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A study of sea lion hydrodynamics using a robotic foreflipper platform ADITYA A. KULKARNI, RAHI K. PATEL, MEGAN C. LEFTWICH, The George Washington University — Unlike most fish and mammals—that utilize BCF swimming—sea lions rely on their foreflippers to generate thrust without a characteristic flapping frequency. This unique swimming style allows the sea lion to be highly maneuverable, while also producing high amounts of thrust. To explore this motion, and the physics that underlies it, we use novel markerless tracking techniques on untrained sea lions at the Smithsonian National Zoo in Washington, D.C to get the complete motion during different maneuvers. High speed video and three-dimensional surface reconstruction techniques are used to extract the foreflippers kinematics during the thrust phase. Using this data, pitch angle is calculated with respect to the base of the flipper to build a scaled robotic flipper. Dye visualization is carried out in a water channel by injecting dye upstream of the leading edge of the flipper with flow speed set to explore different parameters, like Reynolds number or angular velocity. Results show low pressure on the upper surface of the flipper causes the fluid to be pulled around the flipper forming a vortex that moves fully out of the plane.

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