VA RR&D Center *for* Neurorestoration and Neurotechnology (C*f*NN) Seminar Series

"Proprioprosthetics: interrogating sensory pathways for motor rehabilitation, sensory restoration, and the treatment of pain"

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Providence VAMC, Building 1, 5th Floor, Classroom 3
830 Chalkstone Ave., Providence

Arguably every nervous system in existence adheres to a common control framework: sense, think, act, adjust. Noisy sensors of the external world, coupled with imperfect estimates of our physical frame of reference surprisingly lead to precise interactions with one's environment. Our ability to remove our hand from a hot stove, or adjust balance when unexpectedly slipping on a surface exemplifies the tight, innate, and complex relationship between perception and action. Unfortunately, insult to one of or both sensory and motor pathways results in catastrophic reduction in a person's quality of life and their ability to perform activities of daily living. Recently, we leveraged the direct connections between proprioceptive pathways leading into the spinal cord and the motor neuron pathways leaving the spinal cord to reanimate a nonhuman primate's hind limb after spinal cord injury. Further, with the Medtronic Neuromodulation group, we co-developed a brain-spinal interface (BSI) that brought locomotor reanimation back under direct control with fully implanted stimulation hardware. In my presentation, I will discuss where we are going from here, toward the development of restorative neurotechnologies for Veterans and others with paralysis. I will first expose how a principled, model-based approach led to spatiotemporally modified epidural electrical stimulation (EES) profiles that restored normal gait in nonhuman primates. I will then take a step back and discuss how we are extending these models to explore the effect of EES on sensory perception, specifically proprioception as reported by nonhuman primate behavioral performance and direct sensory cortex readout, bringing into importance the understanding of the hidden mental state and the "sensory experience." Finally, I will present our work toward a unified spinal-thalamic-cortical model of sensory percept as well as a human experience.

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