ME Seminar

MECHANICAL ENGINEERING
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Microswimmers in Complex Environments

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ABSTRACT

We study the dynamics of a model microswimmer, a squirmer, in a rheologically complex fluid, namely a nematic liquid crystal. We focus on the importance of anisotropy and elasticity of the suspending fluid in geometrical confinement towards the dynamics of an individual microswimmer. We employ our recently developed mesoscopic simulation method for nematic liquid crystals to simulate the squirmer dynamics which captures both hydrodynamics and thermal fluctuations. A squirmer in a homeotropically aligned nematic liquid crystal cell shows remarkable differences as compared to squirmer dynamics in Newtonian fluids. The squirmer trajectories depend strongly on the self-propulsion mechanism, self-propulsion strength, and degree of confinement. We have obtained three distinct types of behaviour: (i) steady swimming along the channel centreline for pullers, (ii) steady hovering near a wall for strong pushers, and (iii) oscillating motion for weak pushers. The steady hovering state of strong pushers near a wall has been found in recent experiments.

ABOUT THE SPEAKER

Dr. Shubhadeep Mandal is working as an Assistant Professor in the Department of Mechanical Engineering at IIT Guwahati. Prior to this, Shubhadeep was a Post-doctoral Fellow for two years in the of Max Planck Institute for Dynamics and Self-Organization in Gttingen, Germany. Shubhadeep has completed Bachelor of Mechanical Engineering from Jadavpur University in 2012, and subsequently Master of Technology and Doctor of Philosophy from IIT Kharagpur in 2014 and 2018, respectively. The broad area of Shubhadeeps current research is Active Soft Matter with special focus on the hydrodynamics of active particles in complex environments. Recently, he has developed a new mesoscopic particle-based simulation method for nematic liquid crystals called nematic multi-particle collision dynamics (MPCD) method, which incorporates both nematodynamic effects (anisotropic viscosity and elasticity) and thermal fluctuations.

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