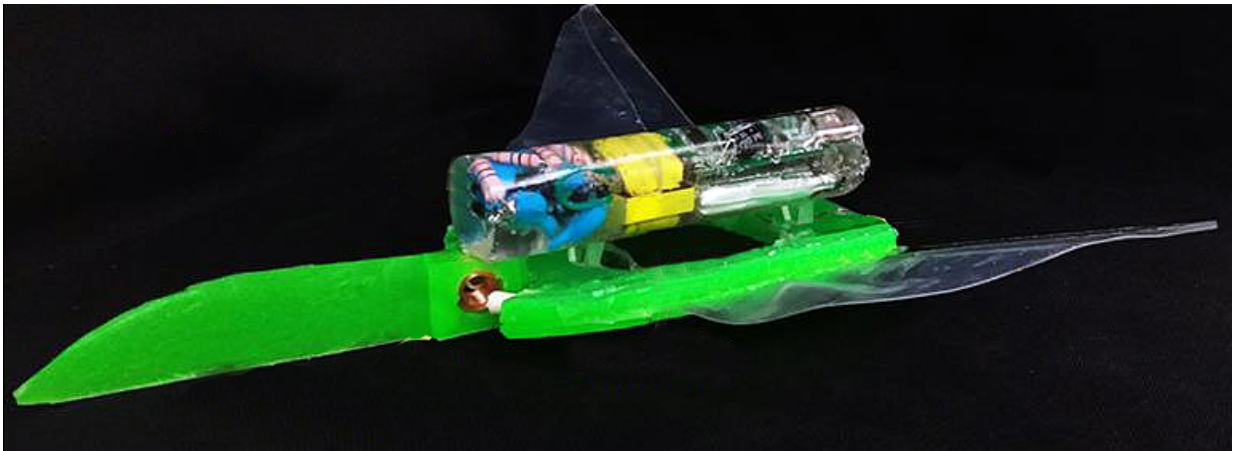# A flexible faster swimming manta-ray like robot

April 6 2017, by Bob Yirka

Something's fishy about this manta-ray-like robot. Perhaps it's the fact that it uses water as a conductor for dangerously high-voltage electrical energy? This system safely bent the robot's flexible layer and helped it flap its fins. Credit: Li et al. 2017;3:e1602045

(Phys.org)—A team of researchers at Zhejiang University in China has created a small, soft-bodied robot able to swim twice as fast as others of its kind. In their paper published in the journal *Science Advances*, the team describes how they came up with a unique way to power the robot, how well it works, and likely applications for it.

Scientists have concluded over the past few years that the best way to propel a robot underwater is to emulate nature—that means soft bodies,

fins and soft parts. To make such robots, engineers have used bendy materials for the body but have found it difficult to create a power source that is bendable as well. In this new effort, the researchers got around that problem by eliminating the need for a motor and using the water in which the artificial fish swims as the ground electrode.

The team made the body out of soft silicone with a pocket for a battery, a small amount of electronics for wireless control and an electrode that runs into the fins. Components are made of a type of hydrogel that reacts to a small electrical current—turning a charge from the battery on and off causes the hydrogel to contract and ease like muscles, which results in flapping, pushing the robot through the water. They also added a tail that is moved using an electromagnet. The result is a 9.3 centimeter robot that looks similar to a manta-ray—one that can swim three centimeters per second for approximately three hours on a single charge, which is twice as fast as any other robot of its kind. It can also operate via tether for unlimited power and faster swimming, handle hot and cold water, and is strong enough to carry a small video camera.

The researchers suggest future generations of their robot could be used as water monitors in lakes, streams or the ocean. It could also be used to look for survivors of plane crashes or boat accidents or by the military as a spy drone—the entire robot can be made transparent except for the battery, receiver and electrode.

Abstract
Soft robots driven by stimuli-responsive materials have unique advantages over conventional rigid robots, especially in their high adaptability for field exploration and seamless interaction with humans.

The grand challenge lies in achieving self-powered soft robots with high mobility, environmental tolerance, and long endurance. We are able to advance a soft electronic fish with a fully integrated onboard system for power and remote control. Without any motor, the fish is driven solely by a soft electroactive structure made of dielectric elastomer and ionically conductive hydrogel. The electronic fish can swim at a speed of 6.4 cm/s (0.69 body length per second), which is much faster than previously reported untethered soft robotic fish driven by soft responsive materials. The fish shows consistent performance in a wide temperature range and permits stealth sailing due to its nearly transparent nature. Furthermore, the fish is robust, as it uses the surrounding water as the electric ground and can operate for 3 hours with one single charge. The design principle can be potentially extended to a variety of flexible devices and soft robots.

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