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Press Release

Neurorobotic hand exoskeleton restores grasp function to quadriplegics

Tübingen led researchers enable quadriplegics to eat and drink independently

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A consortium of European scientists has successfully restored grasp function to six quadriplegics using a non-invasive hybrid brain-neural hand exoskeleton. The system was developed by researchers at the University of Tübingen, Germany, The BioRobotics Institute at the Scuola Superiore Sant'Anna, Italy, and the Guttmann Institute in Spain. The study participants were able, for example, to eat and drink independently at a restaurant. While it was commonly assumed that outside-the-lab brain-machine interface(BMI)-based restoration of hand function would require surgical implantation of neural electrodes, the study – now featured in the inaugural issue of *Science Robotics* – used electric brain activity recorded from the scalp, thus avoiding any surgical procedure.

The Tübingen researchers say the new approach will significantly improve quality of life after high cervical spinal cord injury or stroke. The system translates brain electric activity and eye movements into hand opening and closing motions, restoring intuitive grasp function to an almost normal level, the study shows. Thanks to portable and wireless hardware integrated into a wheelchair, participants could freely move and use the system in their everyday life environment.

Surjo Soekadar, the responsible physician and lead author of the study, says the technology can be adapted to do even more: "Next, we are planning the development of intelligent, context-sensitive and cosmetically unobtrusive neurorobotic systems which patients can mount on their bodies entirely unassisted".

Besides the immediate improvement in the ability to perform activities of daily living as shown by the European research consortium, recent clinical studies suggest that repeated use of such brain-controlled exoskeletons could induce neurological recovery after spinal cord injury or stroke. This BMI-related neuroplasticity, as Dr. Soekadar underlines, may also become a powerful tool to treat neuropsychiatric disorders, such as depression or cognitive disorders which currently represent the third leading cause of global disability-adjusted life years (DALY), i.e. the total number of years lost to illness, disability, or premature death. While large-scale clinical trials will be required for further validation, the system introduced by Dr. Soekadar and his colleagues may now pave the way for such long-term and out-of-the-lab studies.

Publication: Soekadar SR, Witkowski M, Gómez C, Opisso E, Medina J, Cortese M, Cempini M, Carrozza MC, Cohen LG, Birbaumer N, Vitiello N. Hybrid EEG/EOG-based brain/neural hand exoskeleton restores fully independent daily living activities after quadriplegia. *Science Robotics* **1**, eaag3296 (2016). Link to journal: http://www.sciencemag.org/journals/robotics

Video: http://goo.gl/qs3wjf

The hybrid brain-neural hand exoskeleton enables quadriplegics to eat and drink independently.
Photo: Surjo R. Soekadar

The exoskeleton’s control unit (left) and battery (right) can be built into a wheelchair.
Photo: Nicola Vitiello

Dr. Surjo R. Soekadar (left) with a study participant.
Photo: Surjo R. Soekadar

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