

Retraction

Retracted: Analysis of Characteristics of Tennis Singles Matches Based on 5G and Data Mining Technology

Security and Communication Networks

Received 12 December 2023; Accepted 12 December 2023; Published 13 December 2023

Copyright © 2023 Security and Communication Networks. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

This article has been retracted by Hindawi, as publisher, following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of systematic manipulation of the publication and peer-review process. We cannot, therefore, vouch for the reliability or integrity of this article.

Please note that this notice is intended solely to alert readers that the peer-review process of this article has been compromised.

Wiley and Hindawi regret that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

- [1] M. Li, Q. Li, Y. Li, Y. Cui, X. Zhao, and L. Guo, "Analysis of Characteristics of Tennis Singles Matches Based on 5G and Data Mining Technology," *Security and Communication Networks*, vol. 2021, Article ID 5549309, 9 pages, 2021.

Research Article

Analysis of Characteristics of Tennis Singles Matches Based on 5G and Data Mining Technology

Ming Li,¹ Qinsheng Li,¹ Yuening Li,² Yunkun Cui,¹ Xiufeng Zhao,¹ and Lei Guo^{1,3} 

¹Physical Education Department of Taishan University, Taian 271000, China

²English Department of Liaocheng University, Liaocheng 252000, China

³Physical Education Department of Shandong Technology and Business University, Yantai 264005, China

Correspondence should be addressed to Lei Guo; 201513325@sdtbu.edu.cn

Received 14 January 2021; Revised 25 January 2021; Accepted 22 February 2021; Published 2 March 2021

Academic Editor: Chin-Ling Chen

Copyright © 2021 Ming Li et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

The level of technical and tactical decision-making in a tennis game has a very important impact on the outcome of the game. How to discover the characteristics and rules of the game from a large amount of technical and tactical data, how to overcome the shortcomings of traditional statistical methods, and how to provide a scientific basis for correct decision-making are a top priority. Based on 5G and association analysis data mining theory, we established a data mining model for tennis technical offensive tactics and association rules and conducted specific case studies. It can calculate the maximization and distribution rate of certain technologies, also distinguish between the athlete's gain and loss rate and the spatial position on the track, and use artificial statistical methods to cause errors and subjective participation. This solution provides objective and scientific decision support for this problem and is used in the decision-making of the landing point in tennis match technology and tactics. Experimental simulation shows that the data mining technology analysis system used for regional tennis matches is more concise, efficient, and accurate than traditional movie analysis methods.

1. Introduction

Technique and tactics refer to the method of completing the technical action and the tactics and actions taken in the competition to win the victory over the opponent [1, 2]. Tina Miami, an expert in sports training in China, divides different sports groups into three levels: decisive, important, and basic, according to the different importance of techniques and tactics [3, 4].

The importance of technology and tactics in the project is a “decisive role” level. Because tennis is a kind of competitive project, the technical and tactical ability is the decisive factor of the tennis players' competitive ability, the foundation of improving the sports performance, and the key to winning the match [5, 6]. Decision-making is a kind of thinking activity that players often carry on in the competition; tennis competition cannot leave all kinds of technical and tactical decisions. Techniques and tactics are complex and changeable in tennis matches, players often make technical

and tactical choices and decisions based on their personal experience, and players' own knowledge background, competition experience, the level of comprehensive judgment on various kinds of information, and so forth [7, 8]. All will constrain the importance of decision-making. In recent years, with the development of tennis competition, the technique and tactics are more and more varied. It is more and more difficult to rely on individual ability to make a scientific decision on this kind of problem [9]. Using association analysis data mining theory and relying on the Weka data mining platform, a data mining analysis model of association rules between tennis technical and tactical hitting points and scores was established, and specific case studies were carried out to provide the technical and tactical points for tennis matches. Decision problems provide objective and scientific decision support.

Therefore, in order to help athletes and coaches master the rules of tennis competition and improve the scientific nature of technical and tactical decision-making, it is

necessary to establish a tennis technical and tactical decision support system. Data mining appeared in the last century [10, 11]. On this basis, Shanghai Institute of Physical Education, Shi Fu Ying, Liang Chongjin, and others creatively applied data mining technology and tennis technical and tactical decision-making and developed a netball technology and tactics data mining technology analysis system. Compared with the traditional techniques and tactics analysis methods, the data mining technology can more clearly describe and analyse the stroke position and route, the process, and the sequence of losing points [12, 13]. It can help the coach better grasp the general character and characteristics of players' techniques and tactics and provide reference and basis for the training and application of techniques and tactics in the future [14, 15].

The rest of this paper is organized as follows: Section 2 discusses the present situation of research on the technique and tactics of Chinese Women Tennis players, followed by the methods in Section 3. The experiment is discussed in Section 4. Section 5 shows the simulation experimental results, and Section 6 concludes the paper with a summary and future research directions.

2. The Present Situation of Research on the Technique and Tactics of Chinese Women Tennis Players

In recent years, with the increase of opportunities for domestic players to participate in the competition, the increasingly rich game video makes the statistics of the game techniques and tactics increase continuously. How to explore the characteristics of the excellent players' techniques and tactics from the rich data? Providing a scientific basis for coaches and athletes has become one of the most important problems in tennis theory research [16, 17].

2.1. The Connotation of Data Mining Technology. The use of data mining technology to analyse the characteristics and laws of athletes' skills and tactics can timely and accurately obtain and find more valuable information and rules to make up for the shortcomings of traditional statistical means. Therefore, tennis players must use data mining technology to assist their technical and tactical decisions [18, 19]. Data mining technology of characteristics of tennis singles matches is shown in Figure 1.

China's women's tennis is relatively late, and the gap with the world level is large. But in recent years, with the change in the guiding ideology of the General Administration and the hard training of coaches and athletes, the level of sports has improved the Olympic doubles champion and the breakthrough of the Li Na Grand Slam [20, 21]. However, there are still many problems, such as Chinese women athletes who never passed the women's singles first round before the Beijing Olympic Games. In the international tennis world, with more scientific factors being integrated into tennis training, the level of women's singles in various parts of the world has been greatly improved, the confrontation of the matches is becoming increasingly fierce,

and the use of techniques and tactics is more flexible and changeable [22, 23].

The gap between the poultry level players is narrowing day by day, and the technical level of the excellent athletes is similar. Although the technical factors of winning become more complicated, the physical ability has become the key to play the technology and win the competition. Most of the athletes in our country did not undergo systematic physical training during their adolescence and childhood, so they missed the sensitive period of the development of their sports' quality. Therefore, at the high level, the improvement of athletes was also greatly restricted [24, 25]. This has caused great difficulties for the display and maintenance of the technical level of our high-level tennis players. At the same time, the technical and tactical characteristics of athletes must be adapted to their own physical characteristics, in order to better ensure the display of sports technical level and the improvement of competition results. Therefore, it is urgent to find out the problem in the development of Chinese women's tennis by analysing the influencing factors in the competition, but it is difficult to achieve the ideal research effect only through the analysis of the data of several matches [26, 27].

2.2. The Role of Data Mining Technology. In addition, for a long time, the research on tennis match data in our country has been relatively small, and the existing research is mainly based on the comparative analysis of single technical indexes, so the systematic analysis of the various technical and tactical factors that affect the result of the match is even less [28, 29]. This has caused certain influence to discover the insufficiency in the women's tennis of our country, has affected the improvement of the technique of our country's women's tennis to a certain extent. Association analysis is a widely used method of data mining, which is widely used in the fields of business management, medical diagnosis, and data analysis [30, 31]. The basic purpose of association analysis is to mine hidden association nets or strong association rules between data. The methods of association analysis are abundant, and the common algorithms are smart algorithms and growth algorithms [32]. Tennis singles energy consumption model structure is shown in Figure 2.

The research focus of data mining technology is data mining algorithm, its application, and improvement. With the development of network technology and database technology in recent years, the mining of complex data has become the direction of data mining technology, and its application prospect is very broad [33]. At present, another research hotspot in this field is to solve a certain kind of data mining problems scientifically and effectively by comprehensive use of various algorithms [34, 35]. Sports technology, in short, is the method of accomplishing technical action, while the action and strategy used to defeat an opponent is a sport tactic. It is important to note that there are significant differences between the results of different events and the degree of technical and tactical dependence [36]. Tina Miami, an expert in sports training in China, divides different sports groups into three levels: decisive, important,

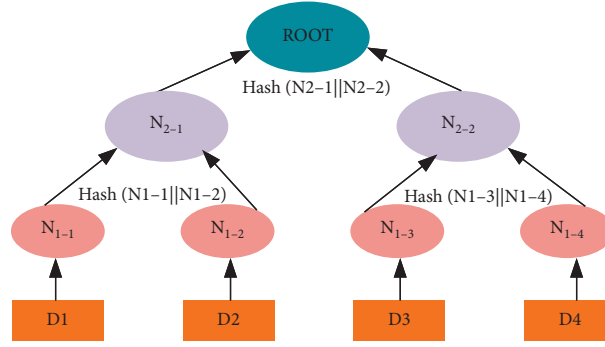


FIGURE 1: Data mining technology of characteristics of tennis singles matches.

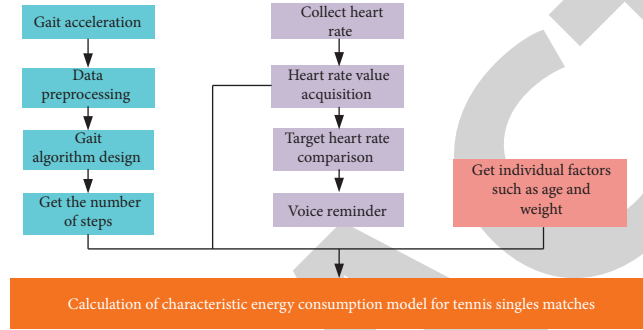


FIGURE 2: Tennis singles energy consumption model structure.

and basic, according to their different importance to each group.

3. Methods

The existing patterns, knowledge, and data relationships are found from many stored data. Extracting valuable information from many technical and tactical data and making scientific decisions on this basis are technical and tactical data mining [37, 38].

It should be noted that when using data mining technology to analyse techniques and tactics, we should take full account of the characteristics of the project, fully consider the characteristics of various algorithms, and select the best method of data mining to explore the pattern of technical and tactical application from the data information. Characteristics and laws of the huge technical and tactical information database are the basis and premise of using data mining to analyse techniques and tactics [39]:

$$CI = \frac{\lambda_{\max} - n}{n - 1}, \quad (1)$$

$$CR = \frac{CI}{RI} < 0.10.$$

In some sports which require high technical and tactical requirements, techniques and tactics are very important factors; the success and defeat of the competition often depend on the success or failure of the players' technical and tactical application:

$$M_i = \prod_{j=i}^n a_{ij}, i = 1, 2, \dots, n, \quad (2)$$

$$\bar{W}_i = \sqrt[n]{M_i}.$$

Therefore, exploring and summing up the characteristics and rules of technical and tactical application in this kind of events is an important way to improve athletes' competitive skill level and can provide the basis and reference for coaches, athletes' daily training, and technical and tactical decisions in competitions:

$$W_i = \frac{\bar{W}_i}{\sum_{j=1}^n \bar{W}_j}. \quad (3)$$

For a long time, the research of techniques and tactics in a competition is a very important research subject and content in sports scientific research [40, 41]:

$$\lambda_{\max} = \sum_{i=1}^n \frac{(AW)_i}{nW_i}. \quad (4)$$

Nowadays, human society has stepped into the era of big data. There are a lot of data around us, both in life and in work, but many people do not know how to use and develop these data:

$$\begin{cases} \sum_{i=1}^l (\alpha_i - \alpha_i^*) = 0, \\ \alpha_i, \alpha_i^* \in [0, C]. \end{cases} \quad (5)$$

In recent years, with the maturation of computer technology and the emergence of some new algorithms, it is possible to mine the technical and tactical data [42]. Data mining is the product of the combination of multidisciplinary technology and a new discipline.

$$\alpha_i [\varepsilon + \xi_i - y_i + w \cdot \varphi(x_i) + b] = 0. \quad (6)$$

$$b = \frac{1}{N_{NSV}} \left\{ \sum_{0 < \alpha_i < C} \left[y_i - \sum_{x_i \in SV} (\alpha_j - \alpha_j^*) \varphi(x_j) \cdot \varphi(x_i) - \varepsilon \right] + \sum_{0 < \alpha_i < C} \left[y_i - \sum_{x_i \in SV} (\alpha_j - \alpha_j^*) \varphi(x_j) \varphi(x_i) - \varepsilon \right] \right\}. \quad (7)$$

Therefore, a higher requirement is put forward for researchers to study shipping, which requires researchers to be familiar with the characteristics of sports items. It is the limitation of these conditions that limits the popularization of this method. In addition, the most suitable method in different sports needs to be further explored. The data mining module of tennis game technique and tactics is an important part and core module of the network ball technique and tactics data acquisition and intelligence analysis system. It consists of two parts, that is, the selection of analysis conditions and the results of analysis [43]. The former includes the comprehensive selection conditions, including the batter in the game, the range of analysis, and the limit of the number of shots. There are four parts of the system and focus, including the two parts, the service wheel or the delivery wheel. It is necessary to pay attention to the final continuity. The situation of the beat is summed up with the "other"; the limit of the number of shots mainly includes the preceding, the beat or the holding of three shots at any time period "at last"; and the data of the result of the ball game. The main points of attention include three aspects: hitting, serving, location, and hitting [44].

4. Experiment

The rules of technical and tactical application in sports competitions are restricted by many factors, which are difficult to explain by conventional methods. Therefore, it is very important to use scientific methods to systematically grasp the rules and regulations of technical and tactical application in competitions [45].

4.1. Analysis of the Rate of Gain and Loss of Service Wheel.

It is very difficult to determine the winning rules in a certain order, so more and more researchers consider the competition. From the current situation of research at home and abroad, it is considered that the dynamic self-organizing system of sports competition and the complex system of thinking that sports competition is dynamic are two kinds of canonical views [46]. The researchers who hold the former point of view hold that the disturbance in the dynamic system is always changing and the disturbance caused by the

It is to explore new knowledge rules and valuable information from data by using traditional analytical methods and complex algorithms. The algorithms mainly include decision tree, clustering, and genetic and neural network:

disturbance causes the system to be in an unbalanced state. At present, there is no good definition of disturbance in sports competition, but this disturbance breaks the original equilibrium state of the system [47]. In squash matches, for example, these disturbances can lead to an opponent's error or a favourable shooting position. With the development of information technology, people can describe a certain activity more and more scientifically and quantitatively, which makes it possible for people to make a quantitative decision. However, the increase of quantitative information also increases the complexity of decision-making. It is difficult to find the hidden laws in these data by a single statistical method, which is not conducive to scientific decision-making [48, 49].

4.2. Analysis of Distribution Rate of Serve Drop Point.

Therefore, how to find the laws from these data for scientific decision-making is a problem that needs to be studied and solved. Using the method of data mining to explore the characteristics of techniques and tactics in sports competitions can make up for the deficiency of the information reflected by traditional statistical means and then obtain and discover more valuable unknown information and rules. The effect diagram of delayed tennis singles data is shown in Figure 3.

It is an effective method to improve the technique and tactics decision level of tennis in our country. Therefore, it is necessary to use data mining to assist tennis technical and tactical decisions. Using the developed tennis techniques and tactics data acquisition software to collect the technical and tactical information of the players who need to make the decision analysis, the main technical and tactical indexes of the acquisition include the hitting point, the hitting position, and the hitting technique. A simulation effect diagram of tennis singles data is shown in Figure 4.

Based on the database of techniques and tactics and combined with the requirement of tennis technical and tactical decisions, the association rules algorithm is used to mine the pattern of technical and tactical information data, which can provide support for tennis game's technical and tactical decisions. Check and process the abnormal data in the database, such as deleting or modifying the default value. The original data extracted from the database is transformed

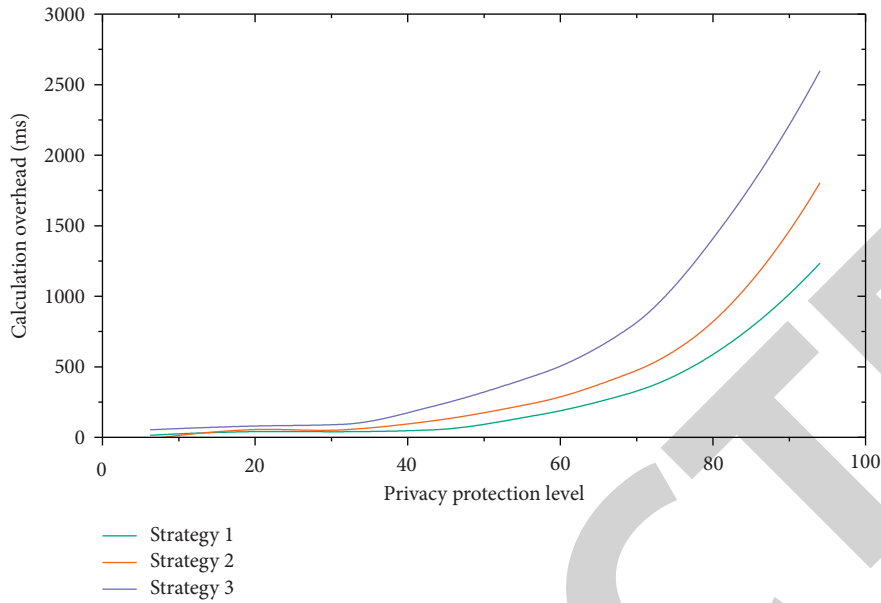


FIGURE 3: Effect diagram of delayed tennis singles data.

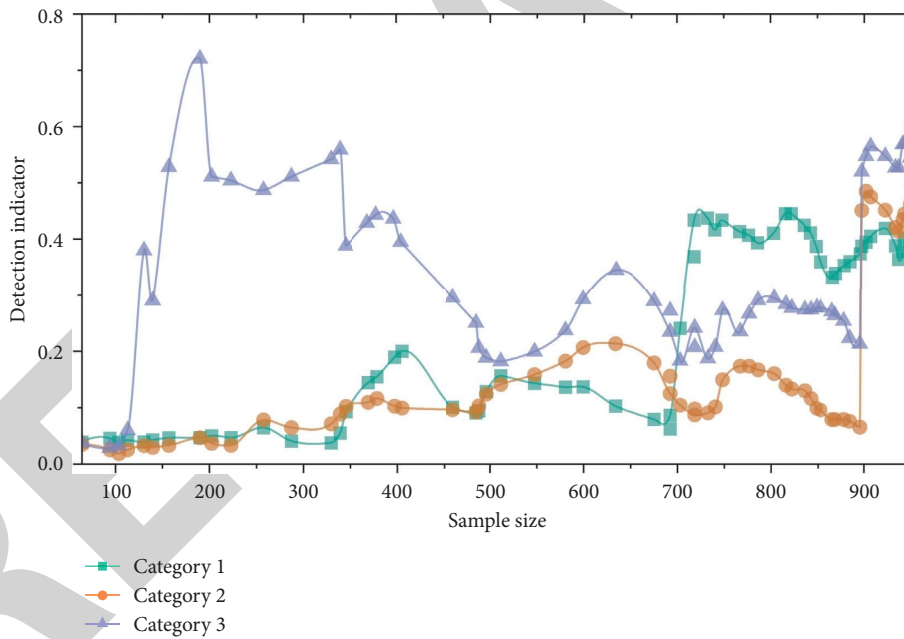


FIGURE 4: Simulation effect diagram of tennis singles data.

to make it consistent in data format, data type, and so on and meets the requirements of mining tools for data input. Considering the feature of the association rules algorithm, the frequent item sets are generated in the combination mode, the decision requirements of hitting point of a tennis ball are required in order, and it is associated with the effect of batting.

4.3. *The Analysis of the Distribution Rate and the Score of the Service Drop Point.* Therefore, using association rule data mining technology to mining the characteristics of tennis technical and tactical hitting point can mine and analyse the relationship between the hitting point and the score of the result of the match between the first two strokes of the serve wheel and the receiving wheel. It can also be used to analyse

the relationship between the final two strokes of each goal and the score of gain or loss. In view of the requirements of tennis serve rules, the information collection system encodes the landing area of the serve separately, so that the first three strokes have no repeat coding. Therefore, association rules can be used to analyse the impact point and score of the first three strokes.

Competitive sports are an important part of sports in our country. With the development of our country's economy, the living level of the people is gradually improved, and the more people pay attention to it. To win the competition is the goal of the athletic sports competition. The victory of the competition is the result of the athletes' hard training and the contribution of science and technology to the scientific research of the competition. Scientific researchers have scientifically studied the factors that affect the success of sports competitions from the aspects of their physical function, psychology, sports techniques, tactics, injuries, and rehabilitation, to provide scientific and technological support from various angles for winning sports competitions and improve the odds of winning a match.

5. Results

It is a very important link for athletes to win the competition by scientifically studying competitive sports competition and providing scientific decision support for all aspects of sports competition. Therefore, strengthening the scientific research of competitive sports is an important aspect to improve the level of competitive sports. Tennis has been widely spread all over the world. Competitive tennis is also popular in the international arena. Various competitions are held frequently. The thesis uses different model algorithms to analyse the tennis singles data and get different conclusions. Simulation test results of tennis singles efficiency are shown in Figure 5.

The most important competitions are mainly the US Open, the Australian Open, and the Wimbledon Tennis Open. The French Open and many major competitions are also the events of the Olympic Games and the Asian Games. Netball and competition have become world competitions and sports events. In China, the main tennis events are the Chinese Open Tennis, Shanghai Masters, and so on. At present, competitive tennis has been treated as an important project in the development of competitive sports in China. Therefore, it is an important way to improve the competitive level of tennis in China by strengthening the scientific research on tennis competition, probing into the winning factors and rules of tennis competition, and providing

scientific and technological support for competitive tennis. Test efficiency analysis of tennis singles match data under different methods is shown in Figure 6.

Sports technique is the method of completing sports action; tactics refer to the tactics and actions taken in a game to defeat an opponent or show the expected result of the match. Technique and tactics are one of the main factors that affect the result of sports competition. It divided the importance of techniques and tactics into three levels for each project group, namely, decisive role, importance role, and basic role, and recognized the role of technology and tactics in the netting antagonism project as a "decisive role" level. It is shown that this kind of project to the technical and tactical requirements is very high. This shows that the success of tennis players in the use of techniques and tactics is often the decisive factor. Therefore, it is an important way to improve the competitive level of tennis in China to study the technical and tactical rules of competitive tennis competition and provide scientific support for the daily technical and tactical training and decision-making of competitive tennis.

6. Discussion

With the increasing number of events in which Chinese athletes participate in international high-level competitions, the accumulation of competition video data is also increasingly abundant, and the accumulation of technical and tactical data collected is increasing. How to find laws from these data for scientific decision-making is a problem that needs to be studied and solved.

Using the method of data mining to explore the characteristics of techniques and tactics in athletes' competitions can make up for the deficiency of the information reflected by traditional statistical means and then obtain and discover more valuable unknown information and laws. It is an effective method in improving the decision level of tennis techniques and tactics in our country. Therefore, it is necessary to use data mining to assist tennis technical and tactical decisions. According to the technical and tactical data of the past competitions, it is a developing direction to study the techniques and tactics of various competitive sports competitions. At present, the modelling of various techniques and tactics mainly includes random model and neural network model. By changing some technical and tactical parameters of the model and combining the results of the model, the main technical and tactical factors affecting the athletes' competition are judged, and the technical and tactical decision support service is provided for the competition.

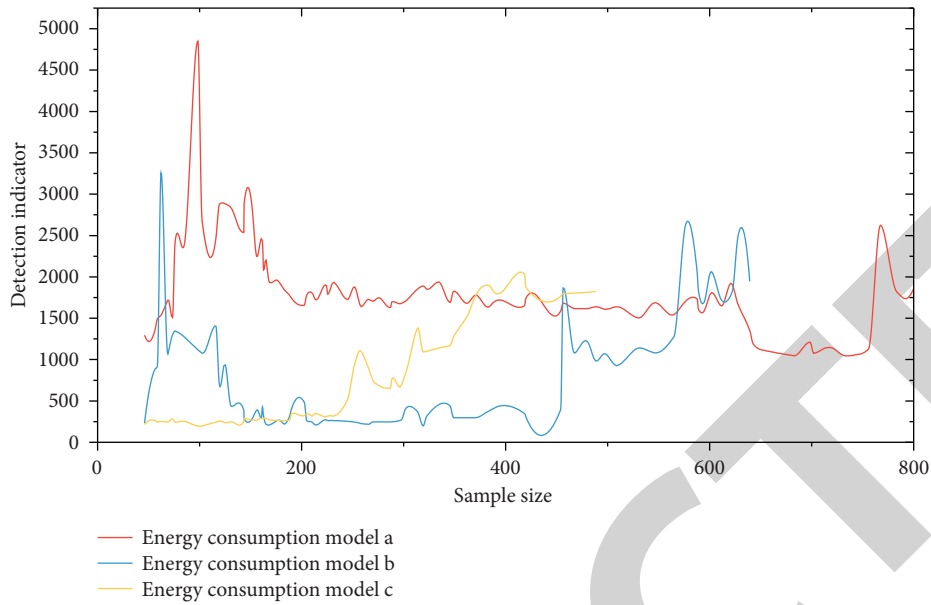


FIGURE 5: Simulation test results of tennis singles efficiency.

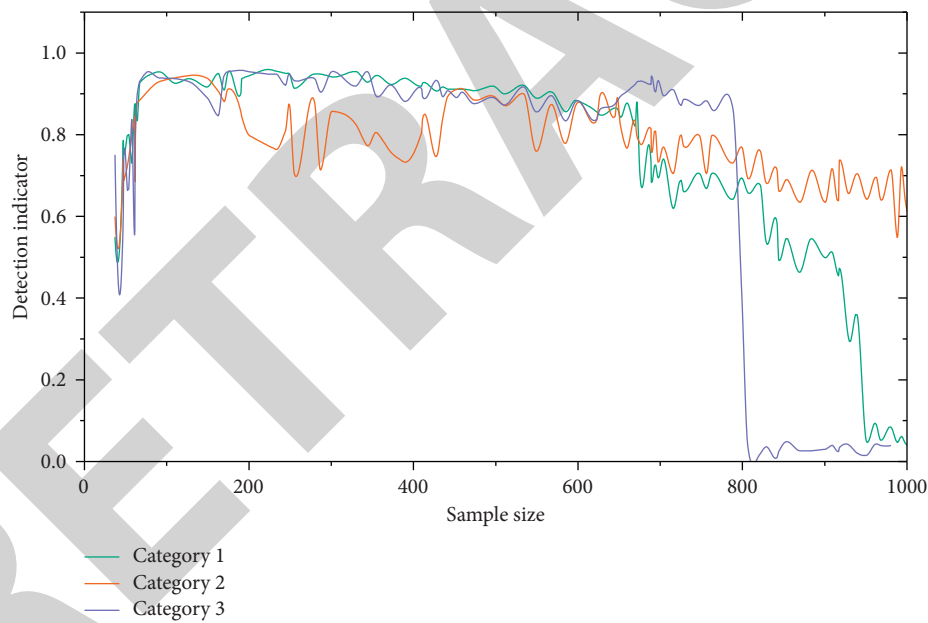


FIGURE 6: Test efficiency analysis of tennis singles match data under different methods.

7. Conclusions and Future Work

Statistical analysis of techniques and tactics is the most frequently used research method for technical and tactical research for a long time. This method can be used to explore the movement mode in which athletes or teams are mainly involved in techniques and tactics, such as recording the patterns that lead to gains and losses in sports and then using them in future competitions and training. It can provide insight into the theory and application of techniques and tactics in the field of sports. Its function is mainly to carry on technical and tactical evaluation and establish a technical and tactical database to lay the

foundation for further research such as technical and tactical modelling.

The disadvantage of statistical analysis of technique and warfare is that it can only make statistical analysis of a certain index in the competition, which in turn reflects that there are a few technical and tactical laws. It is difficult to find the deep rules between the results of various technical and tactical competitions. The computerization of statistical analysis of techniques and tactics is the basis of establishing the database of technical and tactical analysis, which lays a foundation for the further study of techniques and tactics by other methods. In competitive sports, the importance of different sports to athletes' technical and tactical ability is

different. Tina Miami classifies the competition as one of the items which require higher importance of technique and tactics in judging the importance of techniques and tactics in different sports groups.

Data Availability

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

Conflicts of Interest

The authors declare that they have no conflicts of interest.

References

- [1] F. Zhao, F. U. Jianqiu, L. I. Shaocai, H. Sun, and L. I. Naiwen, *Research Trends Analysis of Urban Dust Control Measures Based on the Literature Metrology*, Environmental Science & Technology, New York City, NY, USA, 2019.
- [2] S. W. Young, J. Dakic, K. Stroia, M. L. Nguyen, and M. R. Safran, "Arthroscopic shoulder surgery in female professional tennis players," *Clinical Journal of Sport Medicine*, vol. 27, no. 4, pp. 357–360, 2017.
- [3] S. Yan, "The perception difference analysis of the influence of coastal residents of big data mining technology on marine tourism development," *Journal of Coastal Research*, vol. 115, p. 265, 2020.
- [4] T. Wen, X. Niu, M. Gonzales, G. Zheng, Z. Li, and S. L. Brantley, "Big groundwater data sets reveal possible rare contamination amid otherwise improved water quality for some analytes in a region of marcellus shale development," *Environmental Science & Technology*, vol. 52, no. 12, pp. 7149–7159, 2018.
- [5] N. Tuccitto, "Automated data mining of secondary ion mass spectrometry spectra," *Journal of Chemometrics*, vol. 32, no. 3, Article ID e2968, 2018.
- [6] H. Takahashi, T. Wada, A. Maeda, M. Kodama, and H. Nishizono, "An analysis of the time duration of ground strokes in Grand Slam men's singles using the computerised scorebook for tennis," *International Journal of Performance Analysis in Sport*, vol. 8, no. 3, pp. 96–103, 2017.
- [7] Sylvia, I. Sleep, J. Laurenzi, Bergerson, and Heather, *Evaluation of Variability in Greenhouse Gas Intensity of Canadian Oil Sands Surface Mining and Upgrading Operations*, Environmental Science & Technology, New York City, NY, USA, 2018.
- [8] S. Sleep, I. J. Laurenzi, J. A. Bergerson, and H. L. Maclean, "Evaluation of variability in greenhouse gas intensity of Canadian oil sands surface mining and upgrading operations," *Environmental Science & Technology*, vol. 52, no. 20, pp. 11941–11951, 2018.
- [9] A. Shahmansoori, G. E. Garcia, G. Destino, G. Seco-Granados, and H. Wymeersch, "Position and orientation estimation through millimeter-wave MIMO in 5G systems," *IEEE Transactions on Wireless Communications*, vol. 17, no. 3, pp. 1822–1835, 2018.
- [10] S. Shafiee and S. Minaei, "Combined data mining/NIR spectroscopy for purity assessment of lime juice," *Infrared Physics & Technology*, vol. 91, pp. 193–199, 2018.
- [11] S. Sekander, H. Tabassum, and E. Hossain, "Multi-tier drone architecture for 5G/B5G cellular networks: challenges, trends, and prospects," *IEEE Communications Magazine*, vol. 56, no. 3, pp. 96–103, 2018.
- [12] T. Sally, D. L. Mcdowell, B. Amanda, G. Francois, and P. B. Littlewood, "Technology: sharing data in materials science," *Nature*, vol. 503, 2019.
- [13] R. Prakash, L. Behera, S. Mohan, and S. Jagannathan, "Dynamic trajectory generation and a robust controller to intercept a moving ball in a game setting," *IEEE Transactions on Control Systems Technology*, vol. 28, no. 4, pp. 1418–1432, 2020.
- [14] P. O'donoghue and E. Simmonds, "Probability of winning and match length in Tiebreak Ten tennis," *International Journal of Performance Analysis in Sport*, vol. 19, 2019.
- [15] K. Niu, C. Wang, X. Zhou, and T. Zhou, "Predicting ride-hailing service demand via RPA-LSTM," *IEEE Transactions on Vehicular Technology*, vol. 68, no. 5, pp. 4213–4222, 2019.
- [16] M. Merler, K.-N. C. Mac, D. Joshi et al., "Automatic curation of sports highlights using multimodal excitement features," *IEEE Transactions on Multimedia*, vol. 21, no. 5, pp. 1147–1160, 2019.
- [17] F. Meng, C. Lafleur, A. Wijesinghe, and J. Colvin, "Data-driven approach to fill in data gaps for life cycle inventory of dual fuel technology," *Fuel*, vol. 246, pp. 187–195, 2019.
- [18] M. Matinmikko, M. Latva-Aho, and P. Ahokangas, *On Regulations for 5G: Micro Licensing for Locally Operated Networks*, Telecommunications Policy, Amsterdam, Netherlands, 2018.
- [19] N. Maraga, R. Duffield, D. Gescheit, T. Perri, and M. Reid, "Playing not once, not twice but three times in a day: the effect of fatigue on performance in junior tennis players," *International Journal of Performance Analysis in Sport*, vol. 18, pp. 1–11, 2018.
- [20] X. Li, Q. Xie, and L. Huang, "Identifying the development trends of emerging technologies using patent analysis and web news data mining: the case of perovskite solar cell technology," *IEEE Transactions on Engineering Management*, vol. 99, pp. 1–16, 2019.
- [21] J. V. D. M. Leite, F. A. Barbieri, W. Miyagi, E. D. S. Malta, and A. M. Zagatto, "Influence of game evolution and the phase of competition on temporal game structure in high-level table tennis tournaments," *Journal of Human Kinetics*, vol. 55, no. 1, pp. 55–63, 2017.
- [22] A. Le, Y. Yang, D. Michalski, D. Heron, and M. Huq, "A web-based research system for outcome analysis of NSCLC treated with SABR," *Medical Physics*, vol. 39, p. 3754, 2018.
- [23] G. Laurent, C. Izart, B. Lechenard et al., "Numerical modelling of column experiments to investigate in-situ bioleaching as an alternative mining technology," *Hydrometallurgy*, vol. 188, pp. 272–290, 2019.
- [24] K. Sungwook, "5G network communication, caching, and computing algorithms based on the two-tier game model," *ETRI Journal*, vol. 40, no. 1, pp. 61–71, 2018.
- [25] T. G. Khanh, S. Hidekazu, and S. Kei, "User satisfaction constraint adaptive sleeping in 5G mmWave heterogeneous cellular network," *IEICE Transactions on Communications*, vol. 101, 2018.
- [26] K. Catherine, "Taking advantage of the digital age: technology and big data offer huge opportunities-if we seize them," *Canadian Journal of Cardiology*, vol. 34, no. 2, pp. 95–96, 2018.
- [27] Y. Jifu, R. Christopher, X. Hain, J. Zhan, and M. Dong, "Technological trends for 5G networks influence of E-health and IoT applications," *Journal of Hydrology*, vol. 9, 2019.
- [28] E. Jane, Woo, B. Robert, B. Dale, and B. Miles, "Effects of stratification on data mining in the US vaccine adverse event reporting system (VAERS)," *Drug Safety*, vol. 31, 2018.

- [29] M. James J, H. Jason, W. Kenneth, and S. Eliot L, "Data-driven decision support for radiologists: re-using the National Lung Screening Trial dataset for pulmonary nodule management," *Journal of Digital Imaging*, vol. 28, no. 1, pp. 18–23, 2018.
- [30] A. Fitzpatrick, J. A. Stone, S. Choppin, and J. Kelley, "Important performance characteristics in elite clay and grass court tennis match-play," *International Journal of Performance Analysis in Sport*, vol. 19, no. 6, pp. 942–952, 2019.
- [31] A. Filipi, B. Lesko, G. Munivvana, and G. Ochiana, "Differences in movement speed before and after a split-step between professional and junior tennis players," *Journal of Human Kinetics*, vol. 55, 2017.
- [32] A. Filipic, B. Leskosek, and T. Filipcic, "Split-step timing of professional and junior tennis players," *Journal of Human Kinetics*, vol. 55, no. 1, pp. 97–105, 2017.
- [33] Y. Cui, M.-Á. Gómez, B. Gonçalves, and J. Sampaio, "Clustering tennis players' anthropometric and individual features helps to reveal performance fingerprints," *European Journal of Sport Science*, vol. 19, pp. 1–13, 2019.
- [34] R. Cressman and V. Krivan, "Bimatrix games that include interaction times alter the evolutionary outcome: the Owner–Intruder game," *Journal of Theoretical Biology*, vol. 460, 2018.
- [35] J. Courel-Ibá and B. J. Sánchez-Alcaraz Martínez, "Game performance and length of rally in professional padel players," *Journal of Human Kinetics*, vol. 55, 2017.
- [36] Chih-Lin, Li Han, K. Jouni, H. Jinri, and H. Liuyan, "RAN revolution with NGFI (xhaul) for 5G," *Journal of Lightwave Technology*, vol. 36, 2018.
- [37] S. Chen, Q. Fei, H. Bo, L. Xi, Z. Chen, and J. Liu, "User-centric ultra-dense networks for 5g: challenges, methodologies, and directions," *IEEE Wireless Communications*, vol. 23, 2018.
- [38] N. Betzalel, P. Ben Ishai, and Y. Feldman, "The human skin as a sub-THz receiver-does 5G pose a danger to it or not?" *Environmental Research*, vol. 163, pp. 208–216, 2018.
- [39] F. Andreas, D. J. Dürrenmatt, and H. Stefanie, "Using data mining to assess environmental impacts of household consumption behaviors," *Environmental Science & Technology*, vol. 52, 2018.
- [40] A. Anand and G. D. Veciana, "Resource allocation and HARQ optimization for URLLC traffic in 5G wireless networks," *IEEE Journal on Selected Areas in Communications*, vol. 36, 2018.
- [41] M. Alzenad, M. Z. Shakir, H. Yanikomeroglu, and M. S. Alouini, "FSO-based vertical backhaul/fronthaul framework for 5G+ wireless networks," *IEEE Communications Magazine*, vol. 56, 2018.
- [42] L. S. Álvaro, G. P. Jesús, P. L. Alberto, M. R. Ricardo, J. F. Ortega, and L. Alejandro, "Hormonal and neuromuscular responses during a singles match in male professional tennis players," *Plos One*, vol. 13, no. 4, Article ID e0195242, 2018.
- [43] I. Afolabi, A. Ksentini, M. Bagaa, T. Taleb, M. Corici, and A. Nakao, "Towards 5G network slicing over multiple-domains," *IEICE Transactions on Communications*, vol. 100, no. 11, pp. 1992–2006, 2018.
- [44] L'amministrazione Trump vuole nazionalizzare la rete 5G. *Technology Review* (2018).
- [45] C. Chen, "Fangying song, feng-jang hwang, ling Wu, "A probability density function generator based on neural networks," *Physica A: Statistical Mechanics and Its Applications*, vol. 541, Article ID 123344, 2020.
- [46] L. Li, K. Ota, and M. Dong, "Deep learning for smart industry: efficient manufacture inspection system with fog computing," *IEEE Transactions on Industrial Informatics*, vol. 14, no. 10, pp. 4665–4673, 2018.
- [47] A. Jalali and H. Farsi, "A new steganography algorithm based on video sparse representation," *Multimedia Tools and Applications*, vol. 79, no. 3–4, pp. 1821–1846, 2020.
- [48] H. Song, J. J. Thiagarajan, P. Sattigeri, and A. Spanias, "Optimizing kernel machines using deep learning," *IEEE Transactions on Neural Networks and Learning Systems*, vol. 29, no. 11, pp. 5528–5540, 2018.
- [49] S. De, L. Bruzzone, A. Bhattacharya et al., "A novel technique based on deep learning and a synthetic target database for classification of urban areas in PolSAR data," *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*, vol. 11, no. 1, pp. 154–170, 2017.