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Flow around a corrugated wing over the range of dragonfly flight.
SOORAJ PADINJATTAYIL, AMIT AGRAWAL, Indian Institute of Technology Bombay — The dragonfly flight is very much affected by the corrugations on their wings. A PIV based study is conducted on a rigid corrugated wing for a range of Reynolds number 300-12000 and three different angles of attack (5^o-15^o) to understand the mechanism of dragonfly flight better. The study revealed that the shape of the corrugation plays a key role in generating vortices. The vortices trapped in the valleys of corrugation dictates the shape of a virtual airfoil around the corrugated wing. A fluid roller bearing effect is created over the virtual airfoil when the trapped vortices merge with each other. A travelling wave produced by the moving virtual boundary around the fluid roller bearings avoids the formation of boundary layer on the virtual surface, thereby leading to high aerodynamic performance. It is found that the lift coefficient increases as the number of vortices increases on the suction surface. Also, it is shown that the partially merged co- rotating vortices give higher lift as compared to fully merged vortices. Further, the virtual airfoil formed around the corrugated wing is compared with a superhydrophobic airfoil which exhibits slip on its surface; several similarities in their flow characteristics are observed. The corrugated airfoil performs superior to the superhydrophobic airfoil in the aerodynamic efficiency due to the virtual slip caused by the travelling wave.

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