American Spinal Injury Association
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Brain-Computer Interface Neuromodulation for SCI: Engineering Developments to Clinical Applications

Course ID 182

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This course will present recent findings in the field of neural and rehabilitation engineering and how these findings have been used to inform and steer the development of brain-computer interface (BCI) technologies. The proposed workshop will summarize the discovery process engineers and neuroscientists use to develop new therapeutic interventions and technologies to interface the brain with peripheral devices through BCI. The expert panel will specifically discuss why BCI should be used to control functional electrical stimulation (FES) and show neurophysiological evidence demonstrating that facilitation of cortical circuits and precise activation of muscles using FES could be used to elicit neuroplasticity. The panel will show the results of a clinical trial using BCI-FES for rehabilitation to restore upper limb function and recent developments of an at-home modular implantable BCI planform. The panel will then summarize practical considerations for implementing a BCI-controlled FES system, including hardware and software requirements, classification algorithms, calibration protocols, and control options. The course will conclude with a discussion of how these innovative engineering developments and technological advancements can be integrated into clinical practice to advance neuromotor rehabilitation after SCI. Funding Sources: Buoniconti Foundation of The Miami Project to Cure Paralysis Florida Department of Health: COPBC-R3 Conflict of Interest: Milos R. Popovic is a shareholder and director in the company MyndTec Inc., which manufactures FES therapy systems. Matija Milosevic and Cesar Marquez-Chin are executive board members of the International Functional Electrical Stimulation Society, a nonprofit organization dedicated to promoting awareness, knowledge, and understanding of electrical stimulation technologies and their applications. Draft Agenda: :00 – :10 Why Brain-Computer Interface Should Be Used to Control Functional Electrical Stimulation? (Milos R. Popovic) :10 – :20 Neurophysiology of Brain-Computer Interface-Controlled Neuromodulation Therapy (Matija Milosevic) :20 – :30 Non-invasive Brain-Computer Interface Functional Electrical Stimulation Therapy for Improving Voluntary Function in Chronic SCI (Cesar Marquez-Chin) :30 – :40 Implantable Brain-Computer Interfaces for Restoration of Movement after SCI: Implementation, Performance and Reliability (Abhishek Prasad) :40 – :50 Summary of considerations to implement BCI-controlled FES (Matija Milosevic -Leader; Milos R. Popovic, Cesar Marquez-Chin, Abhishek Prasad - Discussants) :50 – :60 Discussion of the pipeline and strategies for translation of engineering solutions into clinical practice (Milos R. Popovic - Leader; Cesar Marquez-Chin, Abhishek Prasad, Matija Milosevic - Discussants)

Learning Objective 1 To discuss prosthetic and therapeutic application of BCI-controlled functional electrical stimulation (FES) to restore movement after paralysis.

Learning Objective 2 To list practical “take home” messages and requirements for configuring a BCI-controlled FES system.

Learning Objective 3 To discuss strategies for clinical translation of innovative technologies into clinical practice for neuromotor rehabilitation.