

THINK IT, DO IT

Brain, Meet Robot

Pitt researchers have been awarded funding for two projects that will place brain-computer interfaces (BCI) in patients with spinal cord injuries to test whether it is possible for them to control external devices, such as a computer cursor or a prosthetic limb, with their thoughts.

The projects build upon ongoing research conducted in epilepsy patients who had the interfaces temporarily placed on their brains and were able to move cursors and play computer games, as well as in monkeys that, through interfaces, guided a robotic arm to feed themselves marshmallows and turn a doorknob.

“We are now testing BCI technology in the patients who might benefit from it the most, namely those who have lost the ability to move their upper limbs due to a spinal cord injury,” says Michael L. Boninger, MD, professor and chair of physical medicine and rehabilitation. “It’s particularly exciting for us to be able to test two types of interfaces within the brain.”

“By expanding our research from the laboratory to clinical settings, we hope to gain a better understanding of how to train and motivate patients who will benefit from BCI technology,” says Elizabeth Tyler-Kabara, MD, PhD, assistant professor of neurological surgery and of bioengineering and the lead surgeon on both projects.

In one project, funded by an \$800,000 NIH grant, a BCI based on electrocorticography was placed on the motor cortex surface of a spinal cord injury patient’s brain for about four weeks. The neural activity picked up by the BCI was translated through a computer processor, allowing the patient to learn to control computer cursors, virtual hands, computer games, and, finally, a robotic arm and hand. In an emotional session at the culmination of the four-week period, the patient was able to use his mind to raise the robotic hand and “high-five” a researcher. He then extended the hand to touch his girlfriend’s hand—for “the first time in seven years,” he said through tears.



The second project, funded by the Defense Advanced Research Projects Agency for up to \$6 million over three years, is part of a program led by the Johns Hopkins University Applied Physics Laboratory. It will further develop technology tested in monkeys by Andrew Schwartz, PhD, Pitt professor of neurobiology.

The interface is a tiny, 10-by-10 array of electrodes that is implanted on the brain’s surface to read activity from individual neurons. Those signals are processed and relayed to maneuver a sophisticated prosthetic arm.

“Our animal studies have shown that we can interpret the messages the brain sends to make a simple robotic arm reach for an object and turn a mechanical wrist,” Schwartz says. “The next step is to see not only if we can make these techniques work for people but also if we can make the movements more complex.”

In the study, participants will get two separate electrodes. In future research efforts, the technology may be enhanced with an innovative telemetry system that would allow wireless control of a prosthetic arm, as well as a sensory component.

“Our ultimate aim is to develop technologies that can give patients with physical disabilities control of assistive devices that will help restore their independence,” Boninger says.