Zhong, Hongjie; **Lee, Cunbiao**; **Su, Zhuang**; **Chen, Shiyi**; **Zhou, Mingde**; **Wu, Jiezhi**

Experimental investigation of freely falling thin disks. I: The flow structures and Reynolds number effects on the zigzag motion. (English) Zbl 1284.76035

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Summary: This paper describes an experimental investigation of the dynamics of a freely falling thin circular disk in still water. The flow patterns of the disk zigzag motion are studied using dye visualization and particle image velocimetry. Time-resolved disk motions with six degrees of freedom are obtained with a stereoscopic vision method. The flow separation and vortex shedding are found to change with the Reynolds number, Re. At high Reynolds numbers a new dipole vortex is shed that is significantly different from Kármán-type vortices. The vortical structures are mainly composed of leading-edge vortices, a counter-rotating vortex pair and secondary trailing-edge vortices. The amplitude of the horizontal oscillation is also dependent on the Reynolds number with a critical Reynolds number $Re_{cr} \approx 2000$, where the oscillatory amplitude is proportional to Re for $Re < Re_{cr}$, but becomes invariant for $Re > Re_{cr}$. Three-dimensional dipolar vortices were also observed experimentally.

MSC:

76-05 Experimental work for problems pertaining to fluid mechanics
76D17 Viscous vortex flows
70E99 Dynamics of a rigid body and of multibody systems

Keywords:

aerodynamics; flow-structure interactions

Full Text: DOI

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