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High amplitude surging and plunging motions at low Reynolds number JEESOON CHOI, TIM COLONIUS, Caltech, DAVID WILLIAMS, IIT, CALTECH COLLABORATION, IIT COLLABORATION — Aerodynamic forces and flow structures associated with high amplitude oscillations of an airfoil in the streamwise (surging) and transverse (plunging) direction are investigated in two-dimensional simulations at low Reynolds number (Re=$10^2 \sim 10^3$). While the unsteady aerodynamic forces for low-amplitude motions were mainly affected by the leading-edge vortex (LEV) acting in- or out-of phase with the quasi-component of velocity, large-amplitude motions involve complex vortex interactions of LEVs and trailing-edge vortices (TEVs) with the moving body. For high-amplitude surging, the TEV, instead of the LEV, induces low-pressure regions above the airfoil during the retreating portion of the cycle near the reduced frequency, k=0.5, and enhances the time-average forces. The time required for the LEV to convect along the chord becomes an intrinsic time scale, and for plunging motions, there is a sudden change of flow structure when the period of the motion is not long enough for the LEV to convect through the whole chord.

Jeesoon Choi
Caltech

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