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Thrust augmentation in tandem flapping foils by foil-wake interaction ERIK ANDERSON, GEORGE LAUDER, Harvard University — Propulsion by pitching and heaving airfoils and hydrofoils has been a focus of much research in the field of biologically inspired propulsion. Organisms that use this sort of propulsion are self-propelled, so it is difficult to use standard experimental metrics such as thrust and drag to characterize performance. We have constructed a flapping foil robot mounted in a flume on air-bearings that allows for the determination of self-propelled speed as a metric of performance. We have used a pair of these robots to examine the impact of an upstream flapping foil on a downstream flapping foil as might apply to tandem fins of a swimming organism or in-line swimming of schooling organisms. Self-propelled speed and a force transducer confirmed significant thrust augmentation for particular foil-to-foil spacings, phase differences, and flapping frequencies. Flow visualization shows the mechanism to be related to the effective angle of attack of the downstream foil due to the structure of the wake of the upstream foil. This confirms recent computational work and the hypotheses by early investigators of fish fluid dynamics.

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