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Elastic hoops jumping on water: drag-dominant model of water-jumping arthropods HAN BI JEONG, Seoul National University, EUNJIN YANG, Korea Institute of Science and Technology Evaluation of Planning, YUN-SUK JEUNG, Seoul National University, JULIETTE AMAUGER, Ecole Normale Superieure, HO-YOUNG KIM, Seoul National University — Some remarkable milli-scale organisms jump from the water surface using surface tension, such as the well-studied water strider. Larger arthropods, however, require a greater force to complete the same task. In the case of fishing spiders, a pressure drag, rather than capillary forces, is utilized to propel the spiders' bodies into a successful jump. Such a strategy is also discriminated from the unsteady added inertia effects employed by a basilisk lizard, a water-walking reptile. Here, we present a mathematical model of thin elastic hoops jumping on water, inspired by the fishing spider. A pre-deformed hoop coated with superhydrophobic particles floating on water shows similar dynamic conditions to that of the jumping mechanics of fishing spiders. When released, the water applies a force against the deforming hoop, dominantly in the form of drag, propelling the hoop into the air. By combining the vibration model of the elastic hoop and the time-varying drag forces induced by fluid motion, we accurately predict the trajectory and jump efficiency of the hoops. This work can be used to develop large-scale water-jumping robots and to understand the water-jumping mechanics of large semi-aquatic arthropods.

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