Biomechanics of insects flight

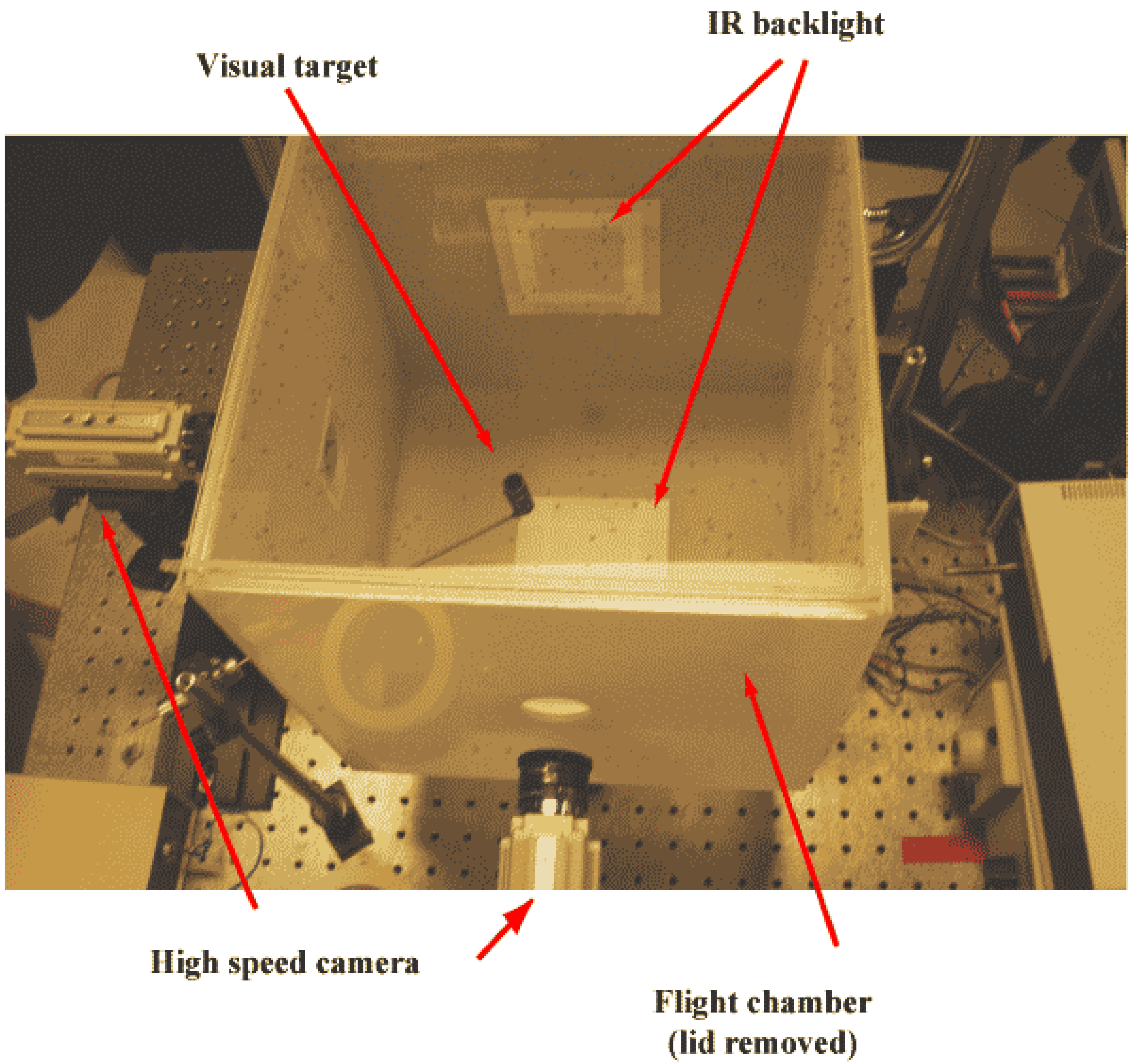
Project Overview

A functional understanding of neural flight control pathways requires a detailed understanding of the biomechanical context in which flight control takes place. Fruit flies provide interesting opportunities to explore flight biomechanics both under stationary hovering conditions, as well as during lightning quick turning maneuvers. This research is performed in collaboration with the Dickinson Lab at Caltech

Aerodynamics of flight maneuvers

Filming

Flies perform acrobatic turns, called saccades, during which they reach an angular velocity of several thousand degrees per second. How do flies modify their wing motion to induce these incredibly fast turns? To explore this question, flies were filmed at 5000 fps and the wing motion analyzed using Kine. Surprisingly, slightest modifications of the stroke pattern are sufficient to induce fast turning after only a few wing beats. This is the setup used to film tiny and quick turning manevuers of fruit flies:



Force measurements

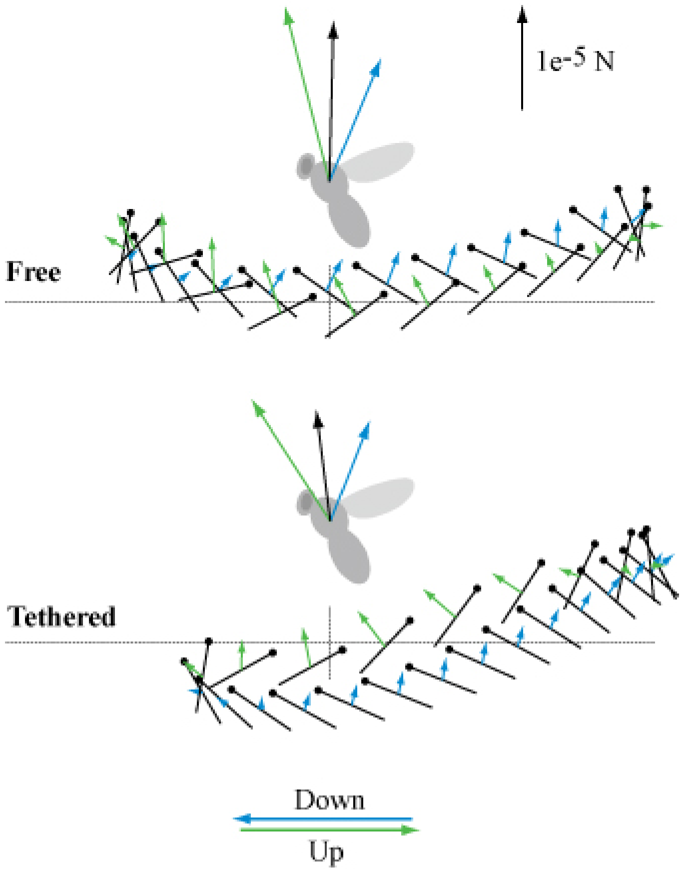
How do these changes modify the aerodynamic forces generated by the wings? Using a dynamically-scaled robotic wing model(Borf) it was possible to directly measure the force output of each wing during saccades, and calculate the aerodynamic torques acting on the body. These analysis reveealed that the aerodynamic torque controlled body acceleration (to overcome inertia), and not velocity (to overcome friction), as a long-standing dogma had it.

You can get a movie a flight maneuver filmed at 5000 fps from Science online and a smaller (8MB avi) here.

Aerodynamics of hovering flight

Other detailed measurements of aerodynamic forces, torques and power were performed in hovering fruit flies both under free-flight conditions, as well as during tethered flight.

A comparison of measurements between these two experimental conditions revealed quite drametic differences in motor behavior. While tethered flight preparations can provide powerful paradigms for the research of flight control, detailed free-flight studies must ultimately be performed to understand flight control function.



Reference	Biomechanics of insects flight http://fly.ini.unizh.ch/wiki/ResearchProjects/BiomechanicsOfInsectsFlight