MAR08-2007-000545

Abstract for an Invited Paper
for the MAR08 Meeting of
the American Physical Society

Propulsion in viscoelastic fluids: waving, flapping

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In this talk, we present recent results on low-Reynolds number locomotion in non-Newtonian fluids. We first consider waving motion, the prototypical biological situation arising e.g. in ciliary transport of mucus, or spermatozoa swimming in complex fluids. We use asymptotic methods to estimate the effect of viscoelastic stresses on the kinematics and energetics of locomotion and transport in complex fluids. In our second problem, we consider simple flapping motion. Because of Purcell's scallop theorem, reciprocal motion such as flapping is known to be ineffective in a Newtonian fluid. We show here instead that a fluid with normal stress differences - such as Oldroyd B - can be used to rectify flapping motion and generate non-zero average forces and flows.