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On the hydrodynamics of archer fish jumpingout of the water: Integrating experiments with numerical simulations FOTIS SOTIROPOULOS, DIONYSIOS ANGELIDIS, Department of Civil Engineering, College of Engineering and Applied Sciences, Stony Brook University, Stony Brook, NY 11794, USA, LEAH MENDELSON, Department of Engineering, Harvey Mudd College, Claremont, CA 91711, USA, ALEXANDRA TECHET, Experimental Hydrodynamics Laboratory, Department of Mechanical Engineering, Massachusetts Institute of Technology, Cambridge, MA 02139, USA — Evolution has enabled fish to develop a range of thrust producing mechanisms to allow skillful movement and give them the ability to catch prey or avoid danger. Several experimental and numerical studies have been performed to investigate how complex maneuvers are executed and develop bioinspired strategies for aquatic robot design. We will discuss recent numerical advances toward the development of a computational framework for performing turbulent, two-phase flow, fluid-structure-interaction (FSI) simulations to investigate the dynamics of aquatic jumpers. We will also discuss the integration of such numerics with high-speed imaging and particle image velocimetry data to reconstruct anatomic fish models and prescribe realistic kinematics of fish motion.The capabilities of our method will be illustrated by applying it to simulate the motion of a small scale archer fish jumping out of the water to capture prey. We will discuss the rich vortex dynamics emerging during the hovering, rapid upward and gliding phases. The simulations will elucidate the thrust production mechanisms by the movement of the pectoral and anal fins and we will show that the fins significantly contribute to the rapid acceleration.

Dionysios Angelidis
College of Engineering and Applied Sciences, Stony Brook University

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