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Coefficient of Restitution in Badminton Racket

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Abstract – In the sport of badminton, the racket holds an important role in controlling the game play itself where it is the main instrument to drive the shuttlecock used. Compared to other racket sports such as tennis, there are still lacks of research that has been done on badminton rackets. Enhancement on the design of the racket can improve the performance of the player. However, the parameters that affect the design of badminton racket are still unclear. The aim of this study is to investigate the behavior of the coefficient of restitution (COR) on badminton racket. This paper tries to discover the areas or points of the maximum and minimum value of COR. In this research, a high speed camera was used to record the rebound height of the shuttlecock. From this data, the values of the COR were obtained. It is concluded, the area of maximum value of COR is suitable for returning smash and placing the shuttlecock to the base line while the area of minimum COR is recommended for the smash and placing the shuttlecock near the net.

Keywords – Badminton, Racket, Coefficient of Restitution

I. INTRODUCTION

Badminton is commonly known as the fastest racket sport due to the shuttle speed compare to others racket sport. It was recorded that the fastest smash for badminton racket was about 421 km/hour. Thus, shows that badminton is a high intensity game that required a good agility and speed to the player. One of the factors that contribute to the increasing performance of the game is due to technology development on badminton racket.

There are lots of effort that has been done by badminton racket manufacturer in order to enhance the racket performances such as improving the material used, optimizing the racket shape and weight. Traditionally, badminton racket frame was made from wood and oval head shape. Now a day, the evolution of racket design brings to new design which the latest is isometric head shape racket with much more good material. The others head shape design has ever produced are such as diamond and teardrop shape.

This evolution of badminton racket is to enhance the performance of the racket itself such as increase the accuracy and speed of the shuttlecock and at the same time help to increase the performance of players. Hitting shuttlecock on the right area or spot on racket face can give lot advantage such as reduce the jarring on the griping handle, produce more accuracy and imparts maximum speed to the shuttlecock.

However, there are still lacks of research on badminton racket about the characteristics and behavior of the exact spot or area on the racket that badminton player should hit the shuttlecock. Some theories from tennis racket research can be used in this investigation because of some similarity between both racket tennis and badminton. Based on tennis racket previous research, a great area or spot to hit the ball on a racket can be found anywhere on the longitudinal axis between the tip and throat depending on the incident speed of the ball [1].

One of the most interesting parts in this paper is to investigate the existing and behavior of COR on badminton racket. Furthermore, aims of this study is to discover the area or points where the value of COR is maximum and minimum.

II. MATERIAL AND METHOD

A. Coefficient of Restitution

Basically, coefficient of restitution (COR) is a ratio of a rebound velocity to the incident velocity. Other than that, it can be also measured by determining the rebound height and drop height which based on

$$\text{COR} = \sqrt{h_r / h_d} \qquad (1)$$

where h_r is rebound height and h_d drop height [1]. To obtain the maximum and minimum value of COR in badminton racket, the racket handle was clamped and the shuttlecock was dropped on certain height. Then, the value of rebound height was recorded. In this research, the rebound height was recorded by using high speed camera [2].