سمینار هفتگی ماده چگال نرم

The hydrodynamics of swimming microorganisms

Abstract

Cell motility in viscous fluids is ubiquitous and affects many biological processes, including reproduction, infection, and the marine life ecosystem. Here we review the biophysical and mechanical principles of locomotion at the small scales relevant to cell swimming (tens of microns and below). The focus is on the fundamental flow physics phenomena occurring in this inertia-less realm, emphasizing the simple physical picture. We review the basic properties of flows at low Reynolds number, paying special attention to aspects most relevant to swimming, such as resistance matrices for solid bodies, flow singularities, and kinematic requirements for net translation. Then we review classical theoretical work on cell motility: early calculations of a swimmer's speed with prescribed stroke, and the application of resistive-force theory and slender-body theory to flagellar locomotion. After reviewing the physical means by which flagella are actuated; we outline areas of active research; including hydrodynamic interactions, biological locomotion in complex fluids, design of small-scale artificial swimmers, and the optimization of locomotion strategies.

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