Understanding housefly flight with broken wings: a numerical perspective

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Abstract

Flying insects, spectacular little flapping machines with enormous evolutionary success, are an invaluable source of inspiration for a large, interdisciplinary community of scientists. The aerodynamic mechanisms they use for propulsion are quite different from human-designed flying machines, and many aspects of their locomotion are not yet understood. In this talk I will show our latest results on housefly (musca domestica) flight with broken wings. We combine wing wear experiments, in which we study how wing damage progresses over time, with state of the art numerical simulations of the aerodynamics of flies with broken wings. The numerical simulations are done with our in-house open-source solver "WABBIT", which combines wavelet-based adaptivity with an efficient parallelization to exploit massively parallel supercomputers. From those high-fidelity data, we derive a simple aerodynamic model, which, combined with the full-scale simulations, allows us to explain the energetic cost of flying with broken wings. This insight allows us to draw conclusions on the reserve flies are built with, which is potentially an important guideline for the design of aerial robots.

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