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Evaluation on performance test of table tennis equipment based on computer graph and image processing technology

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ABSTRACT

The rubber of surface on racket is direct part contact with the table tennis, therefore, it play a decisive role in performance of racket. The paper summarized the graph and image technology, regarded colloidal particles of rubber as the research objects, systematically analyzed the relationship between the performance of racket and property of colloidal particle, and realized the automatic generation and demonstration of the layout of colloidal particles using the computer aided design system of colloidal particles of table tennis. In addition, it made a performance evaluation on the distribution of colloidal particles, and reflected the performance of racket by motion simulation model.

KEYWORDS

Computer graph and image processing technology; Performance of table tennis racket; Mechanics; Simulation; CAD.

INTRODUCTION

Table tennis racket develops from original smooth racket to the one covered with rubber, making an improvement in aspects of speed, strength and rotation of shoot. Rubber as the mantle increases the elasticity and friction of the racket to shoot and improves the shooting technology. Equipments and tools of table tennis, especially the surface mantle of racket will exert an influence to the technology of table tennis. However, table tennis factory in our country especially the factory on a small scale alternately use the several sets of production mold of rubber because of the hysteretic technology and the weak personalized design and consciousness and ability of manufacture. They could not meet the requirements of athletes and enthusiasts to racket. Therefore, in order to improve the performance of rubber of table tennis racket, this research discussed the effect of the colloidal particle attribute on performance of racket using computer graph and image processing technology in the perspective of rubber, offering the corresponding reference value for athletes and enthusiasts to choose racket. Besides, the CAD for table tennis racket have a guiding significance for table tennis equipment manufacturers to design and manufacture the colloidal particle of set of plastic, and thus design a rubber with more obvious performance feature and pertinence[1-3].

OVERVIEW OF COMPUTER GRAPH AND IMAGE PROCESSING TECHNOLOGY

Computer graph and image processing technology is used to design, display, storage, amend and complete the graph and image. It contains image processing 2D production technology and graphics processing 3D production technology, pecific content includes: 1) image digitization, image coding, image intensification, image restoration, picture segmentation and picture analysis, etc. 2) geometric transformation, such as translation, spin, zoom, perspective and projection, etc. 3) modeling or style design 4) hidden lines and hidden surface elimination, oren-nayar-blinn, etc. 5) fitting of curve and surface 6) color design[4].

With the development of the computer technology and the improvement of the life and production, computer graph and image processing technology has permeated to every field with an unexpected speed, especially the CAD, CAM and the terrain, geomorphological map and natural resources map is mature day by day[5].

Generally, the higher performance of computer hardware equipment is, the higher the graphics processing quality is. Graph and image processing software tightly connects computer with display terminal. In addition, graph and image processing software of computer has functions of storage, design and modification and can integrate param bitmapdata effectively and rapidly, which reduce the burden on operation of the CPU. Thus, it offers an effective support for ensuring picture quality and obtaining efficient work efficiency.

EVALUATION OF PERFORMANCE OF TABLE TENNIS BATS

The performance of table tennis bats is evaluated in aspects of accelerating ability, rotation capacity and control capacity[1], thus to confirm if the bats is suitable for fast attack method or the method of chop.

Accelerating ability is defined as that, the power of hitting the ball functions on the ball through bat, and then is transformed into the effectiveness of flying speed. The formula of accelerating speed is:

$$S_{accelerating\ \ speed} = V / VO \quad \textbf{(1)}$$

V_0 : initial operating speed; V : the speed of flying away bat. It can be seen from the formula that the speed flying away racket is positively related to the accelerating ability.

Rotation capacity is defined as the power of hitting the ball functions on the ball, and then is transformed into the effectiveness of autorotation rate of the ball. The formula of rotation capacity is:

$$R_{rotating\ \ capacity} = W / WO \quad \textbf{(2)}$$

W0: initial rotation speed; W: the rotation speed when the ball flies away bat. It can be seen from the formula that the rotation speed when the ball flies away racket is positively related to rotation capacity.

Control capacity is defined as the time of that ball breaking away from racket when the same power and method was used to hit the ball (that is related to the soft and hard feel of baseboard). The formula of control capacity is:

$$C_{control\ \ capacity} = D / DO \quad \textbf{(3)}$$

D_0: initial thickness of sets of plastic; D: the depth that the ball pressing into the set of plastic. It can be seen from the formula that the depth of the ball pressing into the set of plastic is positively related to the control capacity.

Through experiment, we found that the height, diameter and density of colloidal particle can affect the performance of table tennis performance[1].

REALIZATION OF COMPUTER ASSISTED DESIGN SYSTEM FOR COLLOIDAL PARTICLE OF TABLE TENNIS BAT

System requirements and data flowchart

The computer assisted system for colloidal particle of table tennis bat, first, can provide a convenient design system, which can design the needed distribution of colloidal particle. The distribution situation can be presented visually on the computer screen. Second, besides the distribution of colloidal particle, this paper can also make performance evaluation in the design of colloidal particle, including the accelerating speed, rotation speed and control speed of table tennis bat. At last, it can reflect the performance of table tennis racket visually, in order to make comparison on the design of different styles. The flowchart of design system for colloidal particle of table tennis bat[3] is as shown in Figure 1:

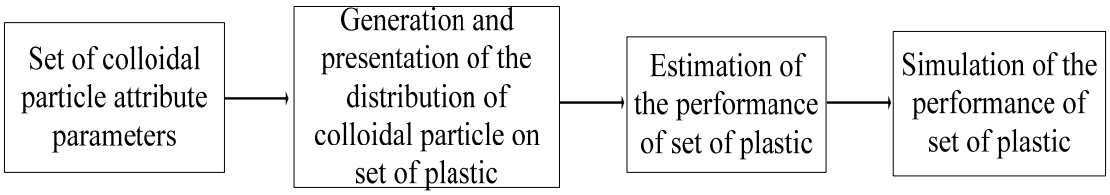

Figure 1 : Flowchart of system module and data

System design

The computer assisted design system on colloidal particle of table tennis racket is based on the design of colloidal particle design, estimation of racket performance and the simulation of table tennis ball movement.

Colloidal particle distribution subsystem provides two design patterns of colloidal particle distribution: dynamic design and mutual design. Conforming the requirements of International Table Tennis Federation on covering of table tennis bat, these two patterns design and make fine adjustment on the colloidal particle by forms of mouse and textbox, respectively. Rubber performance estimation subsystem mainly aims at the performance of bat. The formula for the accelerating capacity is:

$$S_{accelerating\ capacity} = \sqrt{0.044d^2 + 0.49} \quad \textbf{(4)}$$

d: diameter of colloidal particle of bat, the interval of diameter value of colloidal particle is (0, 3.4].

The formula of rotation capacity of racket is:

$$R_{rotation\ capacity} = \frac{dkf}{30kf} = \frac{d}{30} \quad \textbf{(5)}$$

k: proportionality coefficient; f: force of friction provided by every colloidal particle; d: density of colloidal particle of bat. The interval of density value of colloidal particle is:[10, 30].

Formula of control capacity of racket is:

$$C_{control\ capacity} = h/2 \quad \textbf{(6)}$$

h: height of colloidal particle of bat. The interval of height of colloidal particle is[0, 2].وو

Table tennis racket performance simulation subsystem is the third subsystem designed for that system. According to the core idea of this mathematical model—give the movement of ball at any time based on the initial movement and environment conditions of the given ball, the performance of table tennis can be simulated based on this mathematical model. The movement of table tennis ball can be obtained according to calculation formula (7) and (8):

$$v = v_0 V_a \quad \textbf{(7)}$$

$$w = w_0 S_a \quad \textbf{(8)}$$

V_a: accelerating capacity of bat; S_a: rotating capacity of bat; β: included angle between exit direction and normal of racket (acute angle); α: included angle between exit direction and normal of racket (acute angle); c: control capacity: ($0<c<1$).

In addition, the accelerating capacity and rotation capacity of racket are transformed from the movement velocity and rotation velocity after collision of bat, respectively. Control capacity is the presentation of ball output time and angle. (9) and (10) respectively indicate that the rotation direction of the ball is top spin and back spin before collision. The calculation formula is:

$$\beta = \alpha(1 + c) \quad \textbf{(9)}$$

$$\beta = \alpha(1 - c) \quad \textbf{(10)}$$

Test and evaluation of system function

The computer assisted design system for distribution of colloidal particle of racket is realized using mutual test. In addition, the system evaluation on the system is made in the aspects of exhibition platform, dynamic parameter set, mutual parameter set, performance evaluation, performance simulation of multi-racket and custom parameter simulation. We find that the system can pass all the tests. Table of function test[1] is as shown in TABLE 1:

TABLE 1: Table of function test

test modules	test contents	test cases	expected results	actual results	pass or not
Display platform	three dimensional display function	long press the left mouse button and moving	appear three dimensional effect	three dimensional effect is visible	yes
	zoom function	scroll the mouse roller	referents appear zoom in and out	referents appear zoom in and out	yes
	stop promoting function	hold the mouse to stay on the model	appear prompt text, and display the values of model parameters	see the list of colloidal particles properties	yes
dynamic parameter setting	dynamic parameter setting	Single choose the button to select a model	show the distribution represented by mode in display platform	show the distribution represents by the model	yes
	parameter tuning functions	mouse click model icon	enter into the parameters manually modified the page	enter into the parameters manually modified the page	yes
	parameter input restricted function	input illegal value in textbox of colloidal particles density and diameter	system pops up dialogue box	system pops up dialogue box	yes
manual parameter setting	legal data display function	input legal parameter combination in each textbox	system displays the distribution of colloidal particles	system displays the distribution of colloidal particles	yes
	colloidal particles in unit area calculation function	input legal parameter combination in each textbox	display value in the textbox of "the number of colloidal particles in unit area"	display value in the textbox of "the number of colloidal particles in unit area"	yes
Performance evaluation	performance estimation function	after display the colloidal particles in platform, click "parameter evaluation"	corresponding place appears racket performance index parameter value	corresponding place appears racket performance index parameter value	yes
multi racket performance simulation	support single racket performance simulation	join one rocket in simulation queue	enter into simulation interface, and can perform simulation	enter into simulation interface, and can perform simulation	yes
	support multiple racket performance simulation	join multiple racket in simulation queue, and click "performance simulation"	enter into multiple racket performance dialogue box, and perform simulation	enter into multiple racket performance dialogue box, and perform simulation	yes
self-defined parameters simulation	the influence of environmental parameter on table tennis movement curve	keep other parameters unchanged, and change environment variable successively, then perform movement simulation	draw different operation curve	draw different operation curve	yes
	the effect of tennis initialization status on table tennis movement curve	keep other parameters unchanged, and successively change table tennis initial movement parameter, and then perform movement simulation	draw different operation curve	draw different operation curve	yes
	self-defined parameter performance simulation	input legal parameter value in performance parameter textbox, and perform simulation	draw the operation curve of table tennis	draw the operation curve of table tennis	yes

CONCLUSION

This paper designed the computer assisted design system for the distribution of colloidal particle of table tennis racket taking the colloidal particle on the set of plastic as research object and evaluate it though tests. This design system integrated the distribution design, performance estimation and

performance simulation of colloidal particle together. Therefore, this research achievement can guide the manufacturer to some extent, and meanwhile guide the table tennis enthusiasts to purchase racket according to their own characteristics.

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REFERENCES

[1] G.M.Zhou; The Applied research of graph and image processing technology by computer in design and detection table tennis racket equipment, Beijing, North China University of Technology, **(2010)**.

[2] H.M.Wang, J.L.Zhang, X.G.Qu; The usability and influence factor of the rubber in table tennis, Rubber & Plastics Resources Utilization, **1**, 15-22 **(2013)**.

[3] M.Y.Zhang, J.L.Xu; The influence of equipment reform to table tennis, Sports, **4**, 35-36 **(2014)**.

[4] X.Y.Han; Introduction to graph and image processing technology by computer, Fujian Computer, **10**, 83-84 **(2011)**.

[5] X.J.He; Discussion about graph and image processing technology by computer, Massage and Computer, **11**, 164-165 **(2013)**.