

Proposal Title:

Determining the Relationship between tennis racket head area and sweet spot area.

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1. Executive Summary

A tennis racket's sweet spot is an area of low vibrations and being able to hit the ball on the sweet spot results in better shots (i.e. they land on the other side of net as intended). A better understanding of the area of a sweet spot can help inform decisions of racket purchase because rackets are usually used for long periods of time and can become quite expensive. This experiment will use three accelerometers, and an impact hammer to try and generate a transfer function of the vibration of the racket based on location.

2. Objective question

What is the ratio of the area of racket head to the area of the sweet spot?

3. Interest

I've been playing tennis for the past couple of years and generally enjoy finding little ways to improve my game (on top of practicing). Buying a tennis racket is usually a very thorough process because they can get expensive and last a long while. I've been using the same racket since I started in 2016. Being able to use the sweet spot of the racket to hit the ball usually results in the ball landing on the other side with more speed and power which is generally preferred. This experiment will be aimed to try and understand if there are larger sweet spots (normalized by overall racket head size) as this would make the racket more useful and likely worth the investment.

4. Physical Set-Up

This same setup will be applied to three rackets: Three uni-axial sensors will be attached to the racket head separated equidistantly from the center and each other. The rackets will be clamped horizontally to a strong surface and I will use the impact hammer on the center of the racket head and the surrounding area to get data of vibrations and vertical accelerations of the frame. The input will be the impact force from the impact hammer. Additionally the area of the racket head will be taken into account and this data can be gathered from the racket listing online.

5. Data Analysis

Fourier analysis will be used to determine the frequencies of the vibrations at different locations and possibly the transfer function that relates location, force and vibration. This transfer function would give us data on where the sweet spot of the racket is (areas of low vibration) and comparing the area of low vibration to the overall area will give us a ratio for comparing different rackets.

6. Conclusions

If I can find the transfer function for each racket and compare the ratios I'd be able to say that the racket with the ratio closest to 1 (area of sweet spot/area of racket) would be worth the investment and be more useful to a player than the one with the lower ratio. Additionally, results could be used with price values to see if there is an optimal price for a good (has a high area ratio) racket.