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The effect of fin rotation on the flapping propulsion of underwater vehicles[1] CECILIA HUERTAS-CERDEIRA, MORTEZA GHARIB, California Institute of Technology — Bio-inspired propellers have received increased attention as a means of improving the efficiency, maneuverability and stealth of underwater autonomous vehicles (UAVs). In particular, the thunniform propulsion mode of fish, based on the flapping motion of their caudal fin, presents peak long-range propulsive efficiencies. The fin of these swimmers follows predominantly side-to-side motions with comparably small rotations around their longitudinal axis, partly due to the inability of the joint to produce larger rotations. In this talk, we assess the effect that larger rotations — attainable by an engineered joint— would have on the thrust produced by a flapping UAV. Additionally, we evaluate the role of fin flexibility in attaining these rotations in nature and consider the limit case in which the fin moves in a continuous rotation mode. For this purpose, a UAV equipped with a caudal fin capable of producing these large rotations has been developed. Using an experimental optimization procedure, the motion of the fin that produces maximum thrust is obtained for different limits of the rotation value. The procedure is performed for both rigid and flexible fins, and the resulting optima are shown and analyzed in detail.

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