MIMICKING THE MECHANISM OF LIFT GENERATION IN DRAGONFLIES

G.K Suryanarayana, K.M. Naveen*
CSIR-National Aerospace Laboratories
Post Box No. 1779, Kodihalli
Bangalore-560 017, India
Email : gksuryanal@gmail.com
*CFD Engineer
Siemens Technologies and Solutions Pvt Ltd
Bangalore

Vidyadhar Y. Mudkavi
CSIR-4th Paradigm Institute
NAL Belur Campus
Bangalore-560 037, India

Abstract

Human pursuit of flight has learnt many lessons from nature and a few adaptations have led to phenomenal progress. Insect flight uses complex unsteady aerodynamics to generate lift in addition to producing thrust. A close look at the dragonfly provides some clues to mimic its flight using passive means by separating propulsion and lifting mechanisms. Though the dragonfly can independently flap each of its wings to generate lift and thrust, during forward flight, fore-wings alone flap while the aft-wings remain nearly steady. We adopt this as basis for new passive configurations to generate steady lift. Conceptually, we replace fore-wings with a cylinder that is known to shed vortices, to mimic flapping. A simple plate replaces the aft-wings. Flow analysis of such a configuration at Reynolds Number of 7500 revealed a steady flow topology featuring a trapped vortex over the plate, resulting in steady lift to drag ratio of 3. A further optimized configuration consisting of a semi-circular cylinder upstream and a cambered plate downstream resulted in lift to drag ratio of 14.5, which is considerable for these flow regimes, opening up new possibilities for design of nano-flight vehicles.