ROBIO 2008 Plenary Talk

Robotic Technology for Damaged Nervous Systems

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Abstract:

This talk will present two ongoing efforts to use robotic and control technology to aid humans suffering from major paralysis. The first part of the talk will focus on “neural prosthetics.” A "neural prostheses" is a brain-machine interface that enables a human, via the use of surgically implanted electrode array and associated computer decoding algorithms, to control external electromechanical devices by pure thought alone. In this manner, some useful functions that have been lost through disease or accident can be partially restored. After describing our overall efforts to develop a neural prosthetic for humans, we will focus on a novel miniature robotic brain interface that autonomously repositions the electrodes within cortical tissue so as to find and then maintain optimal recording sites. Demonstrations of the device in macaque cortex and our ongoing efforts to produce miniaturized implantable versions of these interfaces will be reviewed.

The second part of the talk will summarize our efforts to develop new strategies for recovering locomotion after severe spinal cord injuries (SCIs). First we will show that a combination of drug therapy and robotically guided exercise therapy can provide significant improvements in the stepping ability of animal models with complete SCI. Next we will describe a novel, flexible high density spinal cord stimulating electrode array. Experiments with these micro-fabricated devices in animal

models demonstrate that such stimulating arrays can induce graded motor responses and step-like motions. Finally, we will present recent results involving the integrated use of drug therapy, robotic exercise therapy, and epidural stimulation to recover highly functional stepping.

Short Bio:

Joel Burdick received his undergraduate degree in mechanical engineering from Duke University and the M.S. and Ph.D. degrees in mechanical engineering from Stanford University. He has been with the department of Mechanical Engineering at the California Institute of Technology since May 1988, where he has been the recipient of the NSF Presidential Young Investigator award, the Office of Naval Research Young Investigator award, and the Feynman fellowship. He has been a finalist for the best paper award for the IEEE International Conference on Robotics and Automation in 1993, 1999, 2000, and 2005. He was appointed an IEEE Robotics Society Distinguished Lecturer in 2003. Prof. Burdick's research interests lie in the areas of robotics, kinematics, and mechanical systems. Current research interests include neural prosthetics and the rehabilitation of spinal cord injuries, sensor based robot motion planning, multi-fingered robotic grasping, and applied nonlinear control theory.