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Experimental study of the fluid structure interaction for falling cards RUIJUN TIAN, COULTON SADLER, FANGJUN SHU, New Mexico State University — In this experimental study, high-speed visualization and PIV measurements were conducted to investigate the dynamic evolution of the flow field generated by gravity driven falling cards. Experiments were done in both water and air using glass slides, which are transparent to avoid laser blockage. Fluttering motion (card sliding from side to side while descending) was observed in water while tumbling motion (card rotates w.r.t. it long axis) happened in air. High-speed images of the falling cards were acquired and processed to analyze its kinematics including velocities and accelerations, both translational and rotational. From the card kinematics, the instantaneous fluid dynamic forces/torque were derived, they were related to the surrounding flow field measured using PIV. It is found that the leading edge vortex plays an important role in falling mode. Its evolution and shedding is closely related to the change of translational and angular acceleration of the falling plates, thus influence the falling mode. In the same fluid, a narrow card intends to tumble while a wide card intends to flutter, mainly due to increased moment of inertia. An empirical or theoretical theory is to be developed to predict the motion and trajectory of a gravity driven falling card.

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