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Swimming speed of an oscillating sheet in Newtonian and viscoelastic fluids MOUMITA DASGUPTA, Clark University, MICHAEL BERHANU, Laboratoire MSC Université Paris Diderot, ARSHAD KUDROLLI, Clark University, BIN LIU, KENNETH BREUER, THOMAS POWERS, Brown University — We discuss a mechanical experimental model of a flexible sheet swimming with a prescribed wave pattern through a fluid. We are motivated by a need for a fundamental understanding of microorganism locomotion through non-Newtonian fluids. To simplify the problem, we suspend a tall flexible cylindrical sheet concentric within a cylindrical tank filled with the fluid. Torque free boundary conditions are imposed by supporting the flexible sheet and the tank with friction-free ball-bearings. A traveling wave is imposed on the sheet with a pair of rollers in the azimuthal direction. We first show that the swimming speed is linear with respect to the phase velocity of the traveling wave for a viscous Newtonian fluid. Then we show that the system is essentially two dimensional as the results do not depend on the height of fluid in the tank. We measure swimming speed in Polyox-water mixtures and Sodium CMC solutions as a function of wave speed. We again demonstrate linear response in the swimming speeds, which also decrease in these viscoelastic fluids relative to the Newtonian case as wave speed increases. Decrease in swimming speed is observed with increase in viscoelasticity of the fluids. We then discuss the dependence of swimming speed on the Deborah number of the fluids.

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