Turning thoughts into actions

A novel brain training device to improve stroke rehabilitation

The use of mind power is no longer a paranormal phenomenon. Scientists at The Hong Kong Polytechnic University have created a robotic arm that can be controlled by thought. Led by the specialist in stroke rehabilitation, Professor Raymond Tong of the Interdisciplinary Division of Biomedical Engineering, a new research grew out of a five-year research unlocking the secrets of our mind and muscle movements. The robotic arm can be fitted on a stroke patient and help move his hand. A hand-shaped exoskeleton is connected to a mind-reading headset which records brain activity. When a person concentrates on moving his hand, the headset will detect the intention of physical movements and drive a robotic arm which wraps around his hand, allowing the paralysed hand to move voluntarily, which is otherwise impossible on their own.

The mind-controlling function works by detecting a patient’s intention of physical movement as well as muscle movements, and translating the signals into action, through complex algorithms developed by experts at biomedical engineering and rehabilitation science.

It will be used in physical therapy and occupational therapy which help stroke patients improve hand functions, or re-learn basic tasks such as grasping or pinching.

Prof. Tong explained, “Neurorehabilitation research in our lab had found a link between brainwave signals and muscle signals. We now knew that in
order to trigger a hand movement, such as doing a good grasp, our brain and hand muscle would send electrical discharge at similar frequencies. We called this phenomenon EEG/EMG coherence. These findings allowed us to accurately decode brainwave signals. In particular that hands and arms are found more difficult to recover than the legs. Now, we are able to build devices that can boost recovery by moving the impaired hands more naturally in training."

Due to a brain damage caused by stroke, there is a deficiency in brainwave signals for controlling muscle movements, and normal muscle contraction becomes impossible. Their innovative method successfully reconnects the brain and the paralyzed hand, making it possible to move muscles with little healthy brainwave signals that are remaining.

“Patients are able to open and close their hands successfully. Completing the hand movements will get correct feedback to the brain. We’re expecting that the robot training will stimulate recovery in the brain far better than conventional therapy,” explained Prof. Tong. The team has also successfully reconstructed 3-D hand movements that are smooth and realistic daily activities, which will add to learning effectiveness.

Representing a radical change in training technique, the advance was exciting but the robot was still at early stage of development. Further studies and clinical experiments will be carried out to validate the technology, where patients will be invited to try out the device. “We’re looking to see what happens in their brains and what happens to motor function control abilities before and after training. A better understanding of the process where the brain reforms itself would lead to more targeted therapy,” Prof. Tong continued.

“Brainwave reading technologies open doors to medical applications that we could only dream about. Mind-controlled robotic training can now target brain activities. It could allow patients affected by severe stroke to regain mobility.”