



# The Role of Robotics in Rehab

Stroke is not only the third leading cause of death in the United States, it is also one of the leading causes of long-term disability. About 4 million people today are stroke survivors who are struggling with resulting neurological deficits, according to the American Heart Association.

For stroke survivors who have sensory deficits, or difficulty feeling sensations with their hands or feet, performing simple tasks like opening a door or drinking a glass of water can be difficult. They can see with their eyes that they have grasped the door handle or water glass, but they cannot feel the sensation of the object in their hands.

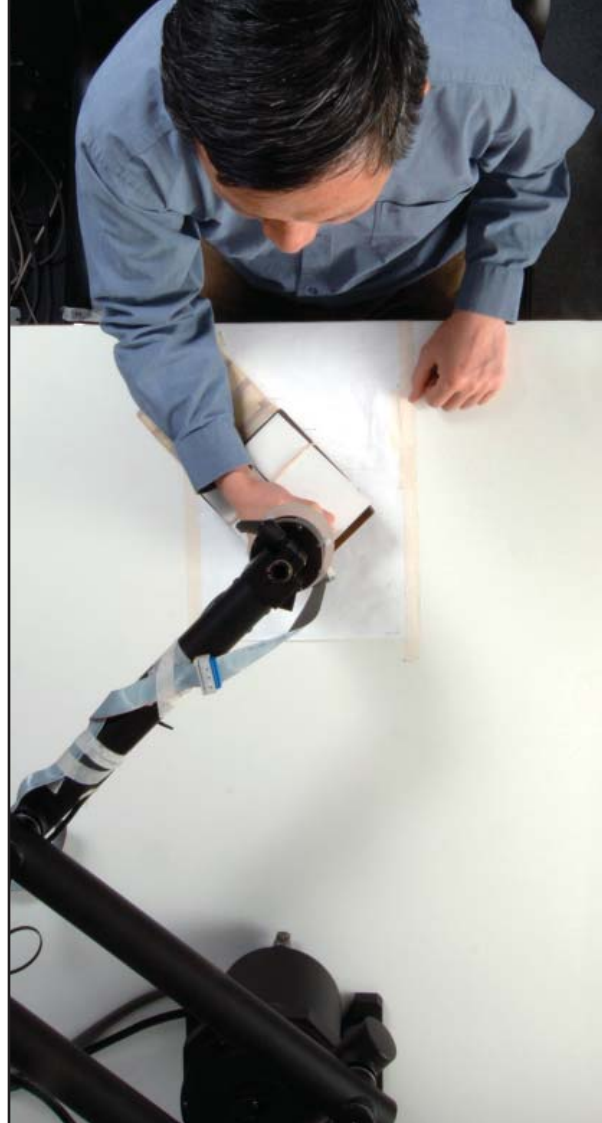
**THE ADVANTAGE OF THE ROBOTIC ARM IS THAT IT MAINTAINS THE CONSISTENCY AND RANGE OF MOVEMENT.**

Wen Liu, PhD, associate professor at the University of Kansas School of Allied Health Department of Physical Therapy and Rehabilitation Science, is engaged in a three-year study funded by the National Institutes of Health that he hopes will help stroke survivors with enhanced sensory input so they can have more success performing movements.

Liu, also a biomedical engineer, has developed a novel form of sensory-enhanced input he believes will help reconstruct the brain cells that control motor function. Specifically, he and his team in the Neuromuscular Research Laboratory have spent the last year engineering a unique handle mechanism for a robotic arm that will increase sensory input during motor training. Hoping to improve muscle control, the handle vibrates a specific area of the hand to remind patients when they are pulling or pushing during therapy. The robotic arm mounts to a table, and patients lay their hand on top. Early on, the robot moves the arm for the subject. As the person progresses and can initiate movement themselves, the robot provides resistance to build muscle strength and improve motor planning much as a physical therapist would during rehabilitation sessions.

“We hope the reconstruction process can be sped up if we have sensory feedback during movement,” Liu said. “We hope this sensory feedback will go into the brain and provide a driving force in sensorimotor reconstruction.”

Liu is also combining this modern robotic technology with the ancient art of acupuncture to help stroke survivors gain more control of their extremities.



**SENSORY FEEDBACK** during movement will hopefully aid in reconstruction of brain function in stroke patients. The robotic arm demonstrated by Dr. Wen Liu, above, guides movement and increases resistance to build muscle strength.

Often, stroke survivors suffer from spasticity – their muscles involuntarily contract when they try to move a limb. Unfortunately, the spastic muscles can make it difficult for the patient to initiate movement and engage in physical therapy.

So in a study funded by the American Heart Association, Liu uses acupuncture to help patients’ muscles relax. “In some patients, acupuncture has been shown to reduce the level of spasticity,” Liu reported.



Wen Liu, PhD

Once the subjects' muscles have relaxed, Liu then uses the robotic arm to help them do exercises designed to improve their muscle control.

The advantage of the robotic arm in physical therapy is that it maintains consistency and range of movement and does not grow weary, like a human therapist. The robotic arm is not designed to eliminate the role of the physical

therapist, Liu noted, but to help therapists work more efficiently and with more than one patient at a time.

Other projects in the Neuromuscular Research Laboratory deal with impaired walking abilities in people as they age, with and without a stroke. This work is completed in collaboration with Nandini Deshpandi, PhD, PT, a physical therapist and neuroscientist. Deshpandi

is a new faculty member who joined the department from the National Institutes of Health, which is funding her research. The stability of a person walking on an even surface is hampered even in healthy individuals as they age, which puts them at risk for falls. Dr. Deshpandi is evaluating new ways in which people can exercise to prevent the loss of gait stability during aging. ■