



**Category:** FES, Brain Stimulation and Neurophysiology

**Workshop Title:** Impact of transcutaneous spinal stimulation and other neuromodulatory techniques on recovery following neurological injuries

**Workshop Organizer(s):** Arun Jayaraman

**In person Speaker(s):**

- Perez, Monica, Shirley Ryan AbilityLab
- Forrest, Gail, Kessler Research Foundation
- Yang, Chen, Shirley Ryan AbilityLab
- Jayaraman, Arun, Shirley Ryan AbilityLab

**Workshop Time:** 10:30 - 12:00

**Attendee Engagement:**

The primary goal of this workshop is to generate discussion about use of these non-invasive neuromodulatory techniques for clinical use and research protocols. The workshop will be designed for a multidisciplinary audience, particularly intending to open a dialogue between clinicians and scientists. Each speaker will interact with the audience during and after their talks to generate discussions about these technologies and how to use them safely and efficaciously and how to combine them with other rehabilitation processes. Participants can also engage with the speakers on how to use their technologies for specific disease states or compare and contrast device models. We will encourage commercial vendors of these technologies to be present at the workshop to help participants to view the technologies and learn from the speakers first hand on how to use them.

**Abstract:**

Neurological injuries like spinal cord injury (SCI) and Stroke lead to damaged synaptic connections between corticospinal axons and motor neurons that innervate muscles, resulting in devastating paralysis and paresis. While current rehabilitation approaches have shown to improve functional gait or upper limb activity, these effects are often accompanied by compensatory strategies due to the incompleteness of their recovery. Throughout life, neural synapses can be modified by Hebbian plasticity (e.g., “neurons that fire together, wire together”) suggesting that this principle could be used to strengthen residual connections after these significant injuries to maximize recovery and thereby function. In our workshop, we will discuss current cutting edge non-invasive neuromodulation techniques, especially transcutaneous spinal cord stimulation. Our team has optimized many noninvasive neuromodulation protocols, specifically, a) Hebbian stimulation protocol that targets in parallel multiple upper- and lower-limb muscles to promote functional restoration of grasping and walking in humans with SCI; b) transcutaneous spinal stimulation technique combined with powered robotic exoskeleton training to improve walking and muscle firing in individuals with SCI; c) A combinational intervention of combining acute intermittent hypoxia with transcutaneous spinal cord stimulation to improve walking function in individuals with SCI; and d) applying transcutaneous spinal stimulation and sensor-driven gait training to improve gait symmetry and function after a stroke. The workshop will start with (a) proof of principle studies showing differences in how to target specific connections to upper- and lower-limb muscles, (b)

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randomized clinical trials highlighting the need for finding the optimal dose to reach the minimal clinically important difference, (c) and guide the listeners on how to introduce these protocols into clinical practice to improve functional restoration.