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Microelastohydrodynamics of swimming organisms near solid boundaries in complex fluids.

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Summary: Microorganisms such as sperm routinely swim close to solid boundaries and within non-Newtonian fluids. In this paper, we exploit the lubrication approximation to model the motion of a flexible sheet near a rigid wall and immersed in a complex fluid. This allows us to specify an internally generated force density on the sheet and allow its shape and velocity to be determined by the interplay between the forcing and the fluid motion. We obtain results for Newtonian and complex fluids, focusing specifically on the influence of shear thinning/thickening and of yield stress. In the latter case, we characterise the threshold forcing that is required for successful swimming to occur. Our results highlight the usefulness of the lubrication approach in modelling micro-scale fluid-structure interactions.

MSC:

76Z05	Physiological flows
76A05	Non-Newtonian fluids
74F10	Fluid-solid interactions (including aero- and hydro-elasticity, porosity, etc.)
92C10	Biomechanics

Keywords:

lubrication approximation; force density; shear thinning; yield stress

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