Seminar

CENTER FOR ADAPTIVE NEURAL SYSTEMS

IRA A. FULTON SCHOOL OF ENGINEERING

A Brain-machine Interface for Regaining Control of a Paralyzed Arm: A Primate Model of Cortically Controlled Functional Electrical Stimulation

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Abstract: We have developed a system in which neural signals recorded from microelectrodes implanted within the brain can be used to control electrical stimulation of paralyzed hand and forearm muscles. Functional electrical stimulation (FES) has often been used to restore the capacity to grasp and manipulate objects to spinal cord injury patients by activating paralyzed muscles through the direct application of electric current. However, providing the user with the means to control the multiple degrees of freedom needed for dexterous manipulation of objects remains an important limitation. The goal of our lab has been to use signals recorded directly from the brain to allow more complex and varied control of grasping FES systems. We have previously shown that multielectrode recordings from the monkey primary motor cortex can be used to predict arm and hand muscle activity during complex reaching tasks. We have now developed a novel FES system which uses information about intended muscle activation extracted from the motor cortex to control stimulation in intramuscular electrodes. In our experiments, two monkey subjects used this cortically controlled FES system to regain voluntary wrist flexion following limb paralysis by blocks of the median and ulnar nerves. Cortically controlled FES of four forelimb muscles approximately doubled the maximum flexion force that the monkeys could achieve. Furthermore, the monkeys were able to voluntarily grade this force to match several different target levels, at speeds of only one-half to two-thirds normal, and force variations of only about twice normal. These results provide an important proof of concept, demonstrating the feasibility of a cortically controlled FES prosthesis for human spinal injured patients. Such systems would offer a significant advantage to patients with injuries in the mid-cervical spinal cord, and potentially even greater benefits to high-cervical spinal cord injured patients with paralysis of the entire upper limb.

Biography:

2001: BS, Mechanical Engineering, University of Cincinnati
2004: MS, Biomedical Engineering, Northwestern University
2008: PhD, Biomedical Engineering, Northwestern University

Location and Time:

Location: ISTB1 227
Date: Aug. 19, 2008
Time: 10:00am—11:00 am

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"designing adaptive engineered systems to promote adaptation in neural systems"

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