Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Effect of advanced and delayed rotation on the dominant flow pattern and its temporal evolution ESRA UKSUL, TU Darmstadt, SWATHI KRISHNA, Syracuse University, KAREN MULLENERS, EPFL — During a flapping cycle of an insect, complex time dependent flows are produced as the wing reciprocates, producing a maximum lift at the stroke reversals. By flipping the wing rapidly at the end of each stroke, the insect modulates the flow around the wing and hence the aerodynamic forces necessary to hover. The duration and starting point of the flip play an important role in determining the amount of lift produced. To understand and tailor the effect of wing kinematics on the aerodynamic performance we focussed on the vortex dynamics of the flow field. Phase-averaged data from particle image velocimetry was used to evaluate the flow features inherent to changes in rotation during a stroke of a flat plate, which is modelled based on hoverfly characteristics. The period of rotation is one-third of the total time period. A +10% phase shift is used for delayed rotation, a -10% phase shift for advanced rotation. Vortex detection methods like the λ_2 and Γ_2 criteria are used to determine the effect of a delay or early rotation on the trajectories, size, shape and location of the prominent vortical structures. Proper orthogonal decomposition is used to study the influence of the phase-shifts on the dominant mode structure and the related time-scales.

Karen Mulleners
EPFL

Date submitted: 21 Jul 2015 Electronic form version 1.4