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Unsteady force measurement of SD7003 foil under pitch-up, hold and pitch-down motion at Re = 1x10^4 for Micro Aerial Vehicle applications SUTTHIPHONG SRIGRAROM, SIM University, WEE SERN CHAI, Nanyang Technological University — The unsteady force applied on the SD7003 foil under pitch-up, hold and pitch-down motion was studied. This canonical pitch-up, hold and pitch down motion pattern resembles the transient lift creation during perching of the micro aerial vehicle in flapping flight. The 2D SD7003 foil with pivot point at 1/4 chord was tested in water tunnel at Reynolds of 1 x 10^4. Three pitch-up rates corresponds to pitch rate, $\Omega+ = 0.2$, 1.4 and 2.8 (reduced frequency, k = 0.62, 4.33, and 8.65) were tested. This is to investigate the effect of rapid pitch and magnitude of the leading-edge vortex (LEV) on the non-linear lift. The faster pitch-up rate results in the stronger lead-edge vortex and deeper subsequent dynamic stall. The non-circular lift due to acceleration effects are captured and shown in $\Omega+ =$ 1.4 case. The effect of the hold time after pitch-up motion was also examined. For the $t_{hold}/t+ = 1.00$ ($t+ \equiv c/U_\infty$), the LEV created during ramp-up motion remains over the foil to provide vortex lift at longer period, resulting in larger average lift over the cycle in comparison to the $t_{hold}/t+ = 0.05$. In addition, the spike in C_L during high-Frequency low-Re ramp and return are captured when k = 0.62. The dominant frequency is found to be O(10) Hz observed from power spectral density.

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