Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Micro-scale undulatory locomotion in heterogeneous viscoelastic environments ARSHAD KAMAL, ERIC KEAVENY, Imperial College London — While many microorganisms swim in viscoelastic fluids, there are notable examples where the suspended microstructure that makes the fluid viscoelastic is at the same length scale as the swimmers. Here, the swimming cells experience the surrounding medium as a set of obstacles suspended in a viscous fluid, rather than a viscoelastic continuum. Using simulations based on the force-coupling method, we explore this situation for a simple undulatory swimmer as it moves through an environment of obstacles that are tethered to random points in space via linear springs. We examine how swimming behaviour is altered by mechanical interactions with the obstacles by varying obstacle density and tether stiffness. We find that the mechanical interactions can either enhance or hinder locomotion, and often for fixed tether stiffness, there is an obstacle density for which the average speed is maximized. We also find cases where the swimmer is completely trapped by the environment. In addition, we find that the velocity fluctuations, and consequently the effective swimmer diffusion, are also highly dependent on environment composition and a non-monotonic dependence on the relevant parameters can be found here as well.

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Date submitted: 28 Jul 2016 Electronic form version 1.4