Stephenson School of Biomedical Engineering
Seminar Series Presents

DESIGNING MOTOR BCIS FOR THE REAL WORLD

Lee E. Miller, PhD

Professor
Department of Physiology
Northwestern University Feinberg School of Medicine

Friday, Sept. 18, 2020 | 9 a.m.

zoom

Meeting ID: 929 0449 5089
Passcode: 04453360

ABSTRACT:

Spinal cord injury is devastating, currently having no cure. Ultimately, we'd want to regrow the damaged axons, but in the meantime, it is now possible to literally reconnect the brain and muscles electronically. My group has pioneered the development of a novel brain computer interface (BCI) that decodes muscle activity (EMG) from signals recorded from the primary motor cortex (M1) of monkeys. We use these predicted EMG signals to control electrical stimulation of paralyzed muscles, a clinical procedure called Functional Electrical Stimulation (FES). FES causes the muscles to contract and thereby cause movement of the paralyzed limb. Following its initial proof of concept several years ago to restore voluntary movement, we've begun to develop a wireless version of this FES-BCI that would be available 24 hours a day. We are examining the cortical representation of unconstrained behaviors in the monkey's home cage and the corresponding relation between cortical activity, EMG, and movement. We are developing deep neural networks that generalize across this range of behavior better than linear decoders. In the past few years, there has been much interest in the fact that information from roughly 100 of the millions of M1 neurons active during movement can be reduced to a small number of "latent" signals. We have demonstrated decoders, based on these latent signals which remain stable even for multiple years. Ultimately, we intend to develop an FES-BCI that will restore voluntary movement across the natural motor tasks of daily life without need for intermittent recalibration.

BIO:

Lee E. Miller, PhD, graduated from Goshen College in Indiana with a bachelor of arts in physics, and later received a master's degree in biomedical engineering and a doctorate in physiology from Northwestern University. He completed postdoctoral training in the Netherlands in the Department of Medical Physics of Radboud University Nijmegen. In 1995, he joined the Northwestern University Feinberg School of Medicine faculty as assistant professor in the Department of Physiology. Today a full professor in the same department, Miller holds a secondary appointment in the Department of Physical Medicine and Rehabilitation and a courtesy appointment in the Department of Biomedical Engineering.

Miller's graduate mentors shaped his career-long interest in the motor and sensory signals that occur in the brain during limb movement. Miller's leadership at the forefront of this emergent field is reflected in frequent invitations to address neural engineering specialists worldwide.

Miller has given serious attention to his role as a teacher and mentor at both the Feinberg School and The Graduate School. Beyond developing curricula and lecturing, he has served on over 30 thesis committees in the United States and abroad. Not least in its educational mission, his lab has hosted many student interns, ranging from a number of freshman biology students from Evanston Township High School, to those coming from foreign graduate programs.