Life Sciences 生命科學

World's first Brain Training Device brings hope to stroke patients

全球首部腦功能訓練儀 為中風病人帶來希望

Based on its sophisticated algorithm, this novel device can detect brainwave, thereby controlling the movement of paralysed limbs and can even control a robotic hand.

憑著其精密的計算和控制方法，這創新的「中風腦功能訓練儀」能探測腦電波，協助病人控制癱瘓肢體的移動，甚至可用於控制機械手。

After using the device for treatment, a stroke patient (left) finds improvement in the movement of his originally paralysed left hand. On the right is Prof. Raymond Tong.
中風病人(左)接受訓練儀療程後，原本癱瘓的左手的活動能力有所提升。右為湯啟宇教授。

Funded by the HKSAR Government's Innovation and Technology Fund, the device was developed by Prof. Raymond Tong Kai-yu at PolyU's Interdisciplinary Division of Biomedical Engineering (BME), together with BME team members and the Industrial Centre at PolyU.

The device can guide stroke patients to reacquire the connection between the brain and the limb, with an EEG headset and an EMG forearm brace used to transmit data for controlling a hand robotic system via a telecare software interface in an iPad app. The award-winning Exoskeleton Hand Robotic Training Device – the "Hand of Hope" – was also invented by Prof. Tong and his team. Now the Brain Training Device can be coupled with the "Hand of Hope" to achieve a higher degree of recovery for stroke patients.

The new algorithm is based on frequency coherence in surface electroencephalography (EEG, brainwave) and electromyography (EMG, muscle activities) to identify voluntary intention and their connection.

"The Brain Training System looks like a cyclist's helmet and can read brainwaves", explained Prof. Tong. "It also has new features to find the specific EEG electrode locations for each stroke patient and reduce the number of electrodes, which can reduce the system cost and the preparation time for brain training."

To find a minimal set of electrodes to control the device with an accuracy of higher than 90%, five chronic stroke patients were recruited and trained for 20 sessions. The researchers found that 32 electrodes are generally needed to maintain the required level of accuracy.

The high accuracy and low number of channels needed means that the device is a viable tool for assistive aid and rehabilitation training. The futuristic system will be made portable and easy-to-use in hospital and home settings.

PolyU has already filed patents for the device in the United States and the Chinese mainland. The findings of the research project behind the brain control algorithm were published as the December 2011 cover story of the leading international journal *IEEE Transactions on Neural Systems and Rehabilitation Engineering.*

這訓練儀由理大生物醫學工程跨領域學部湯啟宇教授領導的研究團隊研發，成員包括生物醫學工程跨領域學部及工業中心的研究人員。此項目獲香港特區政府創新及科技基金的資助。

「中風腦功能訓練儀」能夠讓中風者重新連繫大腦及肢體的信號，其腦電波探測裝置及肌肉電流前臂裝置，亦可透過適用於平板電腦的軟件平臺傳輸數據，控制前臂機械裝置。而早前獲獎的「肌動機械手」(又稱「希望之手」)亦為湯啟宇教授的團隊研發。「中風腦功能訓練儀」更可配合「希望之手」一同使用，提升中風者的復康治療效果。

訓練儀運用了首創的演算方法，檢測人腦電波與肌肉電流的共振頻率，進一步鑒別腦和肌肉之間的神經聯繫，以區分出正確的自主運動意識。

湯教授解釋，訓練儀外型大小如單車頭盔，能探測腦電波，並具有獨特的腦部電極設計，針對每位中風者的病情及需要，選出最合適的腦部電極位置，從而減少所需的電極數量，以及減低裝置費用和預備時間。

為了得出最少所需用以控制訓練儀的電極數量，從而達致超過90%的準確度，五位中風者獲邀參與研究，並進行二十次療程。研究人員發現，若須訓練儀達到90%腦意識的識別準確率，有需要採用三十二個腦部電極。

訓練儀準確度高、所需電極數量少，意味該系統是輔助及復康訓練的有效工具。展望將來，研究人員預期可進一步改良系統成為易攜易用，並適用於醫院及家居的復康工具。

理大已為「中風腦功能訓練儀」在美國及中國取得專利。而該研究的大腦控制演算方法，更成為國際期刊 IEEE Transactions on Neural Systems and Rehabilitation Engineering (2011年12月號) 的封面故事。