Restoration of Motor Skills in Patients with Disorders of the Central Nervous System

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Abstract

Recent technological innovations such as functional neural stimulation (FNS) offer considerable benefits to paralyzed individuals. FNS can produce movement in paralyzed muscles by the application of electrical stimuli to the nerves innervating the muscles. The first part of this talk will describe how smooth muscle movements can be evoked using Utah slanted electrode arrays (USEAs) inserted into the motor nerves of the peripheral nervous system. The standard 4 x 4 mm USEAs contain 100 electrodes of varying lengths. Implantation of a USEA in a peripheral nerve allows highly selective electrical access to individual and small groups of axons. We will review approaches for designing asynchronously interleaved stimulation signals applied via individual electrodes in the arrays to evoke smooth, fatigue-resistant force that closely resembles normal motor function. The second part of this talk will describe efforts to decode cortical surface potentials, recorded with dense grids of microelectrodes. Decoding human intent from neural signals is a critical component of brain-computer interfaces. This information can then be used to control the muscles in tasks involving restoration of motor skills or to control a robot that performs desired tasks. We will discuss recent work on decoding neural data collected from patients implanted with microelectrode arrays. The talk will conclude with a discussion of some of the current research challenges in this area.

Short Biography

Dr. V. John Mathews is a Professor of Electrical and Computer Engineering at the University of Utah. His research interests are in nonlinear and adaptive signal processing and application of signal processing techniques in audio and communication systems, biomedical engineering, and structural health management. He chaired the department of Electrical and Computer Engineering at the University of Utah during 1999-2003. Dr. Mathews is a Fellow of IEEE. He served as the Vice President (Finance) of the IEEE Signal Processing Society during 2003-2005 and the Vice President (Conferences) of the Society during 2009-2011. He is a past associate editor of the IEEE Transactions on Signal Processing, and the IEEE Signal Processing Letters and the IEEE Journal of Selected Topics in Signal Processing and currently serves on the editorial board of the IEEE Signal Processing Magazine. He was a recipient of the 2008-09 Distinguished Alumnus Award from the National Institute of Technology, Tiruchirappalli, India, and the Utah Engineers Council's Engineer of the Year Award in 2011. He serves now as a Distinguished Lecturer of the IEEE Signal Processing Society for 2013 and 2014.