Talk 1 (1.5hr)

Dragonflies in aerial pursuit of their prey

A dragonfly spends much of its day looking for food. Once it identifies a prey, the brain computes and decides an action. The action starts with the response of visual neurons, and continues down to motor neurons, which regulates the muscles. The muscles drive the movement of its four wings. The movement of the wings further generates aerodynamic forces and torques to turn the body. The body can roll, yaw, and pitch. How should a dragonfly adjust its wings so that it follows the desired trajectory to intercept its prey? We have been analyzing free flight data of dragonflies during their pursuits, gathered at HHMI's Janelia Farm's custom built dragonfly arena, to tease out control algorithms that dragonflies use. To start, we have focused on the body pitching dynamics, which is a stereotypical maneuver a dragonfly uses during the final capture of the prey. I will discuss an analytical model for the pitching dynamics that provides a theoretical framework for us to understand data as well as for inferring internal control torques.

Talk 2 (1hr)

Falling, fluttering, tumbling, spinning, and evolution of seeds

Why does a maple seed spin as it falls? Part of the explanation has to to do with laws of mechanics. The trajectory of a seed can be predicted by calculating the Euler equation, which governs the dynamic state of the seed, together with solving the Navier-Stokes equation, which governs the state of the surrounding air. Such a computation is complicated, I will instead describe experiments of falling maple seeds, from which we deduce the mechanisms responsible for maple seed’s initial transition into a helical motion.

But why does a maple seed evolve to such a shape so that it falls in a helical motion?
Not all seeds spin. Tulip tree seeds spin and tumble, and dandelion seeds float. All of these motions slow down seeds’ descent. In addition, I now think that the specific shapes of the seeds lead to steady motions that are stable against large perturbations. The stability and slow descent would enhance seed dispersal by wind. In contrast, the shapes of leaves are selected under different evolutionary pressure, and they tend to fall more erratically.