McCormick

Northwestern Engineering

Engineering Sciences and Applied Mathematics

ESAM Seminar Series Presents:

Fluid-Structure Interactions from Nano- to Macro-Scale, from Engineering to Biology to Medicine

Presented by:

Dr. Hassan Masoud

Courant Institute (NYU) and Princeton University

A fascinating class of problems in contemporary fluid mechanics involves the interplay between dynamic boundaries and fluid flows, the so-called fluid-structure interaction. These problems are of paramount importance in many engineering, biological, and biomedical contexts. In this talk, I will focus on two of such problems motivated, respectively, by the drug release from microcapsules during volume transitions and collective animal locomotion in fluids. First, I will employ a meso-scale computational method to probe the release of nanoparticles and linear macromolecules from microgel capsules that swell and de-swell in response to external stimuli. I will show that not only swelling, but also de-swelling of hollow microcapsules can be utilized for the controlled release. I will further present a novel approach for regulating the release of nanoparticles from de-swelling capsules. This method can be harnessed to design advanced drug delivery and release systems using stimuli-responsive microcarriers. Next, I will discuss the role of fluid dynamics in mediating fish schooling and bird flocking. To this end, I will examine the locomotion of arrays of flapping wings through experiment, simulation, and mathematical modeling. I will show that the wings can take advantage of their collectively generated wake flows and that there exist ranges of flapping frequency over which there are two stable states of locomotion, with one having both higher speed and efficiency than an isolated flapping and locomoting wing. By establishing how efficient collective locomotion emerges naturally for flapping bodies, these results may provide a physical basis for interpreting the structure and dynamics of animal groups and may give additional insight towards designing new kinds of energy harvesting systems.

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For further information see http://www.esam.northwestern.edu

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