NSF-Simons Center for Multiscale Cell Fate Research
UC Irvine

The Frederic & Julia Wan Distinguished Lecture Series

Flexible filaments and swimming cups: just go with the flow

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The motion of waving or rotating filaments in a fluid environment is a common element in many biological and engineered systems. Examples at the microscale include chains of diatoms moving in the ocean, flagella of of individual cells comprising multicellular microbial colonies, as well as engineered helical nanorobots designed to deliver drugs to tumors. Complex fluid environments, such as networks of polymers, can have dramatic effects upon the dynamics of microorganisms as they move through mucus or tissues. In this talk we will present mathematical and computational insights into these viscosity-dominated flows. Our modeling approaches will vary from detailed models that capture flagellar material properties and wave geometry to minimal force-dipole models that represent a flagellum by a single point. We will investigate a few intriguing systems, including helical filaments that penetrate, break, and move through a polymeric network, the journey of extremely long insect sperm flagella through tortuous female reproductive tracts, and the hydrodynamic performance of shape-shifting *Choanoeca flexa* colonies.

Bio: Dr. Lisa Fauci received her PhD from the Courant Institute of Mathematical Sciences at New York University, and directly after that joined the Department of Mathematics at Tulane University in New Orleans, Louisiana, USA. Her research focuses on biological fluid dynamics, with an emphasis on using modeling and simulation to study the basic biophysics of organismal locomotion and reproductive mechanics. Lisa served as president of the Society for Industrial and Applied Mathematics (SIAM) in 2019-2020. She is a fellow of SIAM, the American Mathematical Society, the Association for Women in Mathematics, and the American Physical Society. In 2023, she was elected to the US National Academy of Sciences.