Stretchable 'skin' sensor gives robots human sensation

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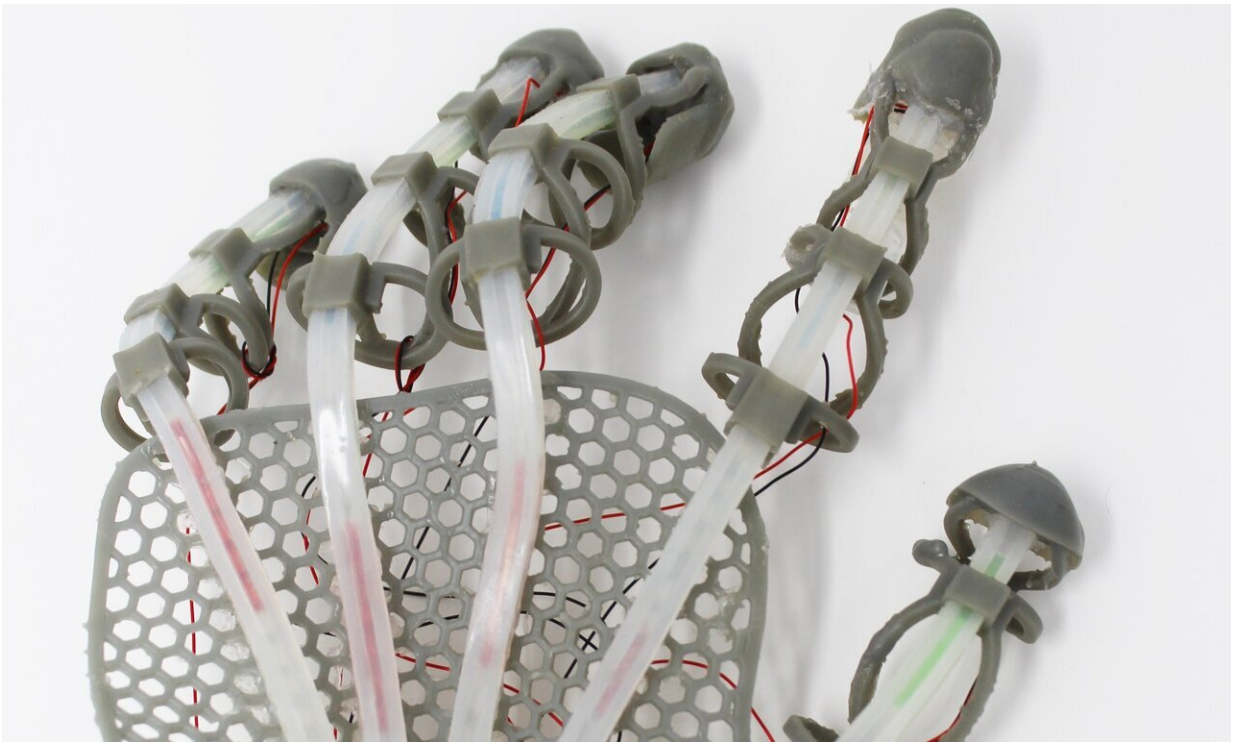


Glove integrated with SLIMS sensor. Credit: Hedan Bai

It's not a stretch to say that stretchable sensors could change the way soft robots function and feel. In fact, they will be able to feel quite a lot.

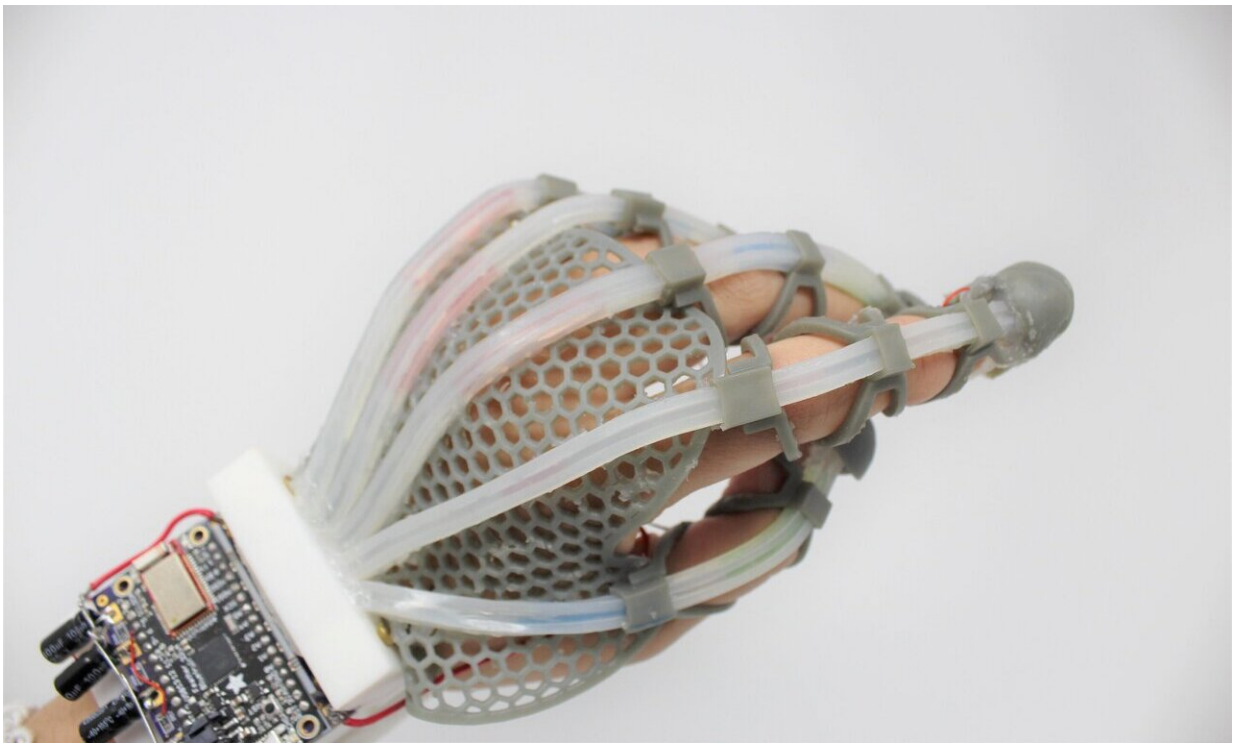
Cornell University researchers have created a fiber-optic sensor that combines low-cost LEDs and dyes, resulting in a stretchable "skin" that

detects deformations such as pressure, bending and strain. This sensor could give soft robotic systems—and anyone using augmented reality technology—the ability to feel the same rich, tactile sensations that mammals depend on to navigate the natural world.

The researchers, led by Rob Shepherd, associate professor of mechanical and aerospace engineering, are working to commercialize the technology for physical therapy and sports medicine.

Their paper, "Stretchable Distributed Fiber-Optic Sensors," published in *Science*. The paper's co-lead authors are doctoral student Hedan Bai and Shuo Li.

Bai drew inspiration from silica-based distributed fiber-optic sensors and developed a stretchable lightguide for multimodal sensing (SLIMS). This long tube contains a pair of polyurethane elastomeric cores. One core is transparent; the other is filled with absorbing dyes at multiple locations and connects to an LED. Each core is coupled with a red-green-blue sensor chip to register geometric changes in the optical path of light.

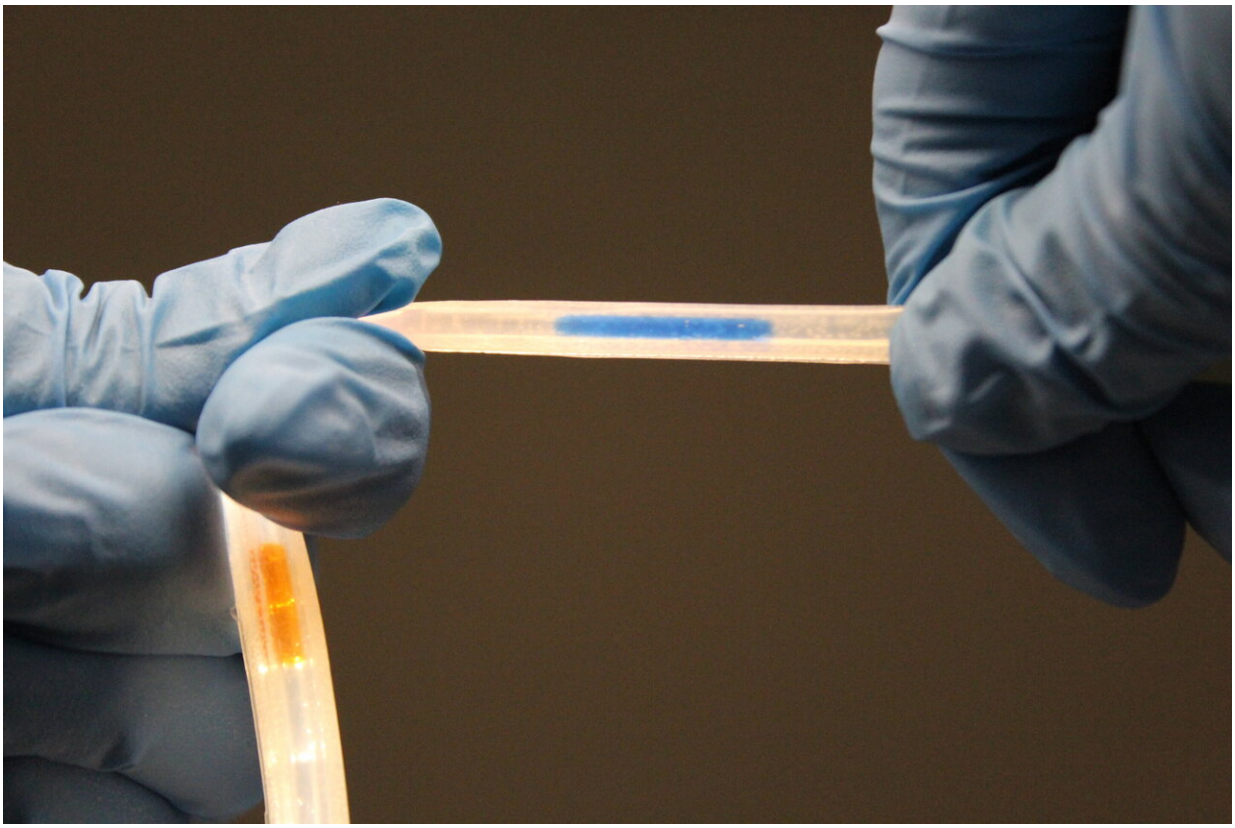


Glove integrated with SLIMS sensor. Credit: Hedan Bai

The researchers designed a 3-D-printed glove with a SLIMS sensor running along each finger. The glove is powered by a lithium battery and equipped with Bluetooth so it can transmit data to basic software, which Bai designed, that reconstructs the glove's movements and deformations in real time.

"Right now, sensing is done mostly by vision," Shepherd said. "We hardly ever measure touch in real life. This skin is a way to allow ourselves and machines to measure tactile interactions in a way that we now currently use the cameras in our phones. It's using vision to measure touch. This is the most convenient and practical way to do it in a scalable way."

Bai and Shepherd are working with Cornell's Center for Technology Licensing to patent the technology, with an eye toward applications in physical therapy and sports medicine. Both fields have leveraged motion-tracking technology but until now have lacked the ability to capture force interactions.



Stretchable DFOS with discrete/gradient dye pattern stretched/twisted/bent. Credit: Hedan Bai

The researchers are also looking into the ways SLIMS sensors can boost virtual and augmented reality experiences.

"VR and AR immersion is based on motion capture. Touch is barely

there at all," Shepherd said. "Let's say you want to have an augmented reality simulation that teaches you how to fix your car or change a tire. If you had a glove or something that could measure pressure, as well as motion, that augmented reality visualization could say, 'Turn and then stop, so you don't overtighten your lug nuts.' There's nothing out there that does that right now, but this is an avenue to do it."

More information: H. Bai el al., "Stretchable distributed fiber-optic sensors," *Science* (2020). science.sciencemag.org/lookup/ … 1126/science.aba5504

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