

FLYING CHARACTERISTICS OF KNUCKLE BALL IN FOOTBALL

Hong, S. 1) & Asai, T. 2)

1) Department of Comprehensive Human Sciences, University of Tsukuba, Japan.

2) Institute of Health and Sport Sciences, University of Tsukuba, Japan.

Keywords: Knuckling Effect Ball, Knuckle Ball, Non-Spinning

Introduction

It is easy to find the non-spinning or low-spinning footballs in recent football games in which the trajectory of balls represents a characteristic of swing that is called as a knuckle effect ball or knuckleball as an unsteady phenomenon. The purpose of this study is to analyze the aerodynamic force and frequency that affect the flying knuckleball kicked by an actual football player using high-speed video cameras and a smoke agent considered the unsteady aerodynamic characteristics of the knuckleball.

Methods

This study measured the trajectory of a flying ball kicked by an actual kicker and visualized the air flow around the ball by coating a smoke agent on the surface of the ball. Balls were halted at the distance of 25 m in front of the goalpost, and a high-speed video camera (1000 fps) and a semi-high-speed video camera (300 fps) were installed at the side of the halted position with a distance of 8 m.

Results & Discussion

For considering the overlap of the dynamic behaviours between the trajectory of knuckle balls and the vortex undulation, it can be seen that the vortex discharged from the trajectory of balls undulated upper and lower directions. Although the large scale undulation trajectory and the ball trajectory represented as different ways, it showed a reverse phase in the comparison of the waveform of the lift force of vertexes applied to the undulation waveforms and balls. As mentioned above, irregular lift forces applied to the knuckleballs were largely caused by the large scale vortex undulation.

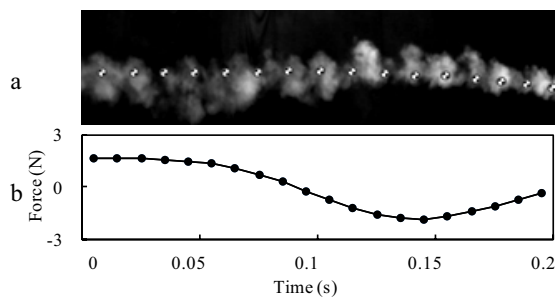


Fig. 1 Relation between large-scale undulation of vortex street (a) with vortex lift force (b) in real flight of a soccer ball. Ball trajectory using a digital technique (a) (Flow is from right to left).

Conclusion

The undulation presented in the large scale vortex of the wake flow in knuckleballs can be considered as a basic mechanism that generates irregular forces applied to the balls.

References

1. Hong, S. & Asai, T. (2010). *Japan J. Phys. Educ. Hlth. Sport Sci*, 55(2): 553-563.