Category: Neuromodulation

Workshop Title: Advancements in Non-Invasive Neuromodulation: Techniques and Applications for Neurorehabilitation

Organizer(s): Arun Jayaraman

Speaker(s): Jayaraman, Arun, Shirley Ryan AbilityLab / Northwestern University
Mooney, Ronan, Shirley Ryan AbilityLab
Madhavan, Sangeetha, University of Illinois at Chicago
Cohen-Zimerman, Shira, Shirley Ryan AbilityLab
Forrest, Gail, Kessler Foundation

Workshop Time: 13:45 - 15:15

Attendee Engagement: To reinforce learning, short quizzes will be integrated throughout the session. This will test attendees' understanding of key concepts presented by each speaker, such as electrode placement and stimulation effects on motor recovery.

We will also facilitate small- and large-group discussions around hands-on troubleshooting exercises, where attendees and speakers will work together to identify challenges and propose solutions for real-world clinical implementation of these technologies for different patient groups.

Abstract: Neurological injuries such as spinal cord injury (SCI) and stroke disrupt synaptic connections between corticospinal axons and motor neurons, leading to significant paralysis, paresis, and cognitive impairments. While current rehabilitation approaches have been shown to improve functional gait, upper limb activity, and cognitive function, these improvements are often accompanied by compensatory strategies due to incomplete recovery. However, neural synapses can be modified through Hebbian plasticity, suggesting that this principle can be leveraged to strengthen residual connections and maximize motor and cognitive recovery.

This workshop will: 1) Present fundamental mechanism research on subcortical motor pathway mapping, 2) Present randomized clinical trials utilizing two different brain stimulation techniques for stroke rehabilitation, 3) Discuss the application of spinal cord stimulation in individuals with SCI, 4) Translate spinal cord stimulation to stroke rehabilitation, and 5) Highlight emerging advancements in vagus nerve stimulation.

We will explore: 1) Different non-invasive stimulation technologies (magnetic and electrical), 2) Stimulation at various anatomical locations (brain, spinal cord, and vagus nerve), 3) Application across clinical populations (SCI and stroke), and 4) Different rehabilitation goals (motor and cognitive recovery).

The goal of this workshop is to generate discussion on how these techniques can be applied in research and provide clinical guidance for improving functional and cognitive outcomes. We will

address current challenges in optimizing these approaches, explore future directions for expanding their application to other neurological conditions, and highlight practical methodologies and tools that can be integrated into clinical practice.