LECTURE 1 - **Low-Reynolds number flows**

In this first lecture I will give an overview of low-Reynolds number hydrodynamics. My purpose is twofold. Firstly I wish to present the underlying mechanical principles behind a number of important processes occurring on very small length scales, for example in colloidal physics or microfluidics, which all require an intuitive understanding of Stokes flows. Secondly I want to set the stage for our use of hydrodynamics in biology at the cellular level, which will be discussed in the second lecture. Topics will include the equations of motion, the principle of reversibility, the reciprocal theorem, energy balance, the motion of solid bodies, the Green's function (Stokeslet) and flow singularities, the motion of slender bodies, and the Stokes-Einstein relationship.

Useful references:

- Happel & Brenner "Low Reynolds number hydrodynamics" (2nd ed, Springer, 1983)
- Kim & Karrila "Microhydrodynamics" (2nd ed, Dover, 2005)

LECTURE 2 - **Low-Reynolds number flows in biology**

In this second lecture I will present the classical hydrodynamics description of swimming microorganisms. The goal is to give an overview of the modeling efforts over the last 60 years relating the kinematics of swimming cells to their propulsion in simple and complex fluids. We will discuss both the locomotion of bacteria using helical rigid flagella as well as the swimming of eukaryotes actuating waving, flexible, flagella or cilia. Topics will include: re-interpreting the Reynolds number in the context of locomotion, the two physical consequences of low-Reynolds number swimming, examples of waving kinematics, modeling cilia arrays, and the effective diffusion of microorganisms.

Useful references:

- Lauga & Powers "The hydrodynamics of swimming microorganisms", Rep. Prog. Phys. 72, 096601 (2009).
- Brennen & Winet "Fluid mechanics of propulsion by cilia and flagella", Annu. Rev. Fluid Mech. 9, 339-98 (1977)