New fingertip sensors to help veterans feel through their prosthetics

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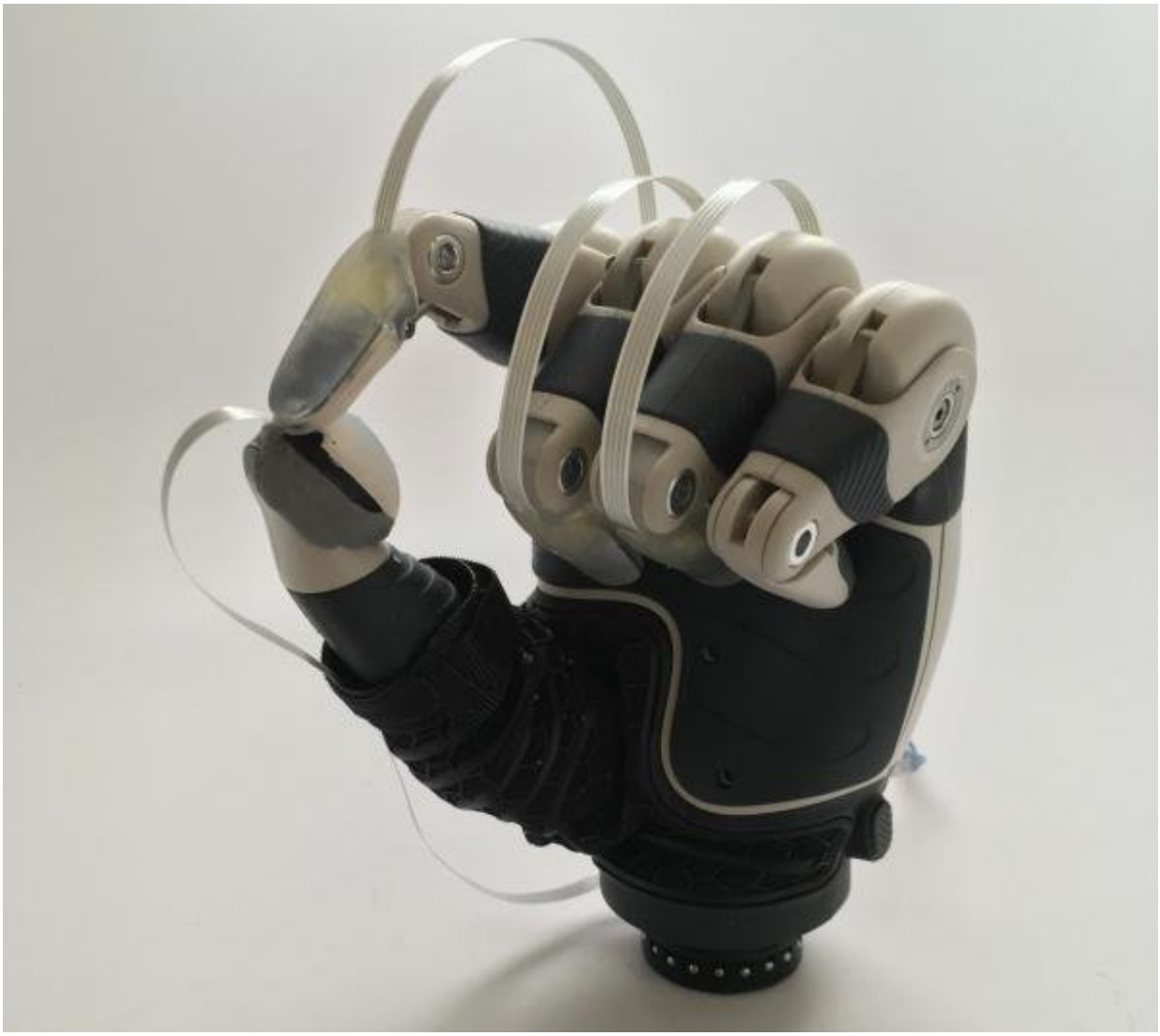

Credit: University of Colorado at Boulder

Today's prosthetic limbs are tools – literal attachments to the body.

They help with the daily activities that impact quality of life, but they are not integrated into the user's body like our intact limbs. That caveat presents a challenge for engineers, scientists and doctors – make a prosthetic hand that is just as capable as the one that was lost.

The missing link? The sense of touch.

Engineers at CU Boulder are working on that problem, perfecting prosthetic fingertip sensors that allow patients to actually feel tactile and sensory sensations through nerve interfaces. These fingertip sensors could eventually be used in take-home clinical trials for amputees with neural interfaces for sensory restoration.

Jacob Segil, a CU Boulder instructor and Veterans Affairs research healthcare scientist, is leading the project here through a new $200,000 contract from the U.S. Department of Veterans Affairs. His work is in collaboration with the Functional Neural Interface Laboratory at the Louis Stokes Cleveland VA Medical Center.

The tips will be paired with work being done by various groups, including Case Western Reserve University Professor Dustin Tyler and his team in the Functional Neural Interface Laboratory. That group has developed technology that can "talk" to nerves. Electrodes are placed inside the amputee next to nerves and muscles that used to serve the hand that was lost. Electrical currents stimulate different nerve fibers to produce realistic sensations that feel as though they are coming from the missing hand or arm.

The measurements of touch from Segil's fingertip sensors allow for better control of a prosthesis by the amputee and, they hope, more embodiment of the prosthetic device. That is, they close the loop

between the brain, nervous system and the prosthesis – blending man and machine together fully.

"Amputees will have a better experience and livelihood if we build them an embodied limb rather than a tool that is completely numb," he said. "It doesn't need to have five fingers, bones or tendons. It can be of plastic, carbon fiber and metal. It can be battery operated. But the most important part is that it is psychologically integrated with them – that it is embodied."

Originally, Segil and his team used a seed grant from the Multi-Functional Materials Interdisciplinary Research Theme to create the fingertip sensors with the help of the Correll Lab at CU Boulder and Associate Research Professor Richard Weir on CU Denver's Anschutz Medical Campus. The tips were then shared with various outside groups working on sensory restoration including Nitish Thakor at Johns Hopkins University, Greg Clark at the University of Utah, Jacqueline Hebert at the University of Alberta, and Tyler's team.

The Cleveland VA noticed the work and offered the new contract to make 25 more for future take-home trials.

"They were looking for fingertip sensors for their specifications. They had makeshift solutions, but they basically couldn't buy the answer," said Segil. "But we were able to engineer these for them."

Segil said the work now is to make the tips more rugged and ready for extended use.

"What we made originally is great for laboratory conditions, but we need something now that will stand up to the elements and to being used 10 hours a day," he said. "There is still a lot of research and development work to be done in order create an artificial system that is as rugged as

our intact anatomy."

Provided by University of Colorado at Boulder