Category: Neuromodulation

Workshop Title: Kilohertz Carrier Frequencies for Transcutaneous Spinal Cord Stimulation: What's All The Buzz About?

Organizer(s): Ashley Dalrymple

Speaker(s): Seáñez, Ismael, Washington University
Butler, Jane, Neuroscience Research Australia and University of New South Wales
Sayenko, Dimitry, Houston Methodist Research Institute
Gad, Parag, SpineX

Workshop Time: 16:00 - 17:30

Attendee Engagement: How will engage attendees: We will engage attendees through a panel session, which will take place for 40-45 minutes. Following short talks by myself (to set the stage and introduce transcutaneous spinal cord stimulation, both with and without high-frequency carriers) and each of the speakers, I will facilitate a panel discussion where attendees can ask questions and have a discussion with the panelists. Because high-frequency stimulation is a hot topic and there is controversy around its use, I think that the discussion will be engaging, informative, and impassioned. The discussion will also include brainstorming of studies needed to better inform what stimulation parameters we should be using for transcutaneous spinal cord stimulation as we move towards translating it into clinical practice.

If possible, I would like to write an article in Artificial Organs describing the discussion and outcomes of this workshop so that the field as a whole can benefit from the conclusions.

Abstract: Transcutaneous spinal cord stimulation (tSCS) is a non-invasive neuromodulation method that has gained popularity over the past few years. Most applications for tSCS are the rehabilitation of upper and lower-limb function and trunk control. tSCS can also reduce spasticity, reduce phantom limb pain, and improve sensation. The field of tSCS is divided into two groups: those that use conventional square wave pulses delivered at ~30 Hz, and those where the waveform has a high-frequency carrier (HFC), typically 10 kHz. Both waveforms have resulted in improved sensorimotor function.

The HFC has been claimed to be less painful due to blocking of local cutaneous afferents, while activating deep Ia afferents. However, recent studies have questioned the touted benefits of HFC, showing that it is actually less efficient at delivering charge and is not more comfortable. While tSCS has gained popularity, the benefits of HFC remains unclear and is a hot and controversial topic.

In order to best serve patients receiving rehabilitation therapy and for translating tSCS as a clinical treatment, we need to identify which waveform is best and why. In this workshop, we will discuss the mechanisms behind neural activation and blocking in the context of HFC for tSCS. I selected these speakers because they have extensive experience using tSCS for

rehabilitation applications, and have investigated the mechanisms of HFC waveform. Some speakers are pro-HFC, while others have demonstrated evidence against its use.

I will introduce the history of tSCS and HFC, providing a broad overview of the recently-determined mechanisms for how HFC activates and/or blocks neurons. Then, each panelist will give a brief (8-10 minute) talk about their work on tSCS and HFC. I will start the panel session with guided questions. The attendees will ask the panel questions and engage in discussion. An outcome for this workshop is to brainstorm clear guidelines and future research studies for using HFC for tSCS.