Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

Experimental study of the fluid and structure interaction for gravity driven falling plates RUIJUN TIAN, FANGJUN SHU, New Mexico State University — Falling motion of thin plates and the induced flow field were investigated in this study. Time-resolved 2-D PIV measurements were conducted to investigate the dynamic development of the flow field induced by falling plates submerged in water. Two types of falling motions were observed, fluttering (sliding from side to side while descending) and tumbling (continuously rotating while falling downward and sliding to one direction), depending on the plate material and the physical dimensions, which forms a few governing non-dimensional parameters. The time-resolved PIV images, which also contain the plate location information, were further processed to extract the location and orientation of the plate. The data were then numerically differentiated to acquire the plate's translational and angular speeds and accelerations. Thus, the instantaneous hydrodynamic force/moment on the plates and the surrounding flow field were correlated to perform empirical analysis on this classical unsteady fluid and structure interaction (FSI) problem. It is discovered that the leading edge vortex plays an important role since its development is drastically related to the dynamic features of falling plates, though it is still unclear if the vortex shedding causes or results from the plates' movement. A theoretical model is proposed to simulate the dynamic features of the falling plates, which will be compared with the experimental data.

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Date submitted: 01 Aug 2014 Electronic form version 1.4