Center for Fluid Mechanics, Division of Applied Mathematics
Fluids and Thermal Systems, School of Engineering
Joint Seminar Series

TUESDAY – NOVEMBER 13, 2012
3:00pm
Barus & Holley, Room 190
Refreshments will be served in the lobby of Barus & Holley following the seminar

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A 'Tail' of Two Flagella: Surprising Mechanics of Swimming Cells

Motile single cells are ubiquitous in natural and man-made environments, and their physical interactions with their habitat play integral roles in a broad range of phenomena, from infertility to biofilm formation. In this talk, I will focus on two problems in the low Reynolds number locomotion of single cells – propulsion and turning – which are investigated using high-speed video microscopy. In the first part, I discuss the propulsion of biflagellated algae, which swim using two articulating flagella to search for nutrients, light, and mates. I will present the first measurements of the unsteady flow fields created by biflagellates, which revealed that the unsteadiness in propulsion increases power consumption by 400% compared to steady swimming. In the second part, I describe the motility of uniflagellated bacteria and focus on turning, since propulsion alone is useless without the ability to change direction. These bacteria have seemingly one degree of freedom: a rotary motor that drives a corkscrew-like flagellum, propelling the cell either forward or backward. Using high-speed imaging to directly track the 20 nm diameter flagellum, we discovered that some bacteria instead use their propulsive thrust to induce a buckling instability in the flagellum, making it bend off axis and thus reorienting the cell in a new direction. These examples illustrate the rich mechanics underlying microbial motility, which hold the potential to improve industrial and medical systems (e.g., bioreactors, in vitro fertilization) and to inspire novel solutions for micro-robotics.

Host: Kenneth Breuer (Kenneth_Breuer@brown.edu)