DFD16-2016-020062

Abstract for an Invited Paper
for the DFD16 Meeting of
the American Physical Society

How flexibility and dynamic ground effect could improve bio-inspired propulsion[1]

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Swimming animals use complex fin motions to reach remarkable levels of efficiency, maneuverability, and stealth. Propulsion systems inspired by these motions could usher in a new generation of advanced underwater vehicles. Two aspects of bio-inspired propulsion are discussed here: flexibility and near-boundary swimming. Experimental work on flexible propulsors shows that swimming efficiency depends on wake vortex timing and boundary layer attachment, but also on fluid-structure resonance. As a result, flexible vehicles or animals could potentially improve their performance by tracking their resonance properties. Bio-inspired propulsors were also found to produce more thrust with no loss in efficiency when swimming near a solid boundary. Higher lift-to-drag ratios for near-ground fixed-wing gliders is commonly known as ground effect. This newly observed "dynamic ground effect" suggests that bio-inspired vehicles and animals could save energy by harnessing the performance gains associated with near-boundary swimming.

[1]This work was supported by the Office of Naval Research (MURI N00014-08-1-0642, Program Director Dr. Bob Brizzolara) and the National Science Foundation (DBI-1062052, PI Lisa Fauci; EFRI-0938043, PI George Lauder).