# Touching moments in prosthetics: New bionic limbs that can "feel"

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Doctoral student Jacob George (left) and professor Greg Clark examine the LUKE arm, a motorized and sensorized prosthetic that has been in development for more than 15 years. Photo courtesy Dan Hixson/University of Utah College of Engineering

After losing his arm in an accident, Keven Walgamott only experienced phantom pain in his arm. This is commonly experienced by people who lose limbs. After he tried on the LUKE Arm, Walgamott could "feel" again. The LUKE Arm is a bionic arm developed by a team at the University of Utah.

Many people who have lost limbs use prosthetic limbs. However, these prosthetics do not feel like part of the body. Researchers around the world have been developing prosthetics that feel more like biological limbs.

Gregory Clark is the lead researcher on the study. He points out that "touch isn't a single sense." Whenever we touch an object, our hand sends neural impulses to our brain. These impulses have important information about the object we are touching. This in turn helps our bodies to interact with the object. For example, we interact with a basketball differently than we do a beach ball.

**Tricking The Brain**

The LUKE Arm allows users to "feel" objects much like they would with a biological limb. Walgamott told researchers that it felt like he had his arm back. Even his phantom pain was reduced. Clark explained that was because the brain was tricked into believing that the prosthetic hand was his real hand. The LUKE Arm is able to replicate the neural impulses people receive from their native arms.

Clark said, "We send electrical signals from the muscles. The brain interprets them as real."

Bionic prosthetics require a device known as a brain-computer interface (BCI). The BCI allows the brain and the prosthetic to communicate. The LUKE Arm uses a neural interface that users can easily wear. Other prosthetics require users to undergo brain surgery. Thanks to new technology, this might be about to change.

### Mind-Controlled Robotic Arm

Bin He is a professor of engineering at Carnegie Mellon University. He and his team have been working on a BCI that does not require brain surgery. In June, his team reported that they have successfully developed a mind-controlled robotic arm. The arm uses "noninvasive EEG signals" so users do not need surgery.

There have been similar BCIs in the past. However, these BCIs had limitations. Users could push a button — a simple action that does not require continuous movement. More complex movements proved to be quite difficult with these BCIs. In He and his team's demonstration, the subject mentally controlled a robotic arm in tracking a cursor. The prosthetic finger was able to follow the cursor in a continuous path — just like a real finger. He said the system could be used with a smartphone app programmed with EEG recordings and wireless electrodes. This would remove the need for brain surgery.

Our native limbs are trained to perform different actions such as throwing a ball. Prosthetic limbs also have to be trained for specific uses.

### "Learning" New Skills

The Imperial College London and the University of Göttingen developed a bionic hand in 2018. Thanks to advanced computer techniques, the hand can "learn" new skills.

"Our main goal is to let patients control the prosthetic as though they were their biological limbs," said Dario Farina. Farina is a lead researcher on the project.

Researchers say that bionic body parts can work for both amputees and paralyzed people. He said, "The BCI system can be tailored to particular needs."

BCIs can improve our bodies' capacities. Will it soon be possible to develop bionic add-ons that give superhuman abilities?

Clark said yes, although he pointed out that we already use technology to gain superhuman abilities. "Glasses restore normal vision to the nearsighted. But telescopes and microscopes allow us to see what would be otherwise unseeable."

Yet in other ways, bionic parts are no match for nature. The human body has thousands of sensors — much fewer than the LUKE Arm.

Clark explained that the field of biomedical engineering exists to improve nature. Helping people who have experienced illness and an accident is particularly important. "But we also try to understand and use nature to improve ourselves," he said.