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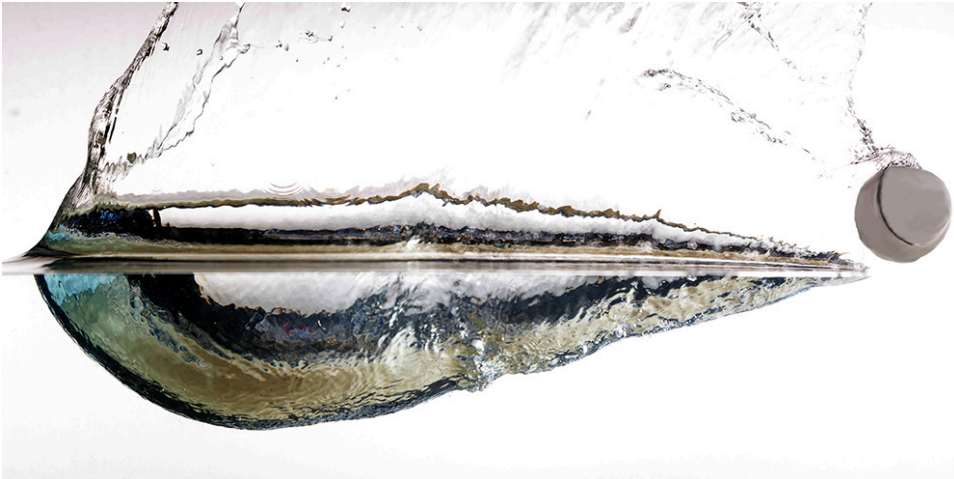
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Walking on Water: USU Researchers Unravel Science of Skipping Spheres | College of Engineering

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Feb. 4, 2016 – It takes a perfect flick of the wrist and just the right angle to get a disk-shaped stone to skip across the surface of the water multiple times. So why is it so easy to get such impressive water-skipping performance from an elastic ball with only a mediocre launch?



A high-speed camera captured this image of an elastic sphere bouncing off the water surface in a tank. (photo: Chris Mabey)

Researchers at Utah State University's College of Engineering say they have some answers that may offer new insight into water impact physics – an important area of study in naval applications and maritime and ocean engineering.

In collaboration with scientists at the Naval Undersea Warfare Center in Newport, R.I., and Brown University, Assistant Professor of Mechanical Engineering Tadd Truscott and his associates at USU's [Splash Lab](#) have unraveled the physics of how elastic spheres bounce on water more easily than rigid ones. Truscott and his collaborators published their findings in the latest edition of [Nature Communications](#) – a top interdisciplinary journal.

The team uses high-speed cameras to capture images of elastic spheres bouncing across tanks of water in a laboratory. They found that elastic spheres skip along the water surface by deforming into an ideal disk-like geometry that resembles a stone one might find near the shore. Due to the sphere's deformed shape, the water exerts a larger lifting force on elastic spheres than stones.



Truscott's study not only reveals the physics of how elastic spheres interact with water, but also predicts how many skips will occur. In addition, the team found that elastic spheres can bounce off the water surface from much higher impact angles compared to rigid spheres – a big clue into why these elastic objects are much easier to skip across the surface.

Skipping objects along the water has a wide range of applications from simple fun and games, to naval operations like the WWII-era Wallis Bomb, or the water-walking locomotion of the Basilisk lizard.

Truscott's setup may look like fun and games, but behind the scenes he and his team are conducting highly technical research with funding from the U.S. Navy. His work could help make inflatable boats and other soft-hull vessels safer for passengers and, on a more playful note, improve the design of aquatic toys.

One such toy, the Water Bouncing Ball, or Waboba for short, was the inspiration for this study.

“Our approach was playful at first,” said Truscott. “My son and nephew wanted to see the impact of the elastic spheres in slow motion, so that was also part of the initial motivation. We simply wondered why these toys skip so well. In general, I have always found that childish curiosity often leads to profound discovery.”

Truscott’s findings have various applications. Not only do they explain the physics of water bouncing balls, they also establish a framework for designers to tune elastic objects for better performance.

“The study also provides insight into methods for modeling objects that interact with the water surface and have elastic responses to the surface like rubber boats, tubes, wakeboards and water skis,” said Truscott. “The elasticity of each of these objects affects the manner in which they interact with the water surface which, as we have shown, can differ dramatically from rigid objects.”

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