order to solve this problem, a popular and widely used method is to use the biological intelligence optimization algorithm to determine the undetermined parameters of the model. The problem of solving the optimal classification surface of the support vector machine can be transformed into the solution of the quadratic function that maximizes the classification interval of data samples. The key is to obtain the target solution of the maximum classification interval. Taking two types of linearly separable data as an example, one The class data are represented by circles, and the other class data are represented by diamonds, which is the optimal classification line. SVM is a tool used for classification and regression (Wang, 2010; Ying, 2016). In the study, the corresponding data table was established to study and analyze it, as shown in Tables 1 and 2.

Table 1 Particle swarm parameter vector classification data table (1)

Group	Correct rate	Particle swarm algorithm
1	85.5	87.3
2	64.6	74.7
3	86.6	95.7
4	95.7	85.3

Table 2 Particle swarm parameter vector classification data table (2)

Group	Basic Particle Swarm Optimization	Chaotic particle swarm algorithm
5	96.7	85.7
6	85.7	96.5
7	74.7	76.4
8	85.7	78.3

It is based on the principle of VC dimension and structural risk minimization in statistical learning theory, and its principle is obtained by solving an optimization algorithm of convex quadratic programming based on maximizing the distance between the two classes. With the rapid development of today's Internet, data is growing rapidly, and at the same time, the internal structure of data has become more and more complex. The main manifestation of the complex data structure is that the data is irregular, which makes the model unable to fit the training data well and the computational cost is too high, resulting in unsatisfactory fitting and prediction results. For time series data, the main reasons for its complex internal structure include high noise ratio, superposition of sub-components with different periods, large amount of data, and data from different sources follow different internal logics.

The generalization ability of the learning machine is not only related to the empirical risk of the training process, but also related to the actual complexity of the learning machine. Based on this, it is proposed that the structural risk minimization induction principle, which

comprehensively considers the empirical risk and the complexity of the learning machine, is a way to achieve this. Principle of a general learning algorithm, it is well used in the study of classification problems (Lee & Lee, 2011; Padulo et al., 2016).

## 4. Research on the hitting action of table tennis players

### 4.1 Research on the electric action of table tennis hitting

The technical action structure before hitting the ball consists of four techniques: stance, lead racket, racket shape, and swing against the ball. Its technical links are simple, clear and clear. The technical action structure when hitting the ball is the most critical and complex technical link in the complete technical action structure. It mainly includes the influence of the relationship between the racket shape and the hitting part on the ball's line change and the relationship between the hitting time and the hitting point when hitting the ball. The important role of footwork movement and center of gravity exchange in hitting the ball, as well as the auxiliary role of the non-holding hand in hitting the ball constitute the technical action structure when hitting the ball. The technical action structure after hitting the ball is composed of swing restoration, center of gravity restoration, footwork restoration and instant relaxation of a certain part of the body. The forms of exercise are: one is the repetitive movement process of technical actions when the same technique is continuously used or tried. For example, consecutive forehands. The second is the movement process of transforming from one technology to another completely different technology. For example, after a forehand attack, it becomes a push technique. The forehand lead racket and the action of hitting the ball are both related and must be regular. The lead racket determines the size of the batting action. In general, the lead racket also serves what kind of hitting action is needed. From the importance of the force, the regularity of the lead racket and the hitting action is that the smaller the force is, the smaller the lead racket will be. The bigger it is, the bigger the mooring is. From the distance of the ball landing on the table, the rhythm of the lead and the batting action is that the closer the ball is to the platform, the lower the lead, and the farther away from the platform, the greater the lead. The relationship between the forehand and the wrist is interdependent. The so-called racket shape has two meanings, one refers to how the racket shape is fixed, and the other refers to how the racket angle is adjusted. Problems in these two aspects will affect the correct completion of the wrist movement.

For example, the dry racket shape is inclined outward or the underspin is strong and the low racket shape is too far forward. The former racket shape is not conducive to the forward and upward rotation of the

wrist. The latter racket shape "eats" the ball too thin, and the arc is not well formed, which directly affects batting percentage. Therefore, the role of the racket shape on the wrist is large, and the hand bowl also acts

on the racket shape (Bianchi et al., 2009; Fu et al., 2016). Therefore, a corresponding data graph was established in the study to analyze and study it, as shown in Figures 3, 4, and 5.

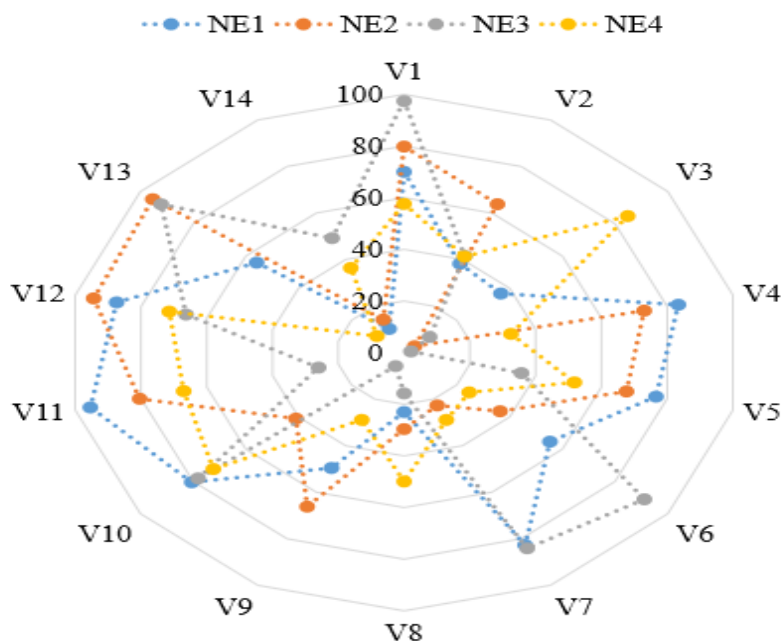


Figure 3 Analysis of the causes of table tennis action

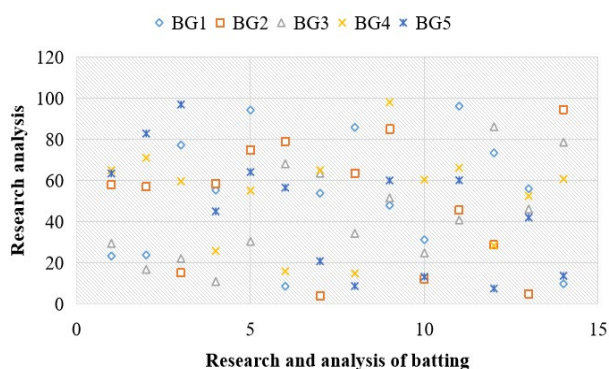


Figure 4 Table tennis impact analysis diagram

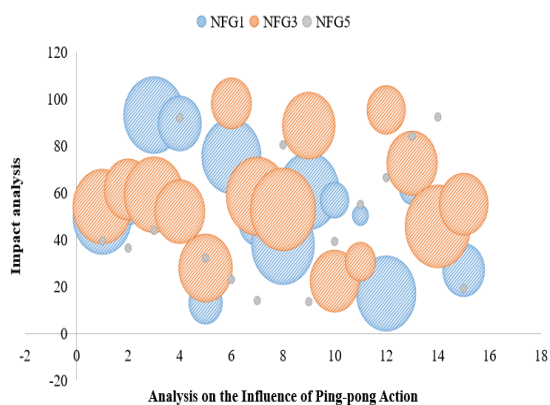


Figure 5 Analysis of Ping-pong's influence on hitting

It can be seen from Figure 5 that there are many reasons that affect the action of table tennis, and its influence will have a certain impact on the action, and its influence is as high as 64.35%. The relationship between hand strokes, graceful and racket shape is as follows: The thumb presses the racket, and the index finger is released, so that the racket shape can be fixed, which is conducive to expanding the hitting force and improving the positive force. Depending on the height of the ball, the thumb and index finger can adjust the height of the racket, which is beneficial to the accurate strike price only in the forehand, the pressing action of the thumb and the sweep. 1.

The top plate action on the back of the racket drives the rotation of the wrist, so that the racket produces frictional force on the ball, which is conducive to creating a reasonable and suitable hitting arc. The surface direction and the angle of the surface correspond to the conditional relationship when the sphere part is in contact with the ball. We divide the ball into points according to the clock, and the three parts are left, center and right. When hitting the ball, we use different types of techniques, the angle of the racket surface and the direction of the racket surface are different, and the points and parts where the racket touches the ball are different. Also, correspondingly different. The line of play will change when hitting the ball. The arm and elbow are an inseparable whole. The elbow should obey the natural motion of the forearm and not be "independent". The general rule is for the forearm to lead low and the elbow to follow. The

forearm is high and the elbow is high. The elbow is slightly lower than the forearm when following the forearm to lead the beat. There are two kinds of wrong elbow movements: one is picking up the elbow. The disadvantages of lifting the elbow have been explained earlier. Swing includes swing direction, swing range, swing speed and explosive power when swinging. The direction of the swing will determine the height of the ball's flight arc and the route of the ball's flight. The swing range will determine the length of the ball's flight arc. The swing speed will determine the forward flight speed of the ball. The explosive force of the swing will determine the force of the ball. . In the process of swinging, the different forms of swinging will produce two forces on the sphere, one is the impact force and the other is the frictional force (Lee & Lee, 2010).

#### 4.2 Research and analysis of table tennis players' hitting action

When we mention the core, we must think of the central part of the human body - the waist and abdomen and its surroundings. In fact, since the appearance of the term core strength training, there has been no definite standard for the definition of the concept of core area by experts and scholars around the world, and there has been controversy, but with the continuous maturity of this theory, its connotation is also constantly enriched. The core strength is gradually developed from the concept of core stability. The concept of core stability has been developed from the "two-column theory", "three-column theory" and spinal stability (Sanya system model) of the human spine studied by international scholars to the Chinese scholars. The four-subsystem mechanism model of core stability was gradually developed and completed, and then the concept of core strength came into being. Core strength first appeared in foreign countries, and it comes from core stability. The main purpose of core stability is to keep the spine in a neutral position at all times, while core strength is to generate lumbar motion based on the neutral position of the spine. During table tennis training, the coaches always hear words such as "turn the waist" and "use the waist to exert force", which is similar to the lumbar spine movement produced by core strength. When athletes play table tennis, they need to hit the ball with the upper limbs and the lower limbs to move quickly, and the stability of the trunk will be difficult to control, while the core strength can improve the stability of the trunk and promote the coordination of the trunk and the limbs. A series of reforms by the ITTF have brought table tennis into a new stage. The current table tennis game pays more attention to the stalemate of hitting the ball. Players from both sides have more rounds of hitting, and the physical fitness of the players is higher than before. The joint movement of the upper limbs is the last force in the process of the athlete's forehand underspin, and it is also one of the important parts of the entire forehand underspin process. Effects have a

direct impact. The changes of the joint angles of the upper limbs can more intuitively reflect the kinematic structure characteristics of the table tennis players in the process of forehand backspin. Therefore, a corresponding data graph was established in the study to study and analyze it, as shown in Figures 6 and 7.

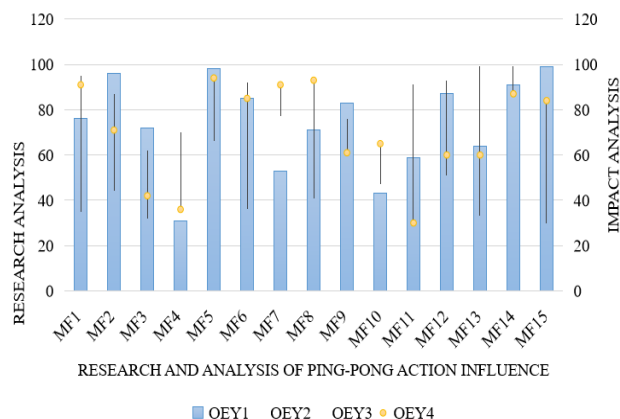


Figure 6 Research on the Influence of Ping-pong Action

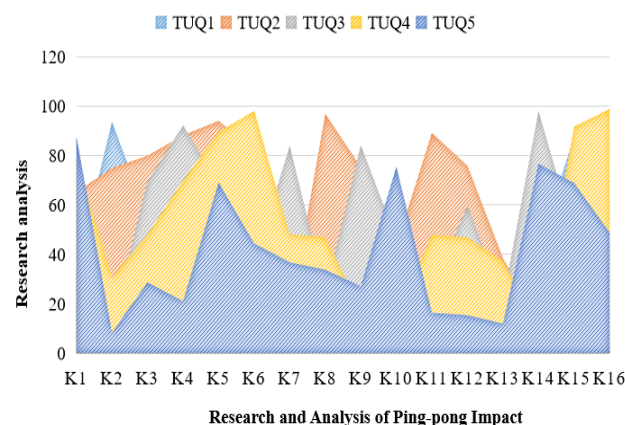


Figure 7 Ping-pong impact analysis data graph

It can be seen from Figure 7 that the vector machine model can have a certain impact on the ping-pong action, and the impact is as high as 67.45%. The angle of each joint of the body during the hitting process is an important index to evaluate the structural characteristics of the hitting action. This paper analyzes the differences in the changes of the joint angles in the lead-in stage, the swing stage and the recovery stage during the batting process of the fast and slow batting action types. The angle change of the shoulder joint of the fast-moving athletes is greater than that of the slow-moving athletes in the restoration stage, and the angle change of the elbow joints of the fast-moving athletes is greater than that of the slow-moving athletes in the lead-in stage, indicating that the fast-moving athletes are more likely to lead than the slow-moving athletes. The arm swing speed is fast in the shooting stage. In the hitting stage, the angle of shoulder joint of fast-moving athletes is smaller than that of slow-moving athletes, and the angle changes of

elbow and wrist joints are larger than those of slow-moving athletes. Slow athletes are more stretched and hit the ball farther from the body than slow athletes. Core strength training should be widely used in our country's traditional projects to make these projects to a higher level.

The attention to this new training method in the field of table tennis shows its advantages. The author's research has found that the completion of the forehand looping technique of table tennis players requires the participation and synergy of each muscle group of the athlete's body, and also requires the athlete to control the center of gravity of the body during the movement process. Core strength training improves the stability of table tennis technique. Core strength training has been widely used in competitive sports by scholars, which fully demonstrates the feasibility and effectiveness of core strength training. Core strength training in the study of tennis and badminton has a promotion effect on tennis serving speed, landing point, badminton's smashing power, and pace movement. This shows that core strength training is necessary for table tennis. It may also play a positive role in the serving speed, smashing power, control of the hitting point, and the movement of the athlete's pace in table tennis.

## 5. Conclusions

The classification accuracy of the support vector machine model depends to a large extent on the selection of its related parameters. By introducing the chaotic particle swarm optimization algorithm, this paper solves the blindness and randomness of the artificial selection of support vector machine parameters and ensures the accuracy of the classification results. Core strength training can

effectively improve the hitting quality of table tennis players, and the quality of hitting directly affects the performance of young players. Therefore, when formulating core strength training plans, coaches should have different focuses and pertinence, make timely adjustments according to individual differences of athletes, and grasp the exercise load to ensure that each athlete can experience the effect of core strength. At the same time, table tennis players are in the stage of physical and psychological growth. When the players have to face their studies and training at the same time, they are under great physical and psychological pressure. Therefore, coaches should pay attention to competition when conducting core strength training, and can join the competition to relieve the physical and mental pressure of athletes. In the process of juvenile table tennis players' forehand backspin, according to the difference of the three-stage duration of the player's batting action, the structure types of the athlete's forehand backspin are divided into two types: fast type and slow type. The study found that there is a significant correlation between the structural characteristics of the batting action and the batting effect. In the process of forehand backspin, fast players should relax the elbow joint in the lead-off stage, the center of gravity is slightly lowered during the lead-off, and the angular velocity changes of the ankle and knee joints should be slowed down. At the moment of hitting the ball, cooperate with the kicking and turning of the upper leg, pay attention to the rationality of the force sequence, and increase the training of lower body strength during training. In the process of forehand backspin, slow players should shorten the lead time and swing time, increase the swing speed during the hitting stage, speed up the center of gravity transition, reduce the range of motion, and increase the speed of the hitting action.

## Reference

- Bianchi, B., Galmonte, A., Siegal, M., Domini, F., Gherzil, A., & Agostini, T. (2009). How players detect the spin of the ball during the return of serve in table tennis. *Proceedings Book of the ITTF Sports Science Congress*,
- Cong, R., Wang, M., & Qi, J. (2017). Scoring Model Based on Support Vector Machine. *Mathematics in practice & theory*, 634(654), 5-74.
- Ding, S., & Qi, B. (2012). Research of granular support vector machine. *Artificial Intelligence Review*, 38, 1-7.
- Fu, F., Zhang, Y., Shao, S., Ren, J., Lake, M., & Gu, Y. (2016). Comparison of center of pressure trajectory characteristics in table tennis during topspin forehand loop between superior and intermediate players. *International Journal of Sports Science & Coaching*, 11(4), 559-565.
- Lee, Y.-S., & Lee, C.-H. (2010). Kinematic and Ground Reaction Force Analyses of the Forehand Counter Drive in Table Tennis. *Korean Journal of Sport Biomechanics*, 20(2), 155-165.
- Lee, Y.-s., & Lee, J.-h. (2011). Kinematic Analysis of the Backhand Power Drive in Table Tennis. *Journal of the Korean Association for Physical Education*, 20(4), 654-732.
- LI, H., LI, C.-L., & HOU, D.-Y. (2010). Analysis of Machine Learning Model Based on Support Vector Machine. *Journal of Jishou University (Natural Sciences Edition)*, 31(3), 39.
- Liu, Q., Ling, Z., & Zeng, X. A. (2015). Combination forecasting model based on grey model and support vector machine. *Journal of Guilin University of Electronic Technology*, 63(63), 64-434.
- Lu, N. (2011). Application of support vector machine model in load forecasting based on adaptive particle swarm optimization. *Power system protection and control*, 39(15).



- Padulo, J., Pizzolato, F., Tosi Rodrigues, S., Migliaccio, G. M., Attene, G., Curcio, R., & Zagatto, A. M. (2016). Task complexity reveals expertise of table tennis players. *J Sports Med Phys Fitness*, 56(1-2), 149-156.
- Peng, X., & Wang, Y. (2009). A geometric method for model selection in support vector machine. *Expert Systems with Applications*, 36(3), 5745-5749.
- Shi, J., & Zhu, M. (2012). An optimization model for forecasting based on grey system and support vector machine. *Journal of Shandong University(Engineering Science)*, 53(74), 35-783.
- Song, F., & Li, P. (2007). Nonlinear Internal Model Control Based on Support Vector Machine alpha-th-order Inverse System Method. *Acta Automatica Sinica*, 33(7), 778.
- Wang, Q. M., & Zheng, J. H. (2015). Study of network parameter model base on support vector machine. *Modern Electronics Technique*, 53(653), 63-745.
- Wang, W., & Guo, H. (2009). Granular support vector machine learning model. *J Shanxi University: Nat Sci Ed*, 32(4), 535-540.
- Wang, W., Men, C., & Lu, W. (2008). Online prediction model based on support vector machine. *Neurocomputing*, 71(4-6), 550-558.
- Wang, Z., Shao, Y.-H., & Wu, T.-R. (2013). A GA-based model selection for smooth twin parametric-margin support vector machine. *Pattern Recognition*, 46(8), 2267-2277.
- Wang, Z. A. J. (2010). Research on Multi-ball Training Methods of Teenage Table Tennis Players. *Journal of Changshu Institute of Technology*, 5(53), 74-733.
- Ying, L. I. (2016). Measurement and Analysis of sEMG on "Core Area" Muscle Group for Improving Table Tennis Players' Forehand Technique and Loop Drive Technique. *Journal of Hebei Normal University(Natural Science Edition)*, 63(653), 634-733.
- Zhong, W., Zhuang, Y., Sun, J., & Gu, J. (2018). A load prediction model for cloud computing using PSO-based weighted wavelet support vector machine. *Applied Intelligence*, 48, 4072-4083.