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Nomenclature

Re	Reynolds number
MAV	Micro aerial vehicle
Cfd	Computational fluid dynamics
UDF	User defined function
LEV	Leading edge vortex
R	Wing length
c	chord length
C_p	Pressure coefficient
C_l	Coefficient of lift
C_d	Coefficient of drag
α	Angle of attack
ψ	Azimuth angle or sweeping angle
$\dot{\psi}$	Angular velocity during sweeping motion
$\dot{\alpha}$	Angular velocity during pitching motion
r_2	Radius of second moment of wing area
rc	root chord
t	taper ratio
AR	aspect ratio
MAC	Mean aerodynamic chord

ABSTRACT

Leading edge vortex (LEV) formation is considered a dominant factor for high lift production during insect flapping. Previous studies suggest that LEV occupies the separation zone on suction side of the wing and does not shed even after many chords of travel. The development of micro aerial vehicle (MAV) inspired from nature is an active area of research. MAV operates at Reynolds number 10^4-10^5; slightly higher than the insects Re range. The motivation behind present research is to investigate whether "stall-absent" phenomenon manifests at Re 34000, representative of MAV. Corrugated dragonfly airfoil with rectangular wing planform is used and wing motion kinematics is restricted to azimuth rotation. Three dimensional finite volume method Fluent is used to numerically solve time dependent incompressible Navier-Stokes equations using pressure based solver.

Computed results at Re 34000 and 100,000, reveal the same phenomena of leading edge vortex formation, as observed in case of insects. There is an intense spanwise flow, comparable to chordwise velocity that ensures that the LEV does not grow in size and sheds. Furthermore, parametric study is also conducted to see the effect of angle of attack, acceleration duration, aspect ratio, and wing planform on corrugated wing in sweeping motion. It was also observed that there is no noticeable difference in aerodynamic efficiency of the wing, subjected to geometric variation.