“It’s A Bee! It’s A Dragonfly! It’s A Robot!” Transcript

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IRA FLATOW: This is Science Friday. I'm Ira Flatow. Can you imagine a robot that could be both like a dolphin and a bee. Try it. Any luck? Well, researchers at Harvard certainly did, and they've come up with a bugbot that has some very special characteristics. The robot is described in the Journal Science Robotics. And you can see a video of it on our website at sciencefriday.com/bugbot.

Joining me to talk more about it is Farrell Halberg. She's a PhD candidate at Harvard Microbiotics Lab, and one of the researchers on this project. Welcome to the show...I'm sorry, it's Helbling.

FARRELL HELBLING: It's totally fine. No, I'm happy to be back. Thank you for your interest in our work.

FLATOW: Well, let's-- let's talk about these robots. They're just so tiny, and they're very cute. Can you describe them to our listeners?

HELBLING: Sure. So the original robobee is a small-scale, bio-inspired robotic insect that can flap its wings and fly like an actual bumble-- like an actual bumblebee. What we have done with this updated design is we've added a few more components that we have custom engineered that allow us to not only fly but also dive into the water, swim, and then break the water's surface, explode up and out, and then land on the surface again so that we could take off and do further tests.

FLATOW: So they do this all by themselves? They know how to do-- jump in, dive, swim, and fly out?

HELBLING: So, we still are controlling the vehicle off-board, but its own mechanisms can do all of these things with just the single vehicle. So, we don't need, you know, a different set of actuators to both fly in air and swim in water. So, it's just the one flapping mechanism that can do both.

FLATOW: How deep can they-- can they go in the water?

HELBLING: Ooh, that's a good question. We actually haven't tried, I guess. The tank that we have in our lab is about, you know, six to eight inches deep, so--

FLATOW: And what type of engineering went into this? I mean, I imagine it's going to have to flap differently in the water than it does in the air.

HELBLING: No, it absolutely does. So, a lot of fluid mechanics went into this, and so a lot of physics and thinking about things at different scales. So, air is 1,000 times less dense than water, so we flap at a much higher frequency in the air, around 265 beats per second in the air. And then once we dive into the water, things slow down a little bit, and we start flapping at a much lower rate, around nine times per second.

There was also a lot to do with, you know, different types of materials, because we're a very lightweight vehicle. So, 15 of these robots actually weigh a penny, to put it in perspective. And so thinking about the different things that need to go on there that will allow us to fly, still take off, you know, different mechanical engineering approaches, how do we-- chemical engineering.

We actually do something, you know, that's really interesting, once we're in the water, to get out of it. We have this problem, because we are so lightweight, that the surface of the water kind of acts like a brick wall.

We're not allowed to break it ourselves.

So, we had to come up with a new mechanism. And, what we do is we actually take water from the surrounding environment, and then we have a small electrolytic plate in the center, and that takes the water and breaks it into oxygen and hydrogen gas. And, so, with that, we can push our wings gently through the surface of the water, once all that gas is collected inside of a chamber. And then, once we ignite it, it causes an explosion that pushes the vehicle all the way out of the water.

FLATOW: It's just like-- you know, it's like an underwater missile launch. We see that there's a gas that has to shoot the rocket out from under-- with a submarine underwater too.

HELBLING: Yeah, something very similar, like a cannon and a cannonball. Something that, you know, you build up the energy, and then, in a fraction of a second, you release everything to get out.

FLATOW: Now, last year you were on the show talking about the robobee.

HELBLING: I was.

FLATOW: Is this robot kind of like the robobee? What's different about it?

HELBLING: Yeah, no. So, it's still the same basic design as the previous version. So, this one-- the previous one had an additional electroadhesive patch that allowed it to perch on surfaces. So, we've taken that off, and we split the two halves of the vehicle apart, and we put this gas collection chamber in the center. And we added the sparker plate, like I said before.

And then there are four buoyant outriggers on the sides, and that allows us to stabilize ourselves on the top. Our wing size is slightly smaller, which allows us to flap in air and swim in water. Like, that was a really big part of the work was trying to find the sweet spot of what our wing size needs to be to both operate in air and in water. It's also about twice as heavy as the old vehicle with all the additional components.

FLATOW: Wow. Looks like you guys are obsessed with making robots that look like insects. Well, good luck with your next experiments with the more stuff you're going to add onto it, Farrell.

HELBLING: Yeah, thank you so much.

FLATOW: You're welcome. Farrell Helbling is a PhD candidate at the Harvard Microbiots Lab at Harvard University.