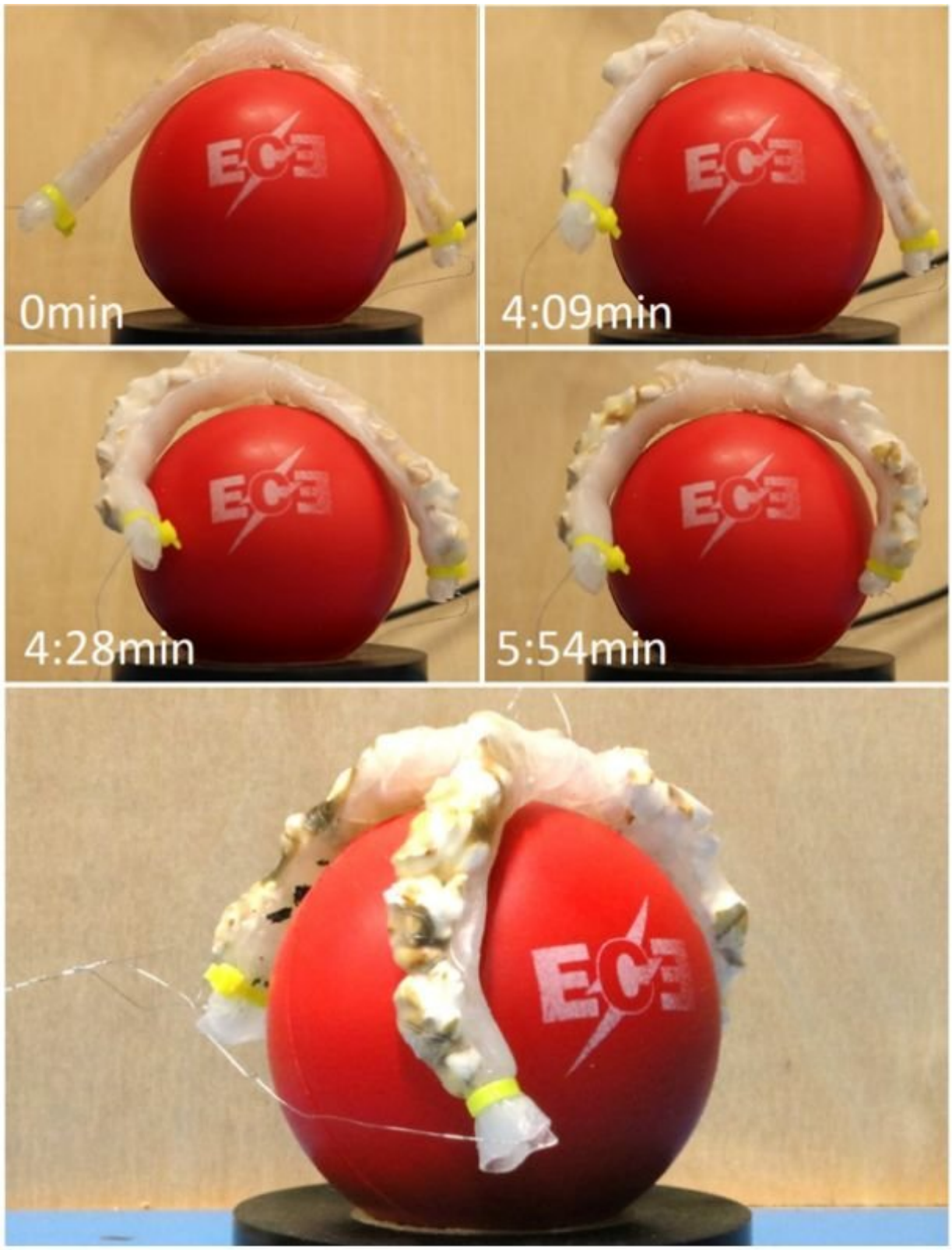
Popcorn robotics: Cornell team explored heated kernels

July 13 2018, by Nancy Owano



Fiber-reinforced elastomer actuator powered using popcorn wrapped in

Nichrome 60 wire. Credit: Steven Ceron et al, Popcorn-Driven Robotic Actuators

From Cornell University, you now have popcorn -driven robotic actuators to think about. Take it with a grain of, well, common sense. As *IEEE Spectrum* 's subhead said, "Popcorn is a cheap, biodegradable way to actuate a robot (once)."

But stay with *IEEE Spectrum*'s Evan Ackerman, the article' author on this, to discover why he believes that, although it's something you can only do once, the use of popcorn for powering an actuator is outright useful.

"You can think of unpopped kernels of popcorn as little nuggets of stored mechanical energy, and that energy can be unleashed and transformed into force and motion when the kernel is heated."

Also keep in mind that as a property "popcorn is super cheap," he wrote, and it being biodegradable and edible were simply bonuses.

A video from *IEEE Spectrum* uploaded earlier this month reflects their work, as laid out in the paper, "Popcorn Driven Robotic Actuators." Their paper is by six authors from Cornell and it was prepared for IEEE International Conference on Robotics and Automation (ICRA) 2018 in Brisbane, Australia.

Popcorn? Yes, that popcorn. Edible popcorn kernels. Kids love to hear the kernels pop and everyone has the pleasure of eating popcorn at movies and for TV watching, but scientists also love the kernels' potential to rapidly expand with high force upon application of heat.

The scientists are popping the question of how popcorn might turn out for robotic applications. Applications? As in what? One of the uses would be a jamming actuator filled with kernels; another scenario involved an origami actuator. Ackerman said they used "recycled Newman's Own Organic Popcorn bags to make their origami actuators, and 80 grams of popped kernels were able to hold up a 4 kg kettlebell."

The researchers characterized three kernel types: medium white, medium yellow and extra-small white.

IEEE Spectrum, on that note, asked Steven Ceron, one of the researchers, about how much variability there was between unpopped and popped characteristics of the different varieties of popcorn. Ceron said you need the same temperature to pop the difference types of kernels. "The final size of the popped kernels, however, can vary drastically depending on the method of heating."

The researchers explored popcorn's use via categories such as expansion ratio, compression strength, transition temperature, popping force and intra-granular friction. They showed popping via microwaves and via heated Nichrome wire.

What's on their minds next: "In the near future, we aim to design the infrastructure necessary for stand-alone popcorn-driven robots. This will require an embedded system capable of heating the kernels, and a pump capable of moving the kernels. Longterm, the work on multi-functional granular fluids presented in this paper may help pave the way for a wide range of applications spanning the fields of rigid, compliant, and soft robots."

IEEE Spectrum picked up on this. "The paper mentions that you'd like to design "stand-alone popcorn-driven robots." Ackerman asked him to flesh the idea out more.

Ceron thought an interesting outcome would be a small robot capable of holding a packed chamber of kernels. "The robot would be able to rapidly/locally heat a single kernel and push it out of the robot, simultaneously filling an open region with popped kernels and propelling the robot forward."

In addition, *Interesting Engineering* said Ceron and team were interested "to perfect other biodegradable options for actuators that could provide eco-friendly and low-cost solutions to these robotics parts."

More information: Popcorn-Driven Robotic Actuators, research paper (PDF)