

Name of Organizer: Brendan Allison

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Title of Symposium: Brain-computer interface (BCI) technology for movement rehabilitation

Description of submitted symposium (please limit to 2000 characters): This symposium will present new directions using BCI technology for movement rehabilitation, primarily for stroke patients. For decades, BCIs have been used to detect motor imagery through EEG data and thereby allow people to spell, move cursors, or perform other tasks simply by imagining movement. Recently, several groups have extended this technology to “close the loop” in physiotherapy by providing rewarding feedback only when patients imagine the movements as instructed. Thus, patients who are noncompliant would not receive FES stimulation, audiovisual cues through a computer, encouraging statements from a physiotherapist, or other rewarding feedback. Instead, real-time automated algorithms can control the activation of feedback devices based on motor imagery, and can provide therapists and others with a log of patient compliance. This is a new application of BCI technology to a new patient group. Considerable research is needed to show that adding motor imagery and creating closed-loop neurofeedback can improve results over physiotherapy alone. Moreover, many aspects need further research, such as feedback and signal processing parameters, task instructions, optimal therapy scheduling, identifying the best candidates for this new type of therapy, and additional sensing or stimulating devices (such as other biosensors or transcranial magnetic stimulation). We will discuss recent progress, emerging paradigms and trends, and the most promising future directions. Each presenter will speak for 15-20 minutes, and we will allow time for questions after each presentation and discussion at the end of the symposium.

Length of time required for symposium?: 90 minutes

Additional Presenters (Limited to 4 additional presenters, list full name and email address) Please Note: Any Non-member speakers must receive prior approval from the Program Chair.: 1) Dr. Vivek Prabakaran, University of Wisconsin at Madison (vprabhakaran@uwhealth.org) 2) Dr. Milena Korostenskaja, Florida Hospital for Children (milena.korostenskaja@gmail.com) 3) Dr. An Do, UC Irvine Medical Center (and@uci.edu) The inclusion of the two non-members was discussed in advance with Dr. Carmichael, and there is always the hope they will join ASNR later.

What is the role of each presenter?: Dr. Allison will review the concepts behind motor imagery BCIs and their application to motor rehabilitation. He will also present results from stroke patients who used this approach with a hospital partner in Romania. Dr. Prabakaran will discuss ongoing work at the University of Wisconsin at Madison with motor imagery BCIs and stroke patients, including tongue stimulation. Dr. Korostenskaja will discuss her work at Florida Hospital for Children related to the neural origins of motor imagery and application of motor imagery- based BCI in clinical practice. Dr. Do will describe invasive and noninvasive BCI applications for upper and lower limb rehabilitation.

Objective 1: Participants will be able to identify the changes in EEG and ECoG activity associated with imagined movement (primarily event-related desynchronization or ERD). They will understand how BCI

systems have traditionally used this information to enable communication for patients with little or no motor control.

Objective 2: Participants will understand the concepts underlying BCI technology for motor rehab, including functional electrical stimulation (FES) and other closed-loop neurofeedback based on BCI activity. Participants will understand how this use of BCI technology different from traditional BCIs, as well as how it could change conventional physiotherapy.

Objective 3: Participants will learn about results from different groups that use this new technology. This will include functional improvement, changes in EEG and ECoG measures, and patients' subjective reports through questionnaires, anecdotes, and short videos. The symposium will present new ideas and devices that presenters are exploring and any initial results that are available.