

The examination for evaluating skills during the rally of the Table Tennis game

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Abstract: The purpose of this study was to examine the method for evaluating skills of table tennis players during the rally of the game. An incidence angle, speed and height of the balls passing above the net were investigated for both winners and losers. In this study, these three factors were defined as the characteristics of the hit ball. In order to observe those three factors, infrared laser units were set up 0.3 m from the net. The intervals of the time which were required for the balls to pass through two fixed units were measured. Those data were digitized and recorded in a personal computer. The above-mentioned characteristics of the hit ball were calculated. The results showed the following tendency. A winner's ball has a larger incidence angle than that of loser's one. On the other hand, the speed and height were not important factors in order to win the games. However, higher the skill levels, the higher the hit ball position and more the speed. It was found that a large incidence angle was necessary to win. In conclusion, observing an incidence angle gives coaches and players the possibility to evaluate skills of table tennis even in different skill levels.

Key words: table tennis incidence angle ball speed ball height evaluating skill

1. INTRODUCTION

Methods of skill evaluation using VTR are adopted in various kinds of sports. As for volleyball, the game analysis and the skill evaluation software such as "Data Volley" and "Touch Volley" are developed.⁵⁾ However, as for table tennis, the software that can evaluate the skill of the player is not developed. It is not sufficiently clarified in the case of table tennis how to analyze the game. That is because table tennis is individual competition, there are many patterns of matches and the rally is very speedy. Therefore, development of game analysis system is very difficult. It is expected that the skill evaluation of more advanced strategy analysis and the player becomes possible, if such software can be developed.

In February, 2000, The International Table Tennis Federation (ITTF) officially adopted a larger ball of which the diameter is 40mm.²⁾³⁾ As a result, a rally continues more than before. It has been reported that the probability that the player loses who hit balls over the table is high.¹⁾ Still very few attempts have been made for evaluating the skill of table tennis players. To

evaluate the skill of the player, it is necessary to clarify the characteristic of the balls hit by the player. The purpose of this study was to examine the method for evaluating skills of table tennis players during the rally. An incidence angle, speed and flight height of the balls passing above the net in both winners and losers were investigated.

2. METHODS

2.1 Experimental device

Infrared laser units were set up 0.3m from the net. The units were assembled as shown in Figure 1. The infrared laser unit has an emitting laser and an optical receiver. A total of 16 infrared lasers unit comprising left 8 and right 8 were set up. The distance between adjacent infrared lasers is 0.04m. When the ball passed the unit, time and channel number were recorded in the PC. The state of the measurement was videotaped. The experimental devices are shown in Figure 2.



Figure 1 The lasers units of the measuring system

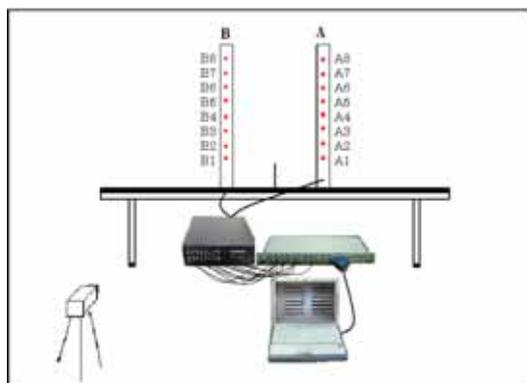


Figure 2 The experimental devices

2.2 Procedure of measuring

The signals from units were converted into a digital code via DAQCard-6024E at 10 kHz. These signals were recorded in the personal computer. Figure 3 shows the personal computer screen when balls passed the infrared lasers.

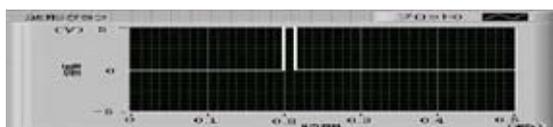


Figure 3 The PC screen when the ball passed the infrared lasers

2.3 Subjects

In this study, 8 males who belonged to Niigata University Table Tennis Club were selected as subjects. Four of them have a high skill standard to participate in the All-Japan Championship. The subjects were asked to warm up to perform one's best in matches in this measurement. After that, the subjects played three games matches.

2.4 Calculation

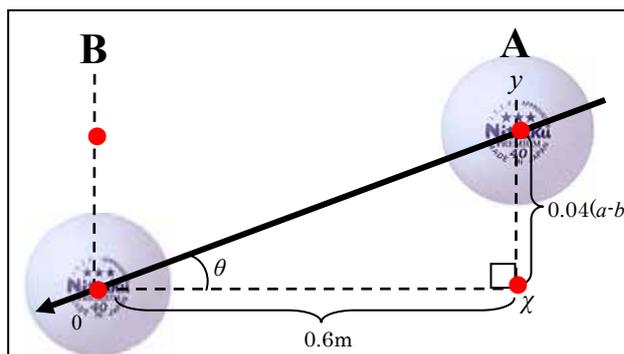


Figure 4 The basic concept of trajectory of the ball

2.4.1 Incidence angle of hit ball

The incidence angle (θ) of the balls when passing above the net was calculated by the following equation.

$$\theta(\text{deg}) = \frac{180}{\pi} \cdot \tan^{-1} \frac{y}{\chi}$$

An example of calculated incidence angle is shown in Figure 4.

χ : The distance of between two laser units (0.6m)

y : The height of difference infrared laser of A and B units ($0.04(a-b)$ m)

2.4.2 Ball speed

The speed (v) of the ball passing right above the net was calculated by the following equation.

$$v(\text{m/sec}) = \sqrt{0.6^2 + \{0.04(a-b)\}^2} / (Tb - Ta)$$

a : The channel number of the laser interrupted by passing ball before the net

b : The channel number of the laser interrupted by passing ball after the net

0.6: The distance of between two laser units (A and B)

$0.04(a-b)$: The height of difference infrared laser of A and B units

Ta : Time when the laser light is interrupted by passing ball before the net

Tb : Time when the laser light is interrupted by passing ball after the net

The number 0.6 in the above equation means the distance between two laser units (A and B), and the expression $0.04(a-b)$ means the height of difference

infrared laser A and B units.

The measurement units of length and time are m and sec, respectively.

2.4.3 Height of a ball above the net from table surface

The height (h) of the ball passing right above the net was calculated by the following equation.

$$h \text{ (m)} = \frac{1}{2} [\{0.04(a-1)+0.18\}+\{0.04(b-1)+0.18\}]$$

The number 0.04 and 0.18 in the above equation mean the distance between adjacent infrared lasers and the lowest height of the lasers from the surface of the table, respectively.

The coordinate of the point which is the center between the lasers interrupted by ball was used to obtain the height of the ball right above the net.

3. RESULTS AND DISCUSSION

3.1 Incidence angle of hit ball

The average incidence angle of balls of winner and loser is shown in the Figure 5. The results of Figure 5 were obtained from all rallies of all matches. The incidence angles of the hit balls by the winners were larger than that of the losers. A significant difference was found between winners and losers ($p<0.05$). The average incidence angle is shown in Figure 6 for each match. The tendency indicated that a winner has the larger incidence angle than that of the loser. In the match of sub.A and sub.C, the incidence angle of the hit ball of sub.A was much larger than that of not skilled player (sub.C) ($p<0.01$). It was shown that an incidence angle was affected by the skill level of the players. The winning percentage of the player who has a larger incidence angle of hitting the ball is high.

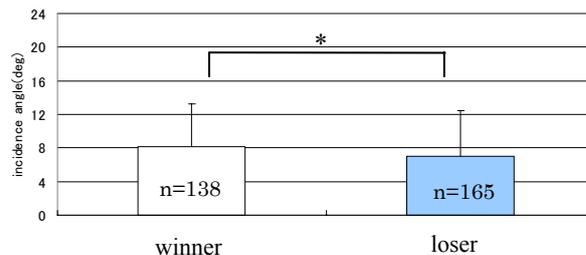


Figure 5 The average incidence angle of the hit balls in all rallies of all matches according to winners and losers

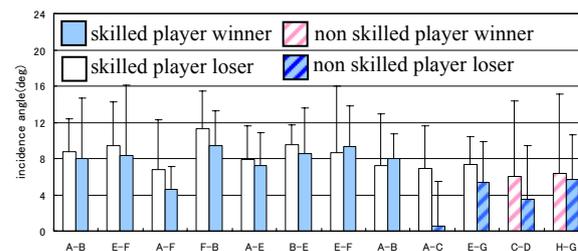


Figure 6 The average incidence angle of each match according to winners and losers

3.2 Ball speed

The ball speeds of winners and losers in all rallies of all matches are shown in Figure 7. There was no significant difference between winners and losers. However, the ball speed right above the net of the losers was faster than the winners. The average ball speed right above the net is shown in Figure 8 in each match. There was not difference of the ball speed in both winners and losers. It is expected that the players rallied at about the same ball speed in the match between the skilled players. On the other hand, in the match of skilled player and non skilled player, the speeds of the ball hit by the losers (non skilled player) were faster than the winners (skilled player). Let us take close look at the match of sub.E and sub.G. The ball speed of non skilled player sub.G was faster than that of sub.E ($p<0.05$). It is expected that non skilled players think that it is an important factor for winning to hit the ball at higher speed. It was found that the ball speed is affected by the skill levels of opponent.

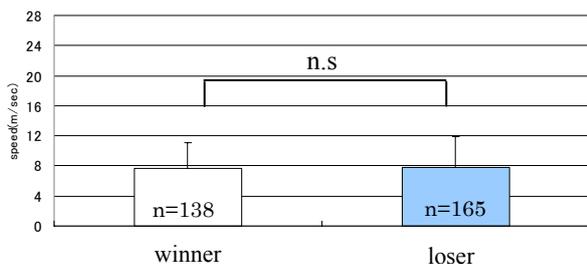


Figure 7 The average ball speed of the hit balls in all rallies of all matches according to winners and losers

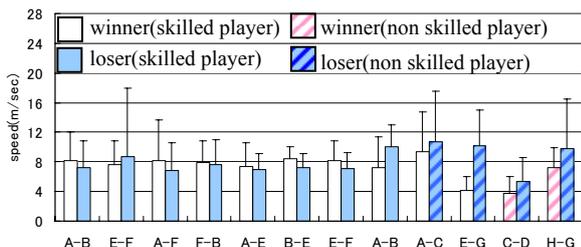


Figure 8 The average ball speed of each match according to winners and losers

3.3 Ball height right above the net

The average ball height right above the net in all rallies of all matches is shown in Figure 9 in which the results are presented for winners and losers. The average ball height right above the net in each match is indicated in Figure 10. In all skill levels, the height of balls hit by the winners was higher than that of the losers. In the match of sub.A and sub.B, the height of the ball hit by sub.A who was considered the skilled player than that of sub.B ($p < 0.05$). This means that the winners hit the balls at a high position. In order to have more possibility to win the match, it is necessary to hit the balls at the higher position.

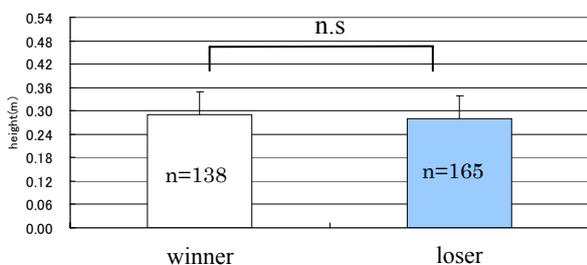


Figure 9 The average ball flight height of the hit ball in all rallies of all matches

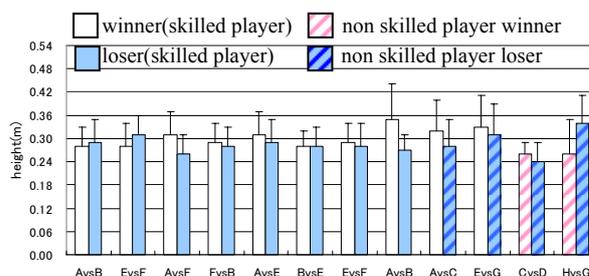


Figure 10 The average ball flight height of each match according to winners and losers

4. CONCLUSION

The results of this study are summarized as follows. Observing an incidence angle gives coaches and players the possibility to assess the skills of table tennis even in different skill levels. On the other hand, height and speed of the balls passing above the net give the possibility to evaluate the contents of matches. As a result, higher the skill levels, the higher position, speed and larger incidence angle are necessary to win the game.

5. REFERENCES

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