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Finite Element Analysis on Badminton Racket Design Parameters

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Abstract

In the sport of badminton, the racket plays an important role because it is the main instrument to drive the shuttlecock. A good design of the racket is crucial to achieve better game performance. However, there is inadequate scientific study in the development of badminton racket design. The aim of this research is to identify the characteristics of racket design parameters which influence the racket performance. Designing a racket requires one to fully understand the racket performance characteristics. Basically, racket performance is referred in terms of sweet spot, which is the spot on a racket head that produces more power and control if a shuttlecock hits on it. Determination of coefficient of restitution (COR) can help to determine the sweet spot on a racket. In this study, several designs of badminton rackets were analyzed using finite element approach to investigate the design parameters that influence a racket performance. Each racket model was created in three-dimensional CAD software (SolidWorks®) and imported into ABAQUS (Explicit) for finite element analysis. The finite element simulation mimics the collision between rubber ball and badminton racket. The results from finite element simulation were compared with experimental results for validation. The parametric studies were conducted using validated finite element model to investigate the effect of string tension, racket structural stiffness, and racket head shape designs with respect to racket performance. Reducing the string tension from 34 lbs to 14 lbs could increase 2.4 % of COR. There was at least a 6 % difference in COR between hollow shaft and solid shaft. Isometric head shape racket produces better COR compared to oval and round shape. It is recommended that, the racket design should consist of low string tension, stiffer racket shaft, and bigger head size in order to produce higher shuttlecock speed.

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