Mind-controlled robotic arm gets closer than ever to human limb

Chris Wickham, Reuters

Researchers in the United States have developed a robotic arm controlled directly by thought with a level of agility closer than ever to a normal human limb.

Jan Scheuermann, a 52 year-old woman who was diagnosed with a degenerative brain disorder 13 years ago and is paralyzed from the neck down, was able operate the robotic arm with a level of control and fluidity not seen before in this type of advanced prosthesis.

Experts are calling it a remarkable step forward for prosthetics controlled directly by the brain. Other systems have already allowed paralyzed patients to type or write in freehand simply by thinking about the letters they want.

And in the last month, researchers in Switzerland used electrodes implanted directly on the retina to enable a blind patient to read.

The development of brain-machine interfaces is moving quickly and scientists predict the technology could eventually be used to bypass nerve damage and re-awaken a person's own paralyzed muscles.

In the meantime, they say, systems like this could be paired with robotic 'exoskeletons' that allow paraplegics and quadraplegics to walk.

COMPLEX ALGORITHM

In the latest study, published in the Lancet, a research team from the University of Pittsburgh Medical Center implanted two microelectrode devices into the woman's left motor cortex, the part of the brain that initiates movement.

The medics used a real-time brain scanning technique called functional magnetic resonance imaging to find the exact part of the brain that lit up after the patient was asked to think about moving her now unresponsive arms.

The electrodes were connected to the robotic hand via a computer running a complex algorithm to translate the signals that mimics the way an unimpaired brain controls healthy limbs.

"These electrodes are remarkable devices in that they are very small," Michael Boninger, who worked on the study, told Reuters. "You can't buy them in Radio Shack."

But Boninger said the way the algorithm operates is the main advance. Accurately

translating brain signals has been one of the biggest challenges in mind-controlled prosthetics.

"There is no limit now to decoding human motion," he said. "It gets more complex when you work on parts like the hand, but I think that, once you can tap into desired motion in the brain, then how that motion is effected has a wide range of possibilities."

It took weeks of training for Scheuermann to master control of the hand, but she was able to move it after two days, and over time she completed tasks - such as picking up objects, orientating them, and moving them to a target position - with a 91.6 percent success rate. Her speed increased with practice.

The researchers plan to incorporate wireless technology to remove the need for a wired connection between the patient's head and the prosthesis.

They also believe a sensory loop could be added that gives feedback to the brain, allowing the user to tell the difference between hot and cold, or smooth and rough surfaces.

"This bioinspired brain-machine interface is a remarkable technological and biomedical achievement," said Grégoire Courtine at the Swiss Federal Institute of Technology in Lausanne, who was not involved in the study.

"Though plenty of challenges lie ahead, these sorts of systems are rapidly approaching the point of clinical fruition," Courtine said in a comment piece in the Lancet linked to the study.

ETHICAL QUESTIONS

Although using technology to restore movement, sight or hearing in the disabled would for many seem uncontroversial, some disability rights groups and ethicists are wary.

They argue that restoring hearing, for instance, could fuel a prejudice that a deaf life is less rich, or less well lived.

Andy Miah, a professor at the University of the West of Scotland who has written extensively about human enhancement in the context of the Paralympics, says it is far from straightforward.

"For instance, a few years ago, there was a case of a deaf lesbian couple who sought to use in vitro fertilization to select for deafness.

"They argued that absence of hearing is precisely not an impairment, but allows access to a rich community."

The ethics become more complex with the prospect of using these technologies to enhance the able-bodied.

"It's quite likely that therapy is the back door to enhancement in these kinds of technological interventions," says Miah. "People will question whether this is desirable, but we already live in a society that tolerates such modifications.

"Laser eye surgery interventions have grown astronomically over the last decade and nobody complains that it is making people superhuman."

For Jan Scheuermann, the experience has been transforming.

"It's given her a renewed purpose," said Boninger. "On the first day that we had her move the arm, there was this amazing smile of joy. She could think about moving her wrist and something happened."

(Editing by Rosalind Russell)

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