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PIV-based pressure, force, and torque measurements of a robotic model swimmer JOHN DABIRI, California Institute of Technology, KELSEY LUCAS, PATRICK THORNYCROFT, GEORGE LAUDER, Harvard University — We apply a recently developed technique for non-invasive pressure measurement to study the dynamics of anguilliform swimming by a robotic flapping foil. The method is based on spatial integration of time-resolved particle image velocimetry measurements. The pressure gradient computed from the Navier-Stokes equations is integrated along multiple paths in the domain, and the local pressure is determined by the median value of the integration results. In addition, the pressure field is integrated on the surface of the foil to compute the instantaneous forces and torque exerted by the foil on the fluid. Direct force and torque measurements from a load cell are used to confirm the accuracy of the PIV-based measurements. Results for flapping foils of varying flexibility are compared to infer the role of the pressure field in the dynamics and energetic efficiency of locomotion.

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