Modboat: A low-cost aquatic robot with a single motor

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Modboat: The low-cost robotic boat created by the researchers. Credit: Knizhnik & Yim.

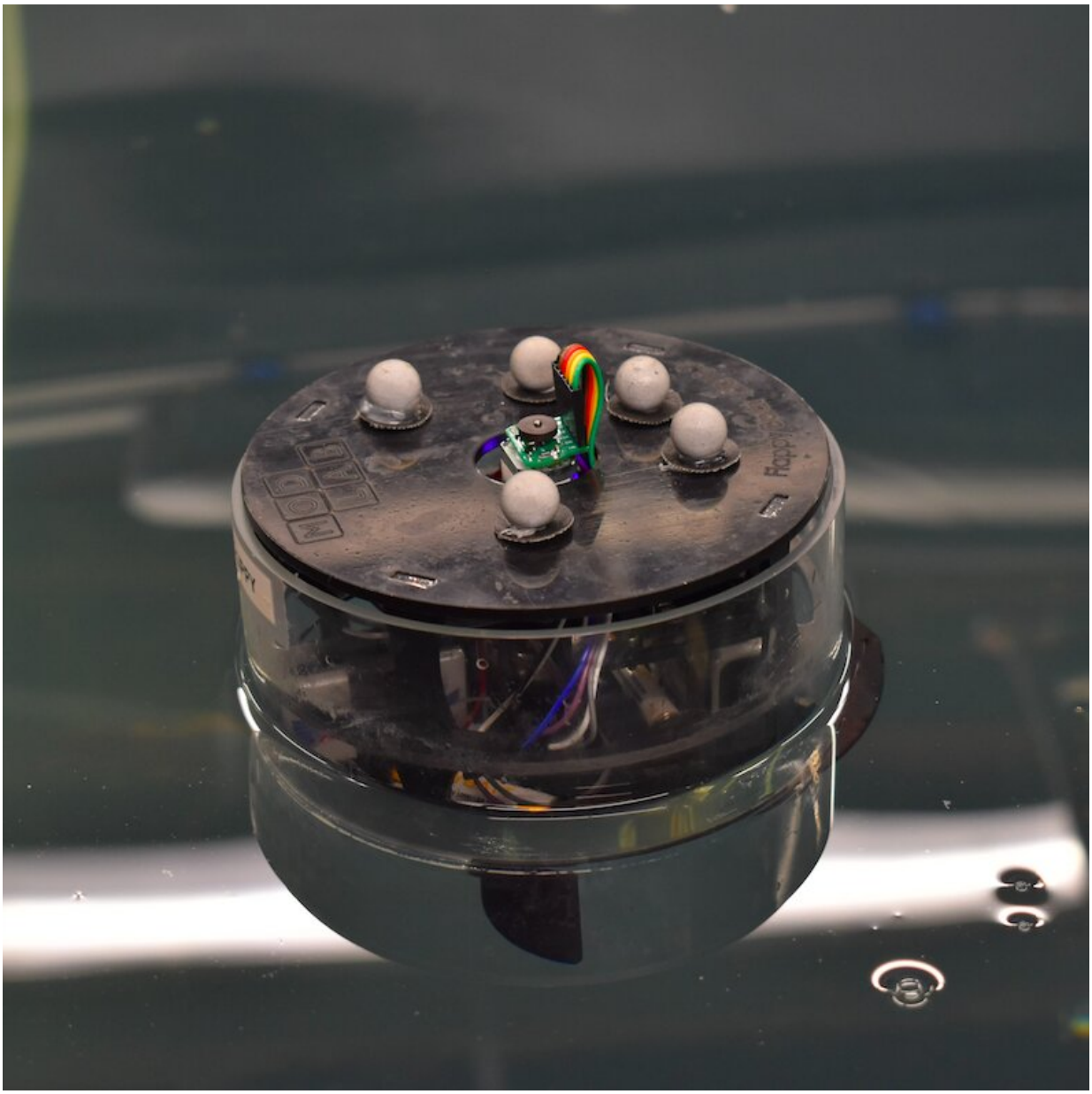
Researchers at the University of Pennsylvania's GRASP Laboratory have recently designed Modboat, a robotic boat that could be used to monitor oceans or carry out marine operations. This low-cost aquatic robot, presented in a paper pre-published on arXiv, can swim in the water using a single motor.

"The original idea for this project came from a 2015 paper written by a team at the Technion, in Israel," Gedaliah Knizhnik, one of the researchers who carried out the study, told TechXplore. "My lab, which explores low-cost robotics, jumped on the idea. We had some prior experience with aquatic robots, so this was a great chance to expand on that."

The long-term goal of the research carried out by Knizhnik and his colleagues at the University of Pennsylvania is to create swarms of low-cost robotic boats that can complete tasks as a team, rather than individually. Their recent study is a first step in this direction, introducing the design for an aquatic robot that is both efficient and affordable.

Modboat, the robot created by the researchers, is fairly simple, yet it can move around effectively in the water. The robot has a main body and two flippers. It moves using a single motor that swings its body back and forth, allowing it to paddle and move forward in water.

The robot can be steered in a particular direction by adjusting the speed at which the motor swings its body left or right and how hard each of its flippers paddle. In contrast with the robot developed at Technion, which the researchers drew inspiration from, Modboat's unique design also allows it to work well in teams.



Modboat in water. Credit: Knizhnik & Yim.

"Our robot is not as good a swimmer as some other robots, but this design is unique in that it only uses one motor, when standard convention dictates you need at least two," Knizhnik explained. "This makes the robot inexpensive to fabricate, so we can build a lot of them and

compensate for its weaker swimming performance."

The researchers evaluated their robot in a series of experiments and found that while it performs considerably well, it struggles to swim in a straight line. The reason for this is that it has a high sensitivity to how its center mass is positioned.

This sensitivity derives from the non-zero roll angle that the offset mass induces on the robot, which in turn increases asymmetries in the thrust of its individual flippers. Toward the end of their paper, the researchers propose an alternative design strategy that could decrease this sensitivity to workable levels.

"Making robots affordable is how we get them into the mainstream, but affordable robots are often less capable than their expensive counterparts," Knizhnik said. "In this study we've shown how we can take a unique design principle and adjust it to make it practical—in this case by facilitating this robot's ability to work in teams. They don't do that just yet, but we've done the prep work."

While the low-cost aquatic robot introduced by this team of researchers is highly promising, its design still needs to be improved before it can be implemented on a large-scale. In the future, however, it could pave the way for the creation of affordable automatic robotic boats that can be deployed in fleets, completing missions at sea faster and more effectively.

"Now that we've shown that this design can work and swim reasonably well, we need to actually get it to swim where we want," Knizhnik added. "We're working on getting it to follow specified paths, so that we can use it for sensor placement, measurement, etc."

More information: Design and experiments with a low-cost single-

motor modular aquatic robot. arXiv:2002.01918 [cs.RO]. arxiv.org/abs/2002.01918

Gilad Refael et al. A Single-Actuated Swimming Robot: Design, Modelling, and Experiments, *Journal of Intelligent & Robotic Systems* (2018). DOI: 10.1007/s10846-018-0776-x