OVERVIEW OF VIDEO DATA COLLECTION FOR 3-DIMENSIONAL MOTION ANALYSIS DURING THE FINAL ROUNDS OF THOMAS & UBER CUP 2000 BADMINTON CHAMPIONSHIPS

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The aim of this paper is to report on the biomechanics project during the final rounds of Thomas & Uber Cup 2000 Badminton Championships. The results of three-dimensional analysis are also reported. To capture the data of world-class badminton players in competition, six synchronized video cameras were used to record video images at 50 field/second for 3-dimensional motion analysis during the Thomas & Uber Cup 2000 Badminton Championships in Malaysia. The semi-final and final matches were recorded. Some of the data was selected, analyzed and published in this paper.

KEY WORDS: video data, 3-Dimensional analysis, Thomas Cup, Uber Cup

INTRODUCTION: Badminton is one of the most intense competitive sports. There are many factors influencing the performance of badminton players, including technique, tactics, physiology, psychology, strength, and injury. The Thomas & Uber Cups are one of the most important competitions at world-class level. During the final rounds of the Thomas & Uber Cups, the world's top players would be expected to be playing at their best. It provides researchers a very good opportunity to collect technical data. This biomechanics project was a collaborative project of Singapore Sports Council (SSC), University of Malaya (UM) and National Sports Council of Malaysia (NSC). This project was also supported by the International Badminton Federation (IBF).

Badminton is one of the most popular sports in the South East Asian region. Elite players, coaches, researchers, junior players and parents in the region, as well as all over the world, are very interested in the techniques of world-class players in competition. The aim of this project was to collect and document the data of world-class badminton players playing in the Thomas & Uber Cups, so as to enable the different movements of these top players to be studied. The data of selected techniques were then processed and analyzed.

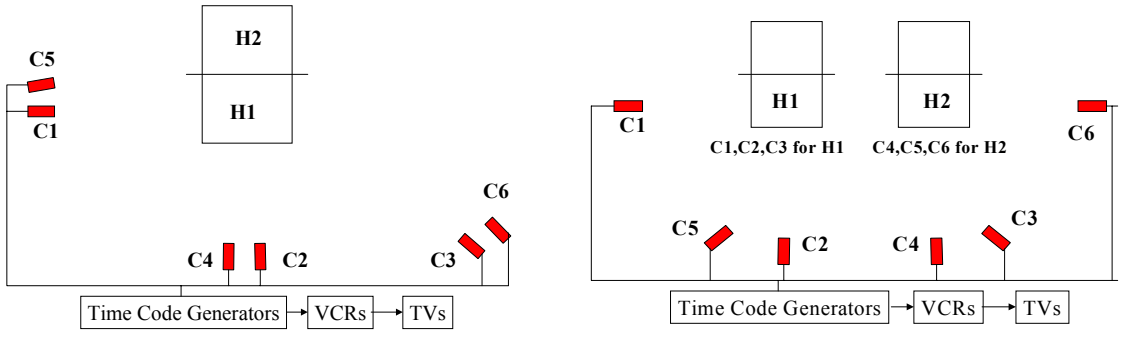

Figure 1 - The location of the cameras: (a) in semi-final and final (b) in preliminary.

This paper presents that the data collection in the competition arena during the 2000 Thomas & Uber Cups, and some of the results of 3-Dimensional analysis of the smashes used by the men's single players.

METHODS: Video was captured during the competition for three-dimensional motion analysis. The captured video was selected according to the technique to be analyzed. Then the selected video was digitized and analyzed, and the data was used to describe the techniques of the world-class players.

The matches were recorded from beginning to the end. As the matches lasted a few hours, it was not possible to acquire data at high speeds. In this project, six Panasonic WV-CP450 (PAL) color video cameras were applied to capture video during the match at rate of 50 fields/second and 1/500 shuttle speed, with three cameras focused on half the badminton court. Figure 1 shows the location of the cameras, with C1~C6 recording two courts. All the cameras were synchronized (genlock) using over 400 meters of cable. There were also six Horita SR-50 time code generators producing time code as event signals, which were recorded together with video image to be used for searching and synchronizing video during data processing. The video of selected techniques were processed and digitized using the Peak Motus Motion Analysis System.

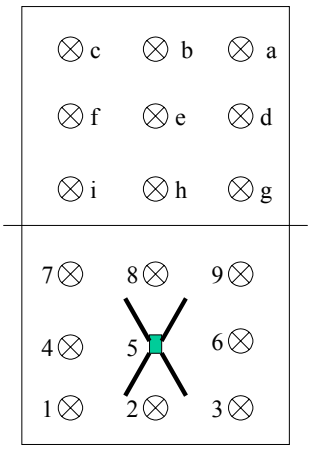

Figure 2 - Points of Calibration.

Since the calibration frame is much smaller than the moving range of players, the space was calibrated using multiple points in each half court. In this way, the techniques of badminton may be analyzed individually by using the different calibration points, for example, points 1, 2, 3, a, b and c for high clear, smash and drop shots. After each session of competition, the calibration frame was set up and calibration done point by point. To reduce the influence of the background, a black curtain was also placed behind the calibration frame for each camera view.

Only the forehand smash stroke of men's single players were selected and discussed.

RESULTS AND DISCUSSION: More than 30 hours of competition was recorded, including preliminary, semi-final and final matches of men's and women's team events. Figure 3 shows a series of stick figures of a smash stroke. The smash stroke is a typical offensive technique. Figure 4 shows the speed data of the shuttlecock during a smash stroke and Figure 5 shows the height of COM (taken from different trials). The speed curve is not smooth because the speed of the shuttlecock during the smash stroke is very fast and the contact time between racket and

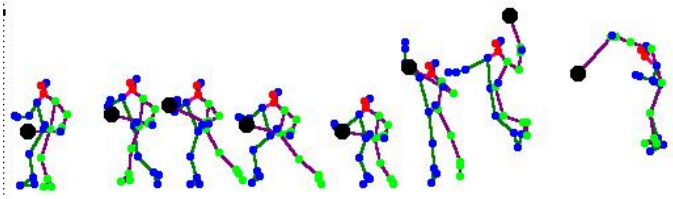

Figure 3 - Stick figures of a smash stroke.

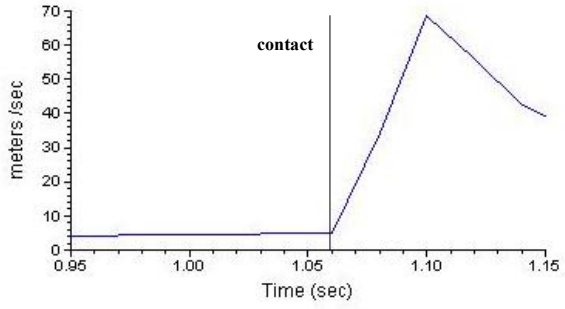

Figure 4 - Data of shuttlecock speed.

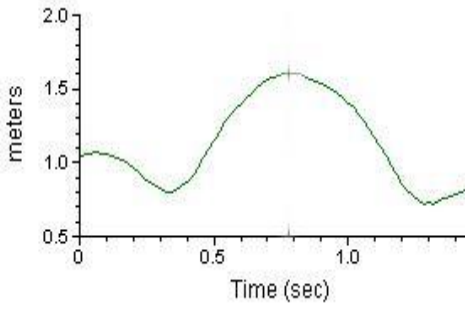

Figure 5 - Data of height of COM.

shuttlecock is very brief while the data was acquired at 50 fields/second. Table 1 gives the shuttlecock speed (V) and the maximum difference in height (∆h) between the center of mass (COM) before and during the forehand smash strokes of selected men's single players. The average speed of the shuttlecock in these analyzed trials ranged from 56.8 m/s to 64.9 m/s while the maximum achieved was 68.7 m/s. These data are similar to those reported in the literature. For world-class players, the average speed was less than from the data collected in the laboratory. This is because the conditions in competition are not as ideal as in the laboratory. Theoretically, individuals with longer limb segments have an advantage in terms of the longer segment and/or fully extending the joints would increase the length of the resistance arm, resulting in greater linear velocities at the end of the levers, thus producing a higher shuttle velocity. However, this is not applicable to every player. Another factor to be considered is that badminton is a tactical game. Players have to adapt to the environment in order to do well. As an example, every player has his/her technique in approaching the game. Some players tend to

Table 1 Speed of Shuttlecock V and Valley-Peak Value ∆h of COM

Men Players	Average V (m/s)	Maximum V (m/s)	Average ∆h (m)	Maximum ∆h (m)
XXZ	56.8	58.8	0.81	0.89
H	59.1	64.6	0.63	0.76
JXP	58.2	63.5	0.73	1.10
HT	62.4	68.7	0.70	0.90
PGC	56.0	58.7	0.61	0.88
PEHL	57.4	63.5	0.33	0.51
KJ	62.0	64.1	0.60	0.74
LHL	57.2	64.2	0.52	0.59
AJC	64.9	67.1	0.34	0.51

play rallies rather than to attack. This may influence the opponent to tag along with the game although their usual game may be different. There are times when players appear to do a jumping smash but actually perform a drop or slice shot. In other words, this player is deceiving the opponent in order to win a rally.

CONCLUSION: The collected data of the matches during the final rounds of the Thomas & Uber Cup 2000 Badminton Championships allowed biomechanists to analyze the motion of the players and the technique they used in a high level badminton competition. The shuttlecock speed of the jump smash of these world-class players ranged from 56.8 m/s to 64.9 m/s. The maximum speed was 68.7 m/s. The average maximum difference between the height of COM before and during the smash stroke (∆h) for the players studied varied from 0.33 m to 0.81m. The smash is considered the basic killing shot in the game of badminton. If it is used effectively, with varieties of angles and steepness or depth, it will create constant worry to the opponent, besides breaking the rhythm and confidence of their defense. As far as this preliminary study shows, there is no consistency between the shuttlecock linear velocity and height of COM. This can be attributed to several factors such as player strategy, weather and the anthropometry of the players. A player can achieve a high and powerful smash stroke without achieving a high height of COM. This is possible because of the powerful arm movement and longer limb segment. On the other hand, higher height of COM may be associated with a weaker smash stroke. This is because badminton is a game which not only involves technical aspects but also the tactical aspects. Players have their own tactical strategy in facing their opponents, including

the use of deception. For example, the player may pretend to do a jump smash stroke but actually perform a drop or slice shot. This would result in a high COM but a low shuttlecock linear velocity. Data acquired during the Thomas & Uber Cup would not only be helpful for quantitative analysis of the technique of these elite players, but also be very useful for coaches working with junior players. It would also enable the characteristics of the game played currently at the highest level to be captured for comparison with those in the past and future.

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