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Swimming speed of an oscillating sheet in Newtonian and viscoelastic fluids MOUMITA DASGUPTA, MICHAEL BERHANU, ARSHAD KUDROLLI, Clark University, HENRY FU, University of Nevada, Reno, KENNETH BREUER, THOMAS POWERS, Brown University — We discuss a mechanical experimental model of a flexible sheet swimming with a prescribed wave pattern - a Taylor swimmer - through a fluid. Our study is motivated by a need for a fundamental understanding of microorganism locomotion through non-Newtonian fluids. In order 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 demonstrate a linear response in the swimming velocity of the sheet with respect to its phase velocity in a viscous Newtonian fluid. Further, we show that the analytical system is essentially two dimensional by varying the height of fluid in the tank. We then discuss measurements of swimming speed in Polyox-water mixtures as a function of wave speed. We demonstrate that the swimming speed in this viscoelastic fluid decrease relative to the Newtonian case as wave speed is increased. We will further discuss the dependence of swimming speed on Deborah number and other characteristics of the fluid.

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