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Undulatory swimming in viscoelastic fluids under geometric confinement: experiments with C. elegans DAVID GAGNON, JERRY SHIH, PAULO ARRATIA, University of Pennsylvania — Many natural biological processes, such as bacteria moving through vesicles in the circulatory system and spermatozoa swimming through millimeter-scale fallopian tubes, require low Reynolds number swimmers to move between two fluid-solid interfaces. Furthermore, these biological systems typically involve non-Newtonian fluids (e.g. blood and mucus), which can be shear-thinning, viscoelastic, or both. Using the model biological organism C. elegans, we introduce two far-field no-slip boundary conditions in the beating plane by observing swimming through thin channels in viscosified Newtonian and viscoelastic fluids. Using image processing and particle tracking velocimetry techniques, we measure both the swimming kinematics and the resulting flow fields as a function of decreasing channel width. As this width approaches the characteristic transverse length scale of the nematode's swimming gate, we observe (i) swimming speed decreases with increasing De, (ii) this decrease in speed can be non-monotonic with decreasing channel width at a given De, and (iii) the change in nematode kinematics appears to be associated with a structural change in the flow field around the swimmer quantified using the flow type parameter.

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