Meet the new guardians of the ocean – robot jellyfish

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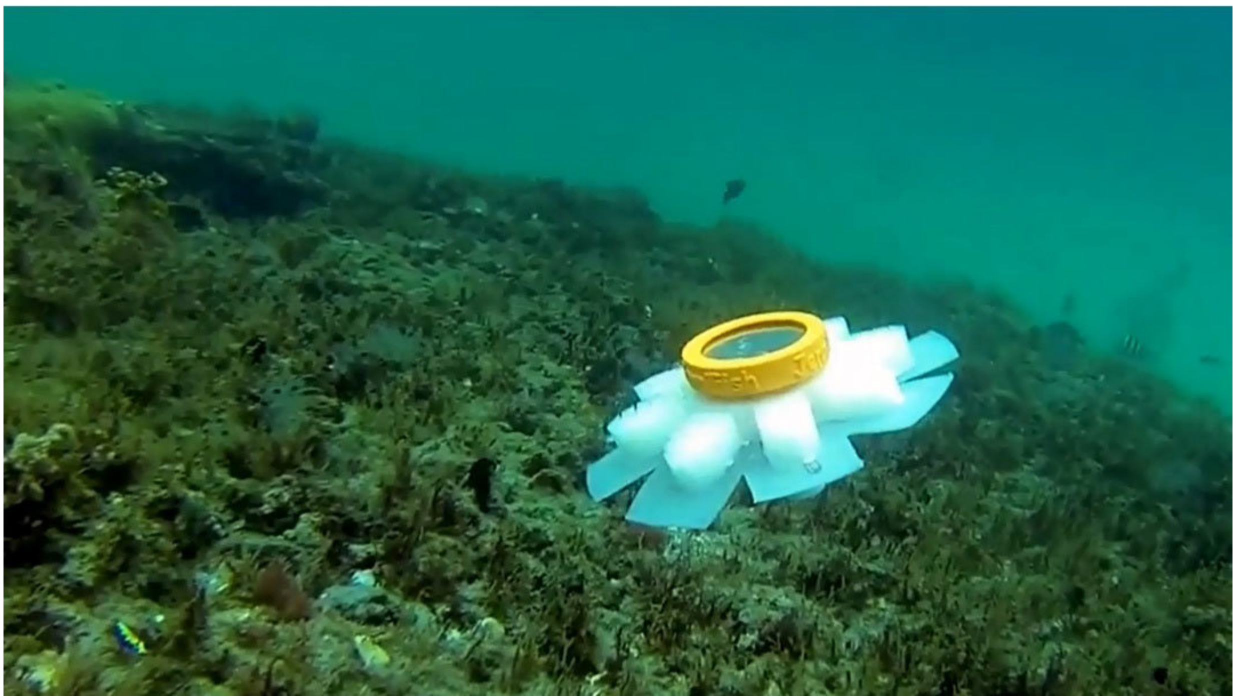

Credit: Simon Davies

New robot jellyfish could be the key to monitoring and caring for fragile parts of the world's oceans without damaging them.

The robots were developed by a team of US scientists, from Florida Atlantic University (FAU) and the US Office of Naval Research. They were designed to be able to swim freely, steer from side to side, and swim through narrow openings.

The researchers set out their findings today in the journal *Bioinspiration and Biomimetics*.

Corresponding author Dr. Erik Engeberg, from FAU, said: "Studying and monitoring fragile environments, such as coral reefs, has always been challenging for marine researchers. Soft robots have great potential to help with this.

"Biomimetic soft robots based on fish and other marine animals have gained popularity in the research community in the last few years. Jellyfish are excellent candidates because they are very efficient swimmers.

"Their propulsive performance is due to the shape of their bodies, which can produce a combination of vortex, jet propulsion, rowing, and suction-based locomotion."

To harness this performance, the researchers used the shape of the moon jellyfish (Aurelia aurita) during the larvae stage of its life cycle. Whereas prior robot jellyfish designs used a variety of different propulsion mechanisms, the team's design for their new jellyfish used hydraulic networks for propulsion.

Dr. Engeberg said: "A main application of the robot is exploring and monitoring delicate ecosystems, so we chose soft hydraulic network actuators to prevent inadvertent damage. Additionally, live jellyfish have neutral buoyancy. To mimic this, we used water to inflate the hydraulic network actuators while swimming."

To allow the jellyfish to steer, the team used two impeller pumps to inflate the eight tentacles. The impeller pump design produced an open circuit of water flow, where water from the environment was pumped into the soft actuators to produce a swimming stroke. When the pumps were not powered, the elasticity of the tentacle actuator silicon rubber material constricted the actuators to push the water back into the environment during the relaxation phase.

This elasticity is like the passive elasticity demonstrated by live jellyfish after bell contractions. The design also removed the need for valves, reducing control complexity, space requirements, and cost.

The team 3-D printed five different robot jellyfish, using silicon rubber for the actuators. Each jellyfish had a varying rubber hardness to test the effect it had on the propulsion efficiency.

They also tested the robots' ability to squeeze through narrow openings, using circular holes cut in a plexiglass plate.

Dr. Engeberg said: "We found the robots were able to swim through openings narrower than the nominal diameter of the robot. In the future, we plan to incorporate environmental sensors like sonar into the robot's control algorithm, along with a navigational algorithm. This will enable it to find gaps and determine if it can swim through them."

More information: Jennifer Frame et al. Thrust force characterization of free-swimming soft robotic jellyfish, *Bioinspiration & Biomimetics* (2018). DOI: 10.1088/1748-3190/aadcb3

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