Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Hydrodynamic performance of macrorobots inspired by quadriflagellate algae KELIMAR DIAZ, TOMMIE L ROBINSON, YASEMIN OZKAN-AYDIN, DANIEL I GOLDMAN, Georgia Inst of Tech, KIRSTY Y WAN, University of Exeter — Animals can coordinate their appendages in rhythmic patterns known as gaits. While appendage coordination is often thought to be exclusive to macroscopic systems, microscopic quadriflagellate algae (body length of 10 m) have been found to coordinate their flagella to various patterns reminiscent of gaits seen in quadrupeds (Wan Goldstein, 2016). To study appendage coordination of quadriflagellates, we developed a macroscopic robophysical model (body length of 3.87 cm) that swims in viscous fluid (mineral oil, 1,000 cSt), replicating low Reynolds number swimming . We focus on three gaits, the pronk, the trot, the gallop, and studied the effects of flagellar orientation. When the flagella were oriented perpendicular to the body, the robot achieved a speed of 0.020-0.1 body lengths per second depending on the gait. Results are comparable to microorganisms performance, where using the trot enables a higher speed than the pronk and the gallop. When the flagella were oriented parallel to the body, hydrodynamic performance decreased significantly for all gaits. The results show that hydrodynamic performance is sensitive to swimming gait and flagellar orientation, and suggest that diverse gaits may have evolved across different phyla as adaptations to distinct ecological habitats.

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Date submitted: 10 Aug 2020 Electronic form version 1.4