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Insect Flight: Aerodynamics, Efficiency, and Evolution

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Insects, like birds and fish, locomote via interactions between fluids and flapping wings. Their motion is governed by the Navier-Stokes equation coupled to moving boundaries. In this talk, I will first describe how dragonflies fly: their wing motions and the flows and forces they generate. I will then consider insects in several species and discuss three questions: 1) Is insect flight optimal? 2) How does the efficiency of flapping flight compare to classical fixed-wing flight? 3) How might aerodynamic effects have influenced the evolution of insect flight?