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Flying fish accelerate at 5 G to leap from the water surface PATRICIA YANG, SULISAY PHONEKEO, KE XU, Georgia Institute of Technology, SHUI-KAI CHANG, National Sun Yat-sen University, DAVID HU, Georgia Institute of Technology — Flying fish can both swim underwater and glide in air. Transitioning from swimming to gliding requires penetration of the air-water interface, or breaking the "surface tension barrier," a formidable task for juvenile flying fish measuring 1 to 5 cm in length. In this experimental investigation, we use high-speed videography to characterize the kinematics of juvenile flying fish as they leap from the water surface. During this process, which lasts 0.05 seconds, flying fish achieve body accelerations of 5 times earth's gravity and gliding speeds of 1.3 m/s, an order of magnitude higher than their steady swimming speed. We rationalize this anomalously high speed on the basis of the hydrodynamic and surface tension forces and torques experienced by the fish. Specifically, leaping fish experience skin friction forces only on the submerged part of their body, permitting them to achieve much higher speeds than in steady underwater swimming. We also perform experiments using a towed flying fish mimc to determine optimality of various parameters in this process, including body angle and start position with respect to the water surface.

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