$2.9 Million Grant to Improve Brain Implants Received

Less than 2 years ago, a brain-computer interface designed at the University of Pittsburgh allowed Jan Scheuermann to control a robotic arm solely with her thoughts. Using the arm to bring a chocolate bar to her mouth and taking a bite was a sweet victory for Ms. Scheuermann, who has quadriplegia.

The feat also was a victory for scientists developing the brain-computer interface technology, which is poised to help other patients with quadriplegia or amputated limbs. Much work still needs to be done to advance the technology for routine medical use, however.

McGowan Institute for Regenerative Medicine faculty member Xinyan “Tracy” Cui, PhD, associate professor of bioengineering in Pitt’s Swanson School of Engineering, was recently awarded a $2.9 million 5-year grant from the National Institutes of Health to move the technology forward. Dr. Cui will focus on the microelectrode arrays, or brain implants, that are used to connect mind and machine. As the primary investigator, she will explore ways to coat the microelectrodes with biological molecules that could not only better maintain the connection between the brain implants and computers that operate devices like robotic arms but also strengthen that connection.

Research has shown that, over time, microelectrode arrays can elicit an inflammatory response and cause damage to neurons, weakening the link. While the harm to the patient isn’t significant, poorer recordings of neural impulses can limit the functionality of the technology and the quality of information reaped by researchers.

“For the first few months, the data are good, but it starts to decline,” she says. “It’s a common trend to see the amplitude of the recorded signal go down, and it becomes lost in the noise. After a year, we lose half the channels.”

“What we hope to do is camouflage [the microelectrode needles] with biochemicals that can escape the immune surveillance response and protect neurons around the electrodes,” Dr. Cui continues. She has high hopes for a cell adhesion molecule called L1, which has shown positive results in animal models. In addition to gaining better understanding of the mechanisms behind L1’s preliminary success, Dr. Cui also plans to pursue and test several other targets.
McGowan Institute for Regenerative Medicine faculty member and Pitt Professor of Neurobiology Andrew Schwartz, PhD, who is leading a study of the robotic arm technology used by Ms. Scheuermann and serving as a co-investigator on Dr. Cui’s team, believes in the potential of the project.

“We did one array, and we had spectacular results,” he says. “We had very nice recordings with large signals, and they lasted longer than what we would normally see. I’m excited about the possibility.”

Dr. Schwartz says that the initial experiments have shown that the coating extends the viability of neural recording via microelectrode arrays by about 6 months beyond what is now a 9- to 12-month window.

Another important component of the grant is funding that will be used to explore a new microscopy technique that will allow Dr. Cui and colleagues to monitor the function of L1 and other tested molecules in a living animal.

“In vivo imaging will allow us to see which neurons are firing and which are not active and, therefore, not being recorded,” she says.

Dr. Cui’s work could advance not only brain-computer interface technology but also other technologies that use microelectrode arrays to help restore sight, hearing, movement, ability to communicate, and cognitive function.

Dr. Cui’s co-investigators are Pitt School of Medicine faculty members Dr. Schwartz; McGowan Institute for Regenerative Medicine affiliated faculty member Carl Lagenaaur, PhD, associate professor of neurobiology; and Alberto Vazquez, PhD, research assistant professor of radiology, as well as T.K. Kozai, PhD, research assistant professor of bioengineering in Pitt’s Swanson School of Engineering.

Illustration: Neural field. –PTEI.

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