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To flap or not to flap: continued discussion with particle image velocimetry of the near wake¹ NATHAN MARTIN, CHRIS ROH, California Institute of Technology, SUHAIL IDREES, University of Cambridge, MORTEZA GHARIB, California Institute of Technology — We continue the discussion of which underwater propulsion mechanism is more effective: flapping used by fish or periodic contractions used by jellyfish. The two propulsion mechanisms are simplified into flapping and clapping plate motions, respectively, to allow for a direct comparison. A device is designed to operate in either mode of propulsion between Reynolds numbers 1,880 and 11,260, based on the average tip velocity and the span of the plate. The stroke angle, stroke time, flexibility, and duty cycle are varied to determine their impact on the generated thrust and the required torque. Overall, the clapping mode tends to require significantly more power to generate a similar thrust compared to that from the flapping mode. The performance of the clapping mode is increased by modifying the duty cycle such that the closing motion is faster than the opening motion causing a greater thrust and a similar efficiency to that from the flapping mode. Interestingly, when using rigid plates, the average thrust generated per cycle is similar between the two modes when the overall kinematics are equivalent. Investigation of the near wake of both modes through digital particle image velocimetry provides insight into the cause of this similar thrust.

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