

## Reconnecting the Hand and Arm to the Brain (ReHAB): BCI control of upper limb FES

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Dr. Robert F. Kirsch, Ph.D. is the Allen H. and Constance T. Ford Professor and Chair of Biomedical Engineering at Case Western Reserve University and the Executive Director of the Department of Veterans Affairs Rehabilitation Research and Development Service “Center for Functional Electrical Stimulation”. He is the Principal Investigator of the Case-Coulter Translational Research partnership, a Fellow of the American Institute for Medical and Biological Engineering (AIMBE), a former Chair of the national BME Council of Chairs (2017), and the Co-Director of a NIBIB T32 training grant. His research focuses on the restoration of arm movements to individuals with complete upper limb paralysis using functional electrical stimulation (FES), as well as high performance user command interfaces such as brain computer interfaces and advanced prosthetic user interfaces. He received a BS in electrical engineering (University of Cincinnati) and the MS and Ph.D. in biomedical engineering (Northwestern University), and completed post-doctoral research (McGill University).

### ABSTRACT

We have developed an implanted neuroprosthesis that uses functional electrical stimulation (FES) to activate the paralyzed muscles of the shoulder, arm, and hand in a coordinated manner to restore arm and hand function, and successfully deployed this system in three people with severe paralysis. We have more recently developed and deployed a FES system for the arm and hand that is controlled by the user via an intracortical brain-computer interface (BCI) to allow a user to direct the actions of their FES-restored arm and hand movements in an effective and intuitive manner. This presentation will describe the performance of a 192-electrode intracortical BCI in commanding arm and hand movements in a paralyzed individual with high cervical spinal cord injury whose movements were restored by functional electrical stimulation. Our next steps in the development of BCI-controlled FES will also be presented.

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