# ME Seminar

## Bacterial and Microtubular Hydrodynamics

**Dr. Debasish Das, University of Strathclyde, Glasgow, UK**

### ABSTRACT

In this talk, I will discuss two topics: swimming bacteria near surfaces and cytoplasmic streaming in egg cells. Flagellated bacteria are hydrodynamically attracted to rigid walls, yet experiments show a 'hovering' state where they swim stably at a finite height above surfaces. We use numerics and theory to reveal the physical origin of hovering. Simulations show that hovering requires an elongated cell body and results from a tilt away from the wall. Theoretical models identify two essential asymmetries: the response of width-asymmetric cells to active flows created by length-asymmetric cells. A minimal model reconciles near and far-field hydrodynamics, capturing all key features of hovering.

The latter part focuses on the fluid dynamics of Drosophila oocytes (egg cells), which exhibit a rotating flow known as cytoplasmic streaming during a maturation stage. This process is crucial for establishing polarity and promoting cytoplasmic mixing. These flows are generated by flexible microtubules inside the cells. The minus ends of microtubules are anchored at the oocyte cortex, and kinesin-cargo complexes move along these microtubules, generating streaming flows in the viscous cytoplasmic fluid. I will show how a fluid-structure elastohydrodynamic instability of these microtubules explains cytoplasmic streaming.

### ABOUT THE SPEAKER

Dr. Debasish Das earned his bachelor's degree in mechanical engineering from the National Institute of Technology, Rourkela, followed by a master's degree in mechanical engineering from the University of Illinois, Urbana-Champaign, specializing in computational science and engineering. He then moved to the University of California, San Diego, where he completed his PhD in Mechanical Engineering. Subsequently, he held a post-doctoral research position in the Department of Applied Mathematics and Theoretical Physics (DAMTP) at the University of Cambridge for three and a half years. Currently, he is a Chancellor's Fellow in the Department of Mathematics and Statistics at the University of Strathclyde, Glasgow. His research interests include solving problems in biological and complex fluids using both analytical and computational methods.

**June 24, 2024, 11:00 AM, AR Auditorium, Mechanical Engineering, IISc**