Indian Institute of Science
Centre for BioSystems Science and Engineering
BSSE Seminar

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Mechanics of Cell Motility: Swimming and Crawling

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ABOUT THE SPEAKER

Suhail did his B.Tech. and Ph.D. from IIT Kanpur in the Department of Biological Sciences and Bioengineering. After finishing B.Tech., he worked as a business analyst for Global Analytics (currently GAIN Credit Inc.) in Chennai where he specialized in the decision systems for the microlending platforms. During his Ph.D. he studied the mechanical behavior of fibrous biomaterials using theoretical modeling and numerical simulations. Currently, he is working as a CNRS postdoctoral fellow at the Laboratory of Interdisciplinary Physics in Grenoble, France. His research interests lie at the interface of biology and physics which include mechanics of cell motility, the role of mechanical forces in embryonic development and systems biology.

ABSTRACT

Motility is an essential characteristic of many biological cells. For unicellular organisms, such as bacteria, it is crucial for their survival. For multicellular organisms, it is required for many physiological functions, such as protection against pathogens by the immune cells, and also during embryonic development and in cancer metastasis.Chlamydomonas reinhardtii, an aquatic unicellular microorganism uses two flagellae to move from one place to another. Its small size results in negligible inertial forces and its motion is described using Stokes flow. Recently, immune cells have also been shown to move in fluid by similar mechanism where shape changes provide cell propulsion. This motion which does not require any support from solid substrate has been labelled “amoeboid swimming”. We have developed theoretical models to study the mechanical principles governing the amoeboid and flagellar swimming. Using these models and numerical simulations we have studied the cell swimming under external fields (forces and flows) and the role of hydrodynamic and ligand-receptor based interactions of amoeboid swimmers with substrates on their motility. We have found that the presence of swimmers in a suspension results in its non-Newtonian rheological properties. Unlike force-dipole based rigid swimmers, the suspensions of deformable amoeboid swimmers show a shear-thinning as well as shear-thickening behaviours. In the presence of an adhesive substrate, the amoeboid changes its motility mechanism from swimming to crawling. In this talk, I will show the transition between swimming and crawling modes of cell migration and the optimal ligand and receptor densities for fast cell crawling.