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Unsteady fluid dynamics around a hovering wing SWATHI KRISHNA, EPFL, Switzerland, MELISSA GREEN, Syracuse University, USA, KAREN MULLENERS, EPFL, Switzerland — The unsteady flow around a hovering flat plate wing has been investigated experimentally using particle image velocimetry and direct force measurements. The measurements are conducted on a wing that rotates symmetrically about the stroke reversal at a reduced frequency of $k = 0.32$ and Reynolds number of $Re = 220$. The Lagrangian finite-time Lyapunov exponent method is used to analyse the unsteady flow fields by identifying dynamically relevant flow features such as the primary leading edge vortex (LEV), secondary vortices, and topological saddles, and their evolution within a flapping cycle. The flow evolution is divided into four stages that are characterised by the LEV (a)emergence, (b)growth, (c)lift-off, and (d)breakdown and decay. Tracking saddle points is shown to be helpful in defining the LEV lift-off which occurs at the maximum stroke velocity. The flow fields are correlated with the aerodynamic forces revealing that the maximum lift and drag are observed just before LEV lift-off. The end of wing rotation in the beginning of the stroke stimulates a change in the direction of the LEV growth and the start of rotation at the end of the stroke triggers the breakdown of the LEV.

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