

CHANGES OF BALL SPIN DURING FLIGHT OF KICKED SOCCER BALL

Takumi Tsukada and Shinji Sakurai

School of Health and Sport Sciences, Chukyo University, Toyota, Japan

KEY WORDS: soccer ball, spin rate, spin axis

INTRODUCTION: Flight trajectories of balls are changed by the lift force, which closely relates to the direction and rate of the ball spin. It was reported that soccer balls decelerate 20-28% after 20m flight (Bray and Kerwin 2003), while there has been no study about the changes of the direction of the spin axis and the spin rate of soccer balls in flight. The purposes of this study were to investigate the changes of the direction of the spin axis and the spin rate of the soccer ball in the flight, and to obtain a basic knowledge about the flight of kicked soccer balls.

METHOD: Three male soccer players participated in this study. The subjects were asked to kick the ball 30 times to a goal located at a distance of 18m with various speed and spin rate. The soccer ball trajectories were filmed using two synchronized video cameras. Three-dimensional ball trajectories were obtained using DLT procedures. At the same time, the ball was filmed just after the ball impact and after 18m flight to obtain the angles of the spin axis and the spin rate using two other video cameras. The optical axes of the cameras were set parallel or perpendicular to the ball flight direction, and the lenses were set so that the image size was maximized. Twenty two trials from 90 kicks in which the ball was in the video image both before and after ball flight were selected for the analysis. The direction of the three-dimensional spin axis and the spin rate were calculated based on the positional changes of the markers drawn on the ball surface (Jinji and Sakurai 2006).

RESULTS AND DISCUSSIONS: Initial speed of the kicked balls ranged from 19-31 m/s, and decreased 16-28 % after 18 m flight (Figure 1). The deceleration rate of slow speed ball is larger than the deceleration rate of fast speed ball. Initial values of the ball spin rate were 2.3-10.1 rps, and decreased 5-15% after 18m flight (Figure 2). In general the deceleration rate was smaller, compared to that for ball linear speed and it was irrespective of the initial spin rate value. The direction of the spin axis was almost the same before and after the flight. From these results, the lift force act the kicked soccer ball is considered to be decreased as flies in the air. But the direction the lift force acts the kicked soccer ball is not change.

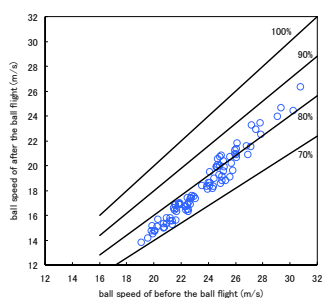


Figure 1: Changes of the ball speed before and after the ball flight

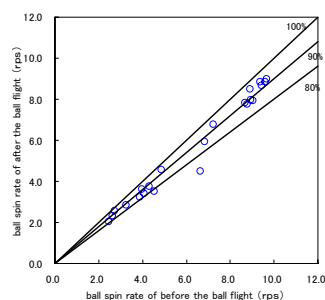


Figure 2: Changes of the spin rate before and after the ball flight

REFERENCES:

- Jinji, T. and Sakurai, S. (2006) Direction of spin axis and spin rate of the pitched baseball. *Sports Biomechanics*, 5, 197-214
- Bray, K. and Kerwin, D. G. (2003) Modelling the flight of a soccer ball in a direct free kick. *Journal of Sports Sciences*, 21, 75-85