The Study of the Effect of Topspin on the Trajectory of a New Tennis Ball

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A defining, yet complicated aspect of tennis is the spin. It was evident that spin greatly alters trajectory after impact, but spin had also been identified to affect aerodynamics while the ball was in flight. The Magnus Effect states that spinning causes an unbalance of pressure around the ball, generating a net lift force. This phenomenon can influence all tennis players—from professionals known for their tactical shots to beginners that have trouble adjusting to balls with spin. Most previous studies had only analyzed a spinning ball's aerodynamic coefficients in wind-tunnels, and a direct relationship between spin and displacement remains generally a qualitative observation. Therefore, this paper sought to quantify the effect of increasing topspin rates on the trajectory ranges in real tennis-play. In the experiment, 100 trials were launched with a ball machine and filmed overhead at an indoor tennis court for spin rates of 0, 450, 950, and 1400 rpm. The locations of the first bounces were identified via the frame-by-frame video analysis application CoachMyVideo (CMV). The trajectory displacements were calculated from an arbitrary reference point using the image-processing application ImageJ before being applied to a mathematical model. After data extraction, statistical analyses with the one-way ANOVA test and one-tailed t-tests confirmed that increasing the spin rates did significantly decrease displacement. Therefore, the results can be applied in tactical shots or in teaching beginners to understand ball placements. Ultimately, this study verified the significance of the Magnus Effect in tennis, suggesting the possibility of additional investigations in engineering applications.