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DECODING THE NEURAL CODE OF HUMAN MOVEMENTS FOR A NEW GENERATION OF MAN-MACHINE INTERFACES

Informe

Información del proyecto

DEMOVE

Identificador del acuerdo de subvención: 267888

Proyecto cerrado

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Coordinado por
UNIVERSITAETSMEDIZIN GOETTINGEN - GEORG-AUGUST-UNIVERSITAET GOETTINGEN - STIFTUNG OEFFENTLICHEN RECHTS
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Mid-Term Report Summary - DEMOVE (DECODING THE NEURAL CODE OF HUMAN MOVEMENTS FOR A NEW GENERATION OF MAN-MACHINE INTERFACES)

The internal generation of human movements derives from electrical activities in the brain, spinal cord, nerves, and muscles. The main limitation in the understanding of the neural mechanisms underlying movement is the current difficulty in associating a specific functional significance to the activity of neural cells. The project DEMOVE aims at solving this problem by developing technologies that will enable us to understand the behavior of pools of motor neurons, which are neural cells in the spinal cord directly conveying electrical motor command signals to the muscles. The DEMOVE technologies include micro-electrodes, advanced computational neuroscience methods, neuromusculoskeletal modeling, as well as man-machine interfacing systems. These methods provide, on the one hand, increasing insights into the origin, planning, and performance of movements, and, on the other hand, offer us the means for the development of novel concepts of subject-specific, intuitive, man-machine interfacing systems for neurorehabilitation. The DEMOVE research fellows have developed innovative microelectrodes that can be inserted directly into human muscles for recording their electrical activity. They have developed computational systems that allow us to extract, from these recordings, the neural commands sent to muscles and to reflect the dynamics of the neural cells located in the spinal cord (i.e. motor neurons). The combination of these electrode and computational systems offer a completely new way to understand the neural basis of movement initiation from the behavior of large populations of neural cells. This possibility has served as the basis for a profound re-examination of many established concepts in movement neurophysiology from a new perspective as well as for the proposal of new concepts in the area of neural control of movement. Moreover, the DEMOVE technologies and computational methods have been used to drive models that allow the prediction of the resulting forces and motions. The DEMOVE fellows believe that this new modeling technology will result in a breakthrough in filling the existing gap between the neural analysis and the functional aspects of movement (neurophysiology meets biomechanics). Finally, the DEMOVE technologies have opened new perspectives in neurorehabilitation, specifically in the control of upper limb prostheses. In the first half of project work, the DEMOVE researchers have developed and provided the proof of concept of all the major technological milestones of the project and have disseminated these concepts in more than 50 scientific publications, including one book. In the second half of the project, these technologies will be refined, validated, and applied for new discoveries on the origin of motion, how this is performed by humans, and how human body parts can be substituted with artificial systems that become a natural extension or replacement of the lost limbs (bionic reconstruction).

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