science FRIDAY

“Predicting the Future of Robotics” Excerpt Transcript

Excerpt from (July 22, 2016) episode of Science Friday.

IRA FLATOW	This is Science Friday. I'm Ira Flatow. Charles Thorpe joins us to talk about how far robotics have come in the last 22 years and where the technology might go in the future. Now he's vice president and provost of Clarkson University in Potsdam, New York. Welcome back.
CHARLES THORPE	Well, Ira, thanks for having me back. You never warned me in '94 that you were going to give me a pop quiz 22 years later.
FLATOW	Seems like yesterday, doesn't it?
THORPE	It does, until you look at what's happened in robots since 1994.
FLATOW	Well, let's talk about-- you were working on that self-driving car way back then. Was it was completely autonomous? Is it different idea than what people are working on now?
THORPE	We had the basics of the completely autonomous vehicle way back then. But we were also starting to work on, if it's not completely good enough for prime time, how do you use all of that robotic technology to watch when you're driving and keep you from becoming an accident statistic? So it's been very gratifying to see the technology we were working on 22 years ago start to save lives, start to wake people up who are drifting off the road, start to do emergency braking and just the beginnings, with people like Tesla, of automated driving.
FLATOW	Where do you think robots are headed now, and the main gist of getting self-driving cars, is that the main thrust that we're seeing today?
THORPE	Well, it certainly is one of the areas, using this robotic technology in everything from self-driving cars to assistance for visually impaired people to better factories. But there are some surprises that came along that we didn't expect. We expected this gradual growth of rough terrain robots, this fairly rapid growth of factory robots. Nobody in '94 anticipated the Roomba. The notion of a robot vacuum cleaner in '94 was a humanoid robot pushing a vacuum cleaner. And the notion of a robot chauffeur in '94 was a humanoid robot sitting behind the wheel of a car. We find that as the robotic technology gets better, it's harder and harder to see. Roomba kind of looks like a flying saucer. Doesn't look like a robot. A Tesla, you can't even see the self-driving technology. It's all buried under the hood and behind the grill.
FLATOW	And I want to expand our conversation to bring on a few more guests as we continue our robot tour. And these are people who are building things that look

	almost like half-animal and half-machine. They're called biobots, a hybrid of animal cells and mechanically printed 3-D printed parts that sort of make you wonder whether we should start calling these things living machines. Let me bring them on and we'll talk about it, see what I mean. Hillel Chiel is a professor of biology, neurosciences, and biomedical engineering at Case Western Reserve University in Cleveland. Welcome to Science Friday.
HILLEL CHIEL	Hi Ira. Nice to talk with you.
FLATOW	You're welcome. Ritu Raman is a mechanical engineer at the University of Illinois at Urbana-Champaign. Welcome to Science Friday.
RITU RAMAN	Hi, Ira. Happy to be here.
FLATOW	Hillel, tell us what you have built here. It's what, part sea slug and part what?
CHIEL	We've for years been studying the sea slug, aplysia californica, and how it feeds. And we had this rather crazy idea that we could take a muscle from the feeding apparatus and put it onto a 3-D printed framework, put that together, stimulate it electrically, and get something that walked. And it worked. This is just a muscle from the sea slug and a 3D printed framework around it, which is what provides the friction, so that when the muscle contracts from the electrical stimulation, one part moves forward and then the other part moves forward.
FLATOW	Wow. And what do we call this?
CHIEL	We call it a biobot. But a hybrid robot is another term that people are using.
FLATOW	Dr. Raman, your team took a different approach. Instead of using an existing animal part of your bot, you actually built the part from scratch using mouse cells. Tell us about that, please.
RAMAN	Sure. So the mouse cells that we use are optogenetic, which means that they have been genetically engineered to respond to blue light. So they contract whenever you shine blue light on them. So we take these cells that have been engineered and we mix them with a bunch of different types of proteins that mimic the extracellular matrix inside the body. So the cells, when they're around these proteins, they basically compact to form a 3D muscle ring or rubber band-like structure that contracts the way that real muscle that you could excise from an animal does.

	So then we do a similar thing where we couple the muscle that we've engineered to a 3D printed skeleton made of a soft compliant plastic. And then we can trigger stimulation, blue light stimulation, and muscle contraction.
FLATOW	Can you do it with other parts of the body besides a muscle?
RAMAN	Yeah. We are working on other cell types as well, for example, trying to use neurons to control the muscle and let it make decisions about when it wants to contract, as well as working with vascular cells or cells from blood vessels to make sure that we can efficiently transport nutrients into the biobots. We started with muscle, because force production and walking is just the most exciting thing. And people like to see that.
FLATOW	And at what point do we call them alive or something?
THORPE	Well, this is the step toward cyborgs. What is this mix of artificial parts and biological parts? And we know that there are some things that the world of biology does really, really, really well that we haven't figured out how to do mechanically. And so some of this coupling is going to be really exciting.
FLATOW	Ritu, could you control a fleet of these bots remotely and make them work together somehow?
RAMAN	Yeah, that's actually some of the motivation behind the work we do. It's part of a larger NSF center called the Emergent Behavior of Integrated Cellular Systems, or EBICS. So part of what we want to do is learn, both on the small scale and on the large scale when many of these biobots are interacting with each other, what kind of more complex behaviors can emerge from those interactions.
FLATOW	Hillel, I saw the movie and you saw the video about these slug bots, I'm going to call them. They don't move terribly fast. I know Eric Kandel won a Nobel Prize for his work with the sea slugs. I think he did it because they had giant neurons, nerve cells.
THORPE	Exactly. And that's another very exciting aspect. We're hoping to actually use some of the organized collections of nerve cells, the ganglia in these animals, as a basis for control. One of the difficulties is, you're trying to reverse engineer the developmental process. And we still don't understand how that works exactly. So sometimes, using something that's the end product may be faster or more effective than trying to reverse engineer it ourselves. So these ganglia could be used for control, we think. And that's what we're going to hope to do.
FLATOW	Let's open the phones, and some interesting comments from our listeners. Gainesville, Florida-- Martin, you're up first. Welcome to Science Friday.

MARTIN	Great, thanks for taking my call. I just have a quick question, and then I'll hang up and listen for the answer. What sort of ethical standards are being applied to this research? It seems like it's very fast emerging, much like genetic engineering has been. Could you discuss briefly what sort of ethics apply, and how do you decide what direction you're going to go in regarding biobots?
FLATOW	All right. Anybody want to jump in?
RAMAN	Sure. So as I said, our research is part of a National Science Foundation Center. And one big requirement of that grant and of all the researchers that work on it is that every year, we meet at a retreat. That's happening next week, actually. And we come up with different sort of ethical modules or vignettes and discuss situations of what happens if biobots do this? What happens if biobots start doing that? What kind of engineering controls can we implement to make sure that not only are we doing interesting designs, but we're doing responsible and safe designs? So I think part of what we need to do as a community of researchers is be open to the idea of trying these things, having engineering controls in place to make sure that we can control for any kind of unforeseeable outcome, but learn how we can control them and not just say, we never know what'll happen. We don't know what's going to happen now, so we need to study it and make sure that we can understand those rules for the future.
FLATOW	Charles Thorpe, vice president and provost at Clarkson University in Potsdam. Hillel Chiel, professor of biology, neuroscience, and biomedical engineering at Case Western Reserve University in Cleveland. Ritu Raman is a mechanical engineer at the University of Illinois at Champaign-Urbana. Thank you all for taking time to be with us today.