Research on the Application of Modern Computer Technology in the Modeling of Basketball Offensive Line Measurement and Calculation

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Abstract. In order to better improve the shooting percentage, this article proposes mathematical modeling and statistical analysis of the offensive line measurement of the basketball's vertical height, horizontal speed, and vertical speed when shooting. Studies have found that excellent shooters can get a high and stable shooting percentage when using dominant hands. Excellent shooters usually like to use a variety of shooting postures. The thesis also develops an interactive and intelligent basketball tactics teaching software system to enable students to initially establish a perceptual understanding of basketball skills and tactics, and improve the teaching effect of teachers explaining basketball training techniques and tactics.

1. Introduction
Basketball offensive tactics emerge with the development of basketball competitions, from scratch, from simple to complex, from partial to overall, gradually evolving from a single tactical play to a complete tactical system. Modern basketball has entered a new era of high-speed offensive and defensive transitions and complex and changeable tactics. The rapid and active transition of offensive and defensive has become an inevitable trend in basketball development. Since entering the 21st century, the development of basketball heralds the arrival of the "small ball era". The style of the small ball era is the frequent use of small lineups in basketball games, advocating high-speed offensive and defensive and even running and bombing style of play, which is a summary of the game style that quickly emphasizes offensive and defensive conversion and 3-point shooting. Offensive tactics coordination is the basic element of the offensive tactics system, and its application characteristics represent the development direction of basketball offensive tactics. Computer-assisted teaching aid uses computers as the core medium of teaching. Through comprehensive processing of various media information such as sound, image, text, graphics, audio, video, animation, etc. a virtual flat basketball court and basketball are constructed with the help of multi-layer overlay technology. , Athletes and other materials, and import background music, game sound effects and commentary sounds to realize the simulation of basketball tactics, so as to analyze the route, timing, advantages and disadvantages of basketball tactics, and carry out tactical innovations, so that a large amount of logic is established between basketball tactics teaching information Connect, integrate an interactive teaching system [1]. Use multimedia assisted teaching technology to develop basketball tactics teaching human-computer interaction software, so that students can initially establish a perceptual understanding of basketball skills and tactics, and improve the teaching effect of teachers explaining basketball training skills and tactics.
2. Mathematical model establishment

There are many factors that affect basketball shooting scores, such as relative release height, release angle, release speed, sphere speed, synchronization between sphere height and ball release, shooting posture, etc. How to effectively coordinate these factors to improve shooting percentage is very important [2]. Mathematical modeling of the vertical height, horizontal speed, and vertical speed of the basketball when shooting free throws is convenient for quantitative analysis of shooting results. According to the shooting rate of 3 level shooters, through the shooting rate analysis, it is not controlled. Manifold analysis (UCM) and regression analysis (RA) have determined the relative importance of different variables in the shooting task to improve the hit rate. All data are filtered through a 4-order Butter Worth low-pass filter with a frequency of 10 Hz, and the gaps of temporary masking marks are filled by VICON Nexus software spline fitting. Export the data from the Nexus software and import it into Matlab, and further process it by customizing the code to calculate the dependent variable. Calculate the center of the ball (COB) by extracting the midpoint of the mark placed on the ball, and use it for further calculation of the release time point. The release time point is defined as the frame recorded when the COB has the highest speed. Calculate the release height, release speed, and the angle with the horizontal plane. In order to better study the task of free throw shooting, the task space is modeled, which is composed of the set distance of the projection ball in the horizontal and vertical directions. These displacements are expressed as:

\[
Y = v_x t + X_0 \\
Y = v_y t - \left(\frac{1}{2}gt^2\right) + Y_0
\]  

(1)

Where \(v_x\) and \(v_y\) are the horizontal velocity and the vertical velocity, respectively, \(t\) is the duration of the movement, \(g\) is the acceleration of gravity, and \(X_0\) and \(Y_0\) are the starting positions. The horizontal distance divided by the horizontal speed can be defined as the movement time, so (2) and (3) can be combined and rewritten as an error function:

\[
0 = H + v_x \left(\frac{d_x}{v_x}\right) + \left(\frac{g}{2}\right)\left(\frac{d_x}{v_x}\right)^2
\]  

(2)

Where \(H\) is the vertical distance between the release point and the edge, and \(d_x\) is the horizontal distance between the release point and the edge. In this way, the task function is rewritten as a combination of variables \(H\), \(v_x\), and \(v_y\) with zero error. The function in (1) can determine the set of variables \((H, v_x, \text{and} v_y)\) that meet the task criteria with zero error. This combination of variables is called the uncontrolled manifold of the task space. If variables outside the task space are introduced, it may lead to changes in the control variables and missed shots. On the contrary, if there are no other variables, any changes along the UCM will not cause a drop in shooting percentage [3]. Considering that the experimental variance in the release parameters relative to the standard allows the variance decomposition: the orthogonal variance to the work space and the variance along the work space. Orthogonal variance is the Euclidean distance variance between the release parameters of any given experiment, that is, the nearest neighbor in all possible (2) manifold combinations. The UCM variance is the total variance \(V_{TOTAL}\). Finally, by dividing the relative quantity on the total variance of each topic, the relative quantity of \(V_{UCM}\) is calculated.

3. Development of the basketball offensive trajectory capture system

The software provides students with a vivid and intuitive interactive learning environment by means of images, graphics, animation, audio, video and other multimedia methods through teachers’ application in teaching and students’ application in pre-class review and post-class review. Master the concept, characteristics, form and composition of basketball tactics, and cultivate students’ good tactical
awareness and flexible adaptability. Master the timing of the use of various tactics, such as the method and sequence of using the positioning formation, and use it flexibly in the game. The article refers to more than 10 related textbooks and monographs such as "Ball Sports-Basketball". The specific content includes the concepts, characteristics, components, design and application of basketball tactics, personal tactics (physical energy allocation tactics, offensive tactics, defensive tactics and Psychological tactics), basic coordination (passing and cutting coordination, sudden distribution coordination, coping coordination, screening coordination, flanking coordination, closing coordination, surrounding center coordination, squeezing coordination, passing coordination, bypass coordination, exchange coordination, fast attack coordination, Defensive and fast attack coordination), team coordination (offensive man-to-man defense, offensive zone joint defense, offensive zone pressing defense, offensive mixed defense, man-to-man defense, zone joint defense, zone pressing defense and mixed defense), teaching content There are text, animation, video, audio, etc. in the form of presentation [4]. The specific presentation form of each part of the content is shown in Table 1.

| Teaching content                                | Text form | Animation form | Audio format | Video format |
|-------------------------------------------------|-----------|----------------|--------------|--------------|
| Concept and characteristics of basketball tactics| √         |                 | ✓            |              |
| Elements of Basketball Tactics                  | ✓         |                 | ✓            |              |
| Design and Application of Basketball Tactics    | ✓         |                 | ✓            |              |
| Practice of Basketball Tactics                  | ✓ ✓ ✓ ✓ ✓  |                 | ✓            |              |

3.1. Environmental construction

3.1.1. Hardware system. The computer network system has created a good teaching environment for modern teaching. Teachers and students can display teaching-related videos, images and texts through hardware systems such as multimedia classrooms, electronic reading rooms, and information resource libraries connected to the network.

3.1.2. Software system. The core part of the network basketball teaching system is a software environment that can effectively realize multimedia resource development, teaching curriculum planning, student communication, teaching system improvement and updating, and other functions. The central part of the software environment is to build a Effectively realize a teaching system for students to learn knowledge, exchange and discuss online.

3.1.3. Reform the teaching system and improve the teaching evaluation system. Online teaching needs to strengthen system management. On the one hand, it is necessary to reasonably adjust the proportion of skill training and physical fitness in sports performance, which can appropriately increase the proportion of physical fitness, and appropriately reduce the proportion of skill training [5]. A comprehensive inspection of physical fitness, theoretical knowledge, attendance, and skill training is crucial to highlight the importance of physical fitness in sports performance. On the other hand, it is also necessary to establish a sound sports performance evaluation and incentive system, which can not only mobilize students' enthusiasm for participating in sports activities, but also highlight the importance of physical fitness exercise. In this way, it is possible to ensure the institutionalization and standardization of the network teaching model, and make the development of network teaching more smoothly.
3.2. Network teaching system model

The establishment of the network teaching system model needs to follow certain laws and is not disorderly and without rules. Based on the modern constructivism theory, it can roughly depict the basic model shown in Figure 1.

![Network teaching system model](image1.png)

Figure 1. Network teaching system model

It can be seen from the figure that the entire design is always in the same frame, and the orderly nature of the teaching system is well reflected [6]. In addition, within the framework, students and teachers can autonomously use a variety of different types of teaching resources, freely walk through the experimental area, feedback area, dictionary area, exchange area and demonstration area, and demonstrate the independence of the teaching system. Is very profound.

3.3. Boundary of the network teaching system

The network teaching system is based on the Internet, and having a boundary or a track can better ensure the scientific operation of the system. In the process of teaching and learning, the activity of conveying and receiving information with the curriculum as the center is essentially the boundary of the network teaching system mentioned in this article. As shown in Figure 2, the link from the introduction of teaching content by the teacher to the end of the course and the teacher's summary is carried out step by step in an orderly manner.

![Boundary of the network teaching system](image2.png)

Figure 2. Boundary of the network teaching system
3.4. Teaching modules and their functions
As shown in the overall interface of basketball tactics as shown in Figure 3, the entire basketball tactics teaching software system is composed of 5 major modules, namely basketball tactics theory, personal basketball tactics, basic tactics, team tactics, and Nunxuan tactics modules. The basketball tactics theory module is composed of six sub-modules, including the concept, characteristics, constituent elements, classification system, and the design and application of basketball tactics. Each module can be divided into three parts: menu, detailed information and simple display [7]. Two modes of sound and mute can be selected in the sound, and the mode of single frame, fast forward, slow forward, pause, and custom speed playback can be selected in the playback mode.

![Figure 3. General interface of basketball tactics software](image)

4. System Test
After making the initial factor loading matrix, it is found that the loading values of the first three factors on the original variables are not too different, so the common factors cannot be explained clearly, so the next step of factor rotation is required [8]. In the factor load matrix after rotation, the factor coefficients have clearly differentiated. Among them, the major absolute values in component 1 are: Z three-pointers, Z three-pointers, Z three-pointers, Z two-pointers, and Z free throws. Component 2: Z average time, Z two-point shots, Z two-point shots, Z free throws, Z free throws. Component 3: Z appearances.

When explaining the above classification, it is found that component 3 and component 2 are of practical significance. However, in component 1, it is found that the Z dichotomy hit rate is negatively correlated, which is biased against the actual meaning. The Z free throw percentage is better explained in component 2. Based on this, the following two variables (Z two-point shooting rate, Z free throw shooting rate) will be eliminated for the second factor analysis. Based on the first calculation and analysis, especially the analysis of the initial factor load matrix and the rotated factor load matrix, the variables "Z two-point hit rate" and "Z free throw hit rate" were decided to be eliminated in this revision.

Table 2 is the test of KMO and Bartlett.

| Bartlett's sphericity test | Kaiser-Meyer-Olkin measure of sampling adequacy | 0.665 |
|---------------------------|-----------------------------------------------|-------|
| Approximate chi-square    | 367.737                                       |       |
| df                        | 36                                             |       |
| Sig.                      | 0                                              |       |

It can be seen from Table 2 that the KMO metric value is 0.665 greater than 0.5, the Sig. value of the sphere test is 0.00 far less than 0.05, and the test P value is very close to 0, which indicates that there is a strong correlation between the variables. So it shows that factor analysis can be done.
Table 3. Common factor variance

|                          | Initial | Extract |
|--------------------------|---------|---------|
| z appearances            | 1       | 0.902   |
| z average time per game  | 1       | 0.726   |
| z double hit             | 1       | 0.933   |
| z Two-point shots        | 1       | 0.917   |
| z three-pointer          | 1       | 0.932   |
| z Three-pointers         | 1       | 0.943   |
| z three-point percentage | 1       | 0.77    |
| z free throw             | 1       | 0.849   |
| z Free throw attempts    | 1       | 0.896   |

It can be seen from Table 3 that the factor commonality of these 9 variables is above 0.7, which can be well explained by the 3 factors. Table 4 is the initial factor loading matrix [9]. It can be seen that the loading values of these three components on the variables are not much different, so further factor rotation is needed for better explanation.

Table 4. Component matrix

|                          | 1    | 2    | 3    |
|--------------------------|------|------|------|
| z appearances            | -0.192 | -0.051 | 0.929 |
| z average time per game  | 0.822 | -0.225 | 0.012 |
| z double hit             | 0.856 | -0.317 | 0.316 |
| z Two-point shots        | 0.911 | -0.064 | 0.288 |
| z three-pointer          | 0.658 | 0.701 | -0.093 |
| z Three-pointers         | 0.685 | 0.683 | -0.087 |
| z three-point percentage | 0.441 | 0.748 | 0.124 |
| z free throw             | 0.798 | -0.418 | -0.194 |
| z Free throw attempts    | 0.71  | -0.593 | -0.201 |

From Table 5, the variables belonging to component 1 are: Z average time, Z two-point shots (number), Z two-point shots, Z free throws (number), and Z free throws. The variables belonging to component 2 are: Z three-point hits (number), Z three-point shots, and Z three-point hit rate. The variables belonging to component 3 are: the number of Z appearances. It can be seen that the factor classification obtained after this revision has more practical theoretical significance, and the explanation will be more realistic.
Table 5. Rotation component matrix

| Ingredient                      | 1     | 2     | 3     |
|---------------------------------|-------|-------|-------|
| z appearances                   | -0.066| -0.11 | 0.941 |
| z average time per game         | 0.816 | 0.236 | -0.059|
| z double hit                    | 0.917 | 0.186 | 0.24  |
| z Two-point shots               | 0.83  | 0.43  | 0.21  |
| z three-pointer                 | 0.187 | 0.937 | -0.142|
| z Three-pointers                | 0.219 | 0.936 | -0.138|
| z three-point percentage        | -0.006| 0.872 | 0.094 |
| z free throw                    | 0.881 | 0.051 | -0.264|
| z Free throw attempts           | 0.897 | -0.144| -0.265|

5. Conclusion
A perfect offensive tactical system is the cornerstone of the team's success. The offensive tactical system is a complex system. The cooperation of offensive tactics is regarded as the smallest unit of the team's offensive tactical system. From the "minimal unit" thinking and design, an efficient fixed offensive tactic is formed. In the end, a multi-level and three-dimensional team offensive tactical system is formed from bottom to top. Special offensive tactics at critical moments can often make the team achieve unexpected results in the game. The perfect combination of individual offensive tactics and team offense can make the team's offensive efficiency lasting. We have designed the relevant basketball technique assisted teaching software. By using the software, teachers can reduce the time for explanation and demonstration, increase the time for students to practice, and effectively improve the teaching efficiency of basketball tactics. The Ebinlos forgetting curve shows that human forgetting is an inevitable phenomenon in the process of memory, and it shows the law of fast and slow. Students use the software after class and combine with practice to consolidate the knowledge of basketball tactics they have learned, and it can improve even more. Mastery of knowledge.

References
[1] Fox, J. L., Stanton, R., Sargent, C., O'Grady, C. J., & Scanlan, A. T. The impact of contextual factors on game demands in starting, semiprofessional, male basketball players. International Journal of Sports Physiology and Performance, vol. 15, pp. 450-456, April 2019.
[2] Hobbs, W., Morgan, S., Gorman, A. D., Mooney, M., & Freeston, J. Playing unpredictably: measuring the entropy of ball trajectories in international women’s basketball. International Journal of Performance Analysis in Sport, vol. 18, pp. 115-126, January 2018.
[3] Zuccolotto, P., Manisera, M., & Sandri, M. Big data analytics for modeling scoring probability in basketball: The effect of shooting under high-pressure conditions. International Journal of Sports Science & Coaching, vol. 13, pp. 569-589, April 2018.
[4] Scanlan, A. T., Stanton, R., Sargent, C., O’Grady, C., Lastella, M., & Fox, J. L. Working overtime: The effects of overtime periods on game demands in basketball players. International Journal of Sports Physiology and Performance, vol. 14, pp. 1331-1337, October 2019.
[5] Scanlan, A. T., Madueno, M. C., Guy, J. H., Giamarelos, K., Spiteri, T., & Dalbo, V. J. Measuring decrement in change-of-direction speed across repeated sprints in basketball: Novel vs. Traditional approaches. The Journal of Strength & Conditioning Research, vol. 35, pp. 841-845, March 2021.
[6] Akkoc, O., Caliskan, E., & Bayramoglu, Z. Effects of passive muscle stiffness measured by Shear Wave Elastography, muscle thickness, and body mass index on athletic performance in adolescent female basketball players. Medical Ultrasonography, vol. 20, pp. 170-176, February 2018.
[7] Carvalho, H. M., Gonçalves, C. E., Collins, D., & Paes, R. R. Growth, functional capacities and
motivation for achievement and competitiveness in youth basketball: an interdisciplinary approach. Journal of sports sciences, vol. 36, pp. 742-748, July 2018.

[8] You, Y., Moussa, S. G., Zhang, L., Fu, L., Beck, J., & Staebler, R. M. Quantifying fugitive gas emissions from an oil sands tailings pond with open-path Fourier transform infrared measurements. Atmospheric Measurement Techniques, vol. 14, pp. 945-959, February 2021.

[9] Eckardt, R., Crocker, A., & Tsai, C. Y. Clarifying and empirically assessing the concept of human capital resource emergence. The International Journal of Human Resource Management, vol. 32, pp. 279-306, February 2021.