PHYSICAL MATHEMATICS SEMINAR

Uncovering the Aerodynamics of the Smallest Insects using Numerical and Physical Models

LAURA MILLER

Departments of Mathematics and Biology
University of North Carolina at Chapel Hill

ABSTRACT:

A vast body of research has described the complexity of flight in insects ranging from the fruit fly, *Drosophila melanogaster*, to the hawk moth, *Manduca sexta*. The smallest flying insects have received far less attention, although previous work has shown that flight kinematics and aerodynamics can be significantly different. In this presentation, three-dimensional direct numerical simulations are used to compute the lift and drag forces generated by flexible wings to reveal the aerodynamics of these tiny fliers. An adaptive version of the immersed boundary method is used to simulate simplified flexible wings in pure translation, rotation, and performing a 'clap and fling' maneuver. Results are validated against dynamically scaled physical models using particle image velocimetry. At the lowest Reynolds numbers relevant to tiny insect flight, the ratio of lift to drag forces decreases. For Reynolds numbers below 10, the relative forces required to rotate the wings and perform 'clap and fling' become substantially greater. Wing flexibility can reduce the drag forces necessary to fling the wings apart while increasing the peak and average lift forces produced during the stroke. These results indicate that flexible clap and fling can improve tiny insect flight efficiency in some situations.

TUESDAY, APRIL 24, 2012
2:30 PM
Building 2, Room 105

Reception at 3:30 PM in Building 2, Room 290
(Math Dept. Common Room)

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