INSECT FLIGHT — VISUALIZING AND MEASURING THE FLOW

RICHARD J. BOMPHREY

Department of Zoology
University of Oxford
South Parks Road, Oxford, OX1 3PS
United Kingdom
richard.bomphrey@zoo.ox.ac.uk

Recent interest in the development of flapping wing Micro-Air Vehicles (MAVs) has led back to investigations of animal flight, which had been somewhat neglected by the aerodynamics community since the focus shifted to ever faster, piloted aircraft. The high-lift aerodynamic mechanisms of insects, in particular, have intrigued numerous biologists and engineers, sporadically leading to infamous publicity such as the 'bumblebee paradox'. Classical and modern techniques have been applied to the subject over the past decade in the form of smoke wire flow visualizations and, even more recently, Digital Particle Image Velocimetry (DPIV). Large-scale mechanical models and live flying insects have been employed, with the living subjects either in free or tethered flight. These experiments have helped us to understand the qualitative flow topologies utilised by insects, and begun to quantify their role in lift generation.

Yet it is not just the MAV builders who benefit from this interaction. Once novel flow measurement techniques are applied to insects, the data yielded can be of great interest to evolutionary biologists wishing to understand which selective pressures have resulted in the enormous diversity of insect wing morphology we see today. As wings are primarily used for flight, it could be reasonable to assume that they are optimised for that task, but it is not known whether aerodynamic efficiency or other determinants affect wing shape. Other pressures might include sexual selection, armoured defence from predators, or the need for a toughened exterior to combat abrasion when living in the hustle and bustle of a high density community. Here I aim to review the current state-of-the-art of flow visualization, topology description, and wake velocity measurement of live flying insects.

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