Scientists Making Fishy Robots For Naval Research

Janet McConnaughey, Associated Press

NEW ORLEANS (AP) — An eel undulating through coastal waters, powered by batteries and checking for mines. A jellyfish is actually a surveillance robot, powered by the atoms around it. Fins pick up intelligence while propelling a robot bluegill sunfish.

The Office of Naval Research is supporting baby steps toward making those visions of the future a reality. For instance, the jellyfish work in Texas and Virginia is focused on how the creatures move in water, and how to mimic or even surpass their abilities. The robojellyfish is currently tethered to hydrogen and oxygen tanks, and ONR project manager Robert Brizzolara said he doesn't plan to try making it move autonomously yet.

There's plenty still to learn about basic hydrodynamics.

"We, as engineers, haven't created anything that swims nearly as well as a very basic fish," said Drexel University's James Tangorra, who is working on a robotic bluegill. Partners at Harvard and the University of Georgia are studying the actual fish; he uses their findings to engineer imitations. "There are great things we can learn from fish ... The way they propel themselves; the way in which they sense water."

Ultimately, the Navy wants "the next generation of robotics that would operate in that very Navy-unique underwater domain," said Jim Fallin, a spokesman for Space and Naval Warfare Systems Center Pacific, which is doing separate work in San Diego. One aspect is finding long-lived power sources to let drones loiter a long time to collect information, he said.

Possible uses include spying, mapping, and mine detection and removal.

The Navy is not the only agency paying for such research. In 2007, the Defense Advanced Research Projects Agency offered small business innovation research money for an underwater robot that could navigate rivers, inlets, harbors and coastal waters to check for general traffic, obstacles, things on and under the bottom, and "specific vessels of interest."

The ONR studies are more basic. The grants aren't aimed as much at creating drones as at understanding how things move forward underwater, Brizzolara said.

The Navy uses torpedo-shaped drones and tethered vehicles to detect mines and map the ocean floor. But propellers and jets can be easily tracked on radar and sonar. Robots modeled after water creatures could be both more efficient and

harder to detect, and could move through perilous waters without endangering people, researchers say.

The work isn't all at universities. The Office of Naval Research opened a 50,000-square-foot robotics laboratory this year. A prototype dubbed Razor, developed at the Naval Undersea Warfare Center in Newport, Va., uses flippers for stealth.

Like the jellyfish work and the University of Virginia studies on manta rays, the eel research at the University of New Orleans is all about hydrodynamics. The spark is UNO professor emeritus William Vorus' theory that sinuous undulations, though a slow way to swim, should allow forward movement without creating a wake.

Brandon M. Taravella, who studied under Vorus and is now an assistant professor of naval architecture and marine engineering at UNO, sees the robot eel as a possible surveillance tool. But the Office of Naval Research's three-year, $900,000 grant is focused on making an eel and seeing whether it can swim without disturbing the water around it.

Other scientists have checked real eels, Taravella said. "It's pretty high-efficent ... but still has some wake. That's why we're not dropping eels into the tank." Computer-generated models indicate just how a robot eel should move to get through the water without any drag. Creating one to do that is far from easy.

Like many of the other projects, this one is still in early stages. Most of the time, the nameless first-year prototype is hooked onto a metal pole called a mast, which is attached to sensors on a platform pulled by metal cables from one end of a 160-foot-long towing tank to the other.

At the end of one session half of its batteries were removed and it was set into the water for a free swim toward the platform. When it hit one side or headed under the platform, Taravella and graduate student Baker Potts guided it back by sticking canoe paddles in its way.

"This time it tracked straighter a lot better ... Remember? It was going in circles," said Potts.

Taravella said, "Year 2, we're hoping to have it remote controlled. By Year 3, we hope to have it fully autonomous," They'd also like it to wriggle up and down as well as side to side, letting it rise and dive.

MIT has a pike, a sea turtle and two generations of Charlie the Robotuna. Michigan State is working on a school of fish.

One aim is outdoing nature, at least as far as swimming goes, Brizzolara said.

"We'd like to understand the very good performance that some sea creatures can achieve. But also we'd like to see if we can improve on that," he said.

"We can produce perhaps a better result than a sea creature that's been optimized by nature. We haven't done that yet. But that's one of our long-term goals," Brizzolara said.

The research could have a broad range of uses, said Drexel's Tangorra. Part of understanding how fish move is understanding how their nervous systems pull together a wide assortment of information and impulses. And knowing how their fins work could improve other equipment used to control the flow of liquid, from big pumps and pipes to blood flowing in a body.

And, he said philosophically, "You don't look at a sunfish and say, 'Oh my gosh, this is the most incredible evolved device that ever came through.' But you look at it and see that evolution is a wonderful thing."