Abstract Submitted
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Propulsion at low Reynolds number via beam extrusion[1] FREDERICK GOSSELIN, PAUL NEETZOW, Ecole Polytechnique de Montreal — We present experimental and theoretical results on the extrusion of a slender beam in a viscous fluid. We are particularly interested in the force necessary to extrude the beam as it buckles with large amplitude due to viscous friction. The problem is inspired by the propulsion of Paramecium via trichocyst extrusion. Self-propulsion in micro-organisms is mostly achieved through the beating of flagella or cilia. However, to avoid a severe aggression, unicellular Paramecium has been observed to extrude trichocysts in the direction of the aggression to burst away. These trichocysts are rod-like organelles which, upon activation, grow to about 40 μm in length in 3 milliseconds before detaching from the animal. The drag force created by these extruding rods pushing against the viscous fluid generates thrust in the opposite direction. We developed an experimental setup to measure the force required to push a steel piano wire into an aquarium filled with corn syrup. This setup offers a near-zero Reynolds number, and allows studying deployments for a range of constant extrusion speeds. The experimental results are reproduced with a numerical model coupling a large amplitude Euler-Bernoulli beam theory with a fluid load model proportional to the local beam velocity.

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