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Octopus-inspired drag cancelation by added mass pumping GABRIEL WEYMOUTH, FRANCESCO GIORGIO-SERCHI, University of Southampton — Recent work has shown that when an immersed body suddenly changes its size, such as a deflating octopus during rapid escape jetting, the body experiences large forces due to the variation of added-mass energy. We extend this line of research by investigating a spring-mass oscillator submerged in quiescent fluid subject to periodic changes in its volume. This system isolates the ability of the added-mass thrust to cancel the bluff body resistance (having no jet flow to confuse the analysis) and moves closer to studying how these effects would work in a sustained propulsion case by studying periodic shape-change instead of a one-shot escape maneuver. With a combination of analytical, numerical, and experimental results, we show that the recovery of added-mass kinetic energy can be used to completely cancel the drag of the fluid, driving the onset of sustained oscillations with amplitudes as large as four times the average body radius. Moreover, these results are fairly independent of the details of the shape-change kinematics as long as the Stokes number and shape-change number are large. In addition, the effective pumping frequency range based on parametric oscillator analysis is shown to predict large amplitude response region observed in the numerics and experiments.

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