"Super Strong Robot 'Muscles' Inspired By Origami" Excerpt Transcript

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IRA FLATOW: This is Science Friday. I'm Ira Flatow we've all seen construction equipment like backhoes and jackhammers powered by hydraulic pumps and pistons and they do the heavy work. But it turns out that the intricate folds of origami which can transform the plainest piece of paper into a 3-D work of art, origami can also turn a lowly piece of plastic sheeting into an artificial muscle capable of lifting something a thousand times its own weight.

To tell us about it is Daniela Rus. She is director of the Computer Science and Artificial Intelligence Lab at MIT in Cambridge. Her work appears in the proceedings of the National Academy of Sciences this week. Welcome to Science Friday.

DANIELA RUS: Thank you so much.

FLATOW: Tell us, Dr. Rus, you built these muscles with inspiration from origami. Tell us what interests you about origami and as a roboticist.

RUS: So I am interested in making robots. Now traditionally, robots are made as complex systems. So they consist of many parts that require significant human development effort and expertise to put them together. But in nature, things happen in much more elegant ways. And in particular, folding in nature occurs to create a wide spectrum of complex structures, morphofunctional structures. And this is where origami robots come in. Because inspired by the folding processes in nature, we can invent a new approach to making complex and beautiful machines using the ancient art of origami.

FLATOW: So. you see, you take the origami sort of as the backbone. The paper is the backbone. And you sheath it in some plastic. And then you suck the air out. And so it curls up, as if it's a finger in some cases, just simply by the air pressure difference.

RUS: Exactly. And what it does can be controlled by the shape of the origami structure we put inside. And so for instance, we can make these machines contract in one dimension like linear muscles. We can achieve two dimensional contraction. We can achieve bending, rotation, twisting. We can achieve a variety of motions just using this very simple principle you described so well, I have to say.

FLATOW: Thank you. Another project I know you've worked on is a robotic pill that you can swallow and have it unfold in your stomach. Whoa. Tell us about that.

RUS: So we've been working with origami in many different applications. And the origami pill came because we were inspired to think about the future of medicine where we might imagine a time when surgeries happened without incisions, without pain, without the risk of infections. And for that kind of vision, we created a robotic pill. So we made the little origami robot that we packaged in an ice pill. You can swallow the ice pill. And when the pill gets into your stomach, the ice melts and the origami robot unfolds.

And now, because the origami robot has a little magnet embedded in it, we can use an external magnetic field to control the location and the movement of this robot. And we can do a lot of interesting things with this technology. For example, we can remove foreign objects that get accidentally swallowed and lodged inside your stomach. And you might ask, who swallows foreign objects?

FLATOW: I'm a parent. I don't ask that question. I know the answer.

RUS: So this robot can actually pull out the button batteries that get lodged in the stomach coating and can puncture holes in the muscle tissue very fast. And with this little antidote origami pill, you can pull that battery out of the stomach coating very fast and very, very smoothly. You can also use these robots to patch wounds inside the body, to deliver medicine, to take tissue samples. So there are many, many different applications we can envision for this type of device.

FLATOW: Now I understand that you want to take some of these techniques and build an elephant. Am I getting that right?

RUS: Yes. So in our paper, we have actually shown how to make one muscle using these techniques. And now we want to compose these muscles to create big, human scale machines that can work side by side with humans in factories or in homes. So we are actually not going to make a real life sized elephant. We're going to make a baby elephant that is human sized. But we're very interested in the trunk of the elephant. We're very interested in the ability of these soft yet strong muscles to do delicate operations and strong operations at the same time. And if you watch an elephant use its trunk, it's amazing how that trunk can pick up a peanut. And it can also knock over a competitor.

FLATOW: Wow. I'm looking forward to putting one of these together myself, being the tinkerer that I am. So hurry up and get it ready.

RUS: Well, we have recipes.

FLATOW: You have recipes?

RUS: We have recipes for making them. They are published along with our paper.

FLATOW: OK. Thank you, Dr. Rus for taking time to be with us today.

RUS: Thank you so much.

FLATOW: Daniela Rus is director of the Computer Science and Artificial Intelligence Lab at MIT.