Massachusetts Institute of Technology
Department of Mechanical Engineering

MMEC SEMINAR SERIES

Mechanics: Modelling, Experimentation, Computation

Tuesdays @ 4:00pm – Room 3-370 **September 30, 2014**

Complex Fluids, Dead and Alive: Self Propulsion & Elastic Instabilities

Paulo E. Arratia, *University of Pennsylvania*

Many liquids of practical interest contain polymers and/or particles and often exhibit complex rheological behavior due to the non-trivial interaction between the fluid microstructure and the applied stresses. In this talk, I will discuss recent results that illustrate such interaction. I will show that the material properties of such fluids can strongly affect the motility (i.e. swimming) behavior of microorganisms such as the nematode C. elegans (L~1 mm), the algae C. reinhardtii (L~ 10 μm), and the bacterium E. coli (L~ 1 μm). We find that in some cases the addition of polymers to a fluid can increase the organism's swimming speed (E. coli) while in other cases it can hinder selfpropulsion (C. elegans, C. reinhardtii). These results are in partial agreement with recent theoretical models for undulating sheets and cylinders, and demonstrate the intimate link between swimming kinematics and viscoelasticity. In addition, I will show that the flow of a dilute viscoelastic fluid in straight microchannels (L=100 μm) can become unstable to finite amplitude disturbance even in the absence of inertia (i.e. Re!0). Remarkably, the transition to the unstable flow state for the viscoelastic fluid in the microchannel is subcritical and is akin to the transition from laminar to turbulent flows in ordinary Newtonian fluids where the control parameter is the Reynolds number. Taking together, these results show that complex fluids can give rise to rich and potentially useful behavior even under relatively simple flow conditions.

Seminar Host: Ken Kamrin (kkamrin@mit.edu)

Please join us for ***refreshments beforehand, outside Room 3-370***

For more information, visit our website at http://web.mit.edu/mmec/
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