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Improved Swimming Performance in Hydrodynamically- coupled Airfoils SINA HEYDARI, Department of Aerospace and Mechanical Engineering, University of Southern California, Los Angeles, CA 90089, USA, MICHAEL J. SHELLEY, Applied Math Lab, Courant Institute, New York University, 251 Mercer Street, New York, New York 10012, USA, EVA KANSO, Department of Aerospace and Mechanical Engineering, University of Southern California, Los Angeles, CA 90089, USA — Collective motion is a widespread phenomenon in the animal kingdom from fish schools to bird flocks. Half of the known fish species are thought to exhibit schooling behavior during some phase of their life cycle. Schooling likely occurs to serve multiple purposes, including foraging for resources and protection from predators. Growing experimental and theoretical evidence supports the hypothesis that fish can benefit from the hydrodynamic interactions with their neighbors, but it is unclear whether this requires particular configurations or regulations. Here, we propose a physics-based approach that account for hydrodynamic interactions among swimmers based on the vortex sheet model. The benefit of this model is that it is scalable to a large number of swimmers. We start by examining the case of two swimmers, heaving plates, moving in parallel and in tandem. We find that for the same heaving amplitude and frequency, the coupled-swimmers move faster and more efficiently. This increase in velocity depends strongly on the configuration and separation distance between the swimmers. Our results are consistent with recent experimental findings on heaving airfoils and underline the role of fluid dynamic interactions in the collective behavior of swimmers.

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