**T he potential of a system combining high-resolution E E G , Robotics and V i rtual R eality fo r the neu ro-motor rehabilitation of st ro ke su rvivors**

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A novel system for the neuro-motor rehabilitation of upper limbs has been used in a post-stroke survivor for the simultaneous acquisition of functional brain signals and kinematic measures during the performance of rehabilitation tasks. The system integrates high-resolution EEG (HR-EEG) with a passive robotic device (Trackhold) and five dedicated Virtual Reality (VR) training applications.

The brain functional re-organization is monitored during the execution of motor patterns replicating activities of daily living (ADL) induced by the VR training applications. The patient underwent 13 rehabilitation sessions with the new system during one month of traditional rehabilitation. At sessions 1, 7 and 13, clinical tests were administered to assess the level of recovery from motor impairment, and HR-EEG was recorded during the execution of the five VR training applications. For each session and each training application, four kinematic indices of motor performance were calculated and compared with the outcome of the clinical tests. Kinematic data were also used to segment the EEG data, and functional source maps associated with each motor task were reconstructed and projected on the real patients' anatomy (MRI data). Time-frequency contrast images and Laterality indices were calculated to assess activation-deactivation patterns and hemispheric dominance. The repetition of these measures throughout rehabilitation permitted to

typify the functional changes associated with motor function recovery. Despite his age, the patient showed an high participation in the rehabilitation process, and cortical activation changes were detected during recovery in relation to various motor patterns. The main differences in cortical activation were found in areas involved in motor and somatosensory processing. These results suggest that this new system can add useful quantitative measures of motor performance and neural recovery to the classical tests used in the clinic. In conclusion, this new system seems a promising tool for novel robot-based rehabilitation paradigms tailored to individual needs and neuro-motor responses of the patients.

Keywords: Neuro-rehabilitation, motor recovery, stroke, high resolution electroencephalography, robotics, virtual reality.