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MECHANICAL ENGINEERING COLLOQUIUM SERIES 2014-2015

Henry M. Paynter Lecture in Robotics

Recovery of Function in Major Spinal Cord Injury Using Epidural Stimulation

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Approximately 1,250,000 people in the U.S. suffer from spinal cord injury (SCI), with 400,000 confined to wheel chairs. Not only do the injured lose the ability to stand and walk (and sometimes move their arms), they suffer from additional injury-induced complications including loss of bladder and bowel control, decreased cardiovascular and pulmonary health, inability to regulate body temperature, and loss of muscle strength and bone density. The totality of the injury and its secondary dysfunctions makes daily activities of living a challenge. Because the median age of SCI in the U.S. is 28 years; SCI individuals require an additional $2.4-$4.0 million in healthcare costs over their lifetimes.

A team of researchers at Caltech, UCLA, and Univ. of Louisville have been collaborating for several years to develop new technologies and new therapies for motor complete SCI patients—those who have lost motor control below the level of their injury. The centerpiece of this approach is a multi-electrode array which is implanted over the lumbosacral spinal cord in the epidural space between the dura and the interior of the vertebral canal. This talk will describe the basic technology behind multi-electrode epidural stimulation. When this technology is coupled with locomotor training (and drug therapy when possible), our preliminary human studies have shown that SCI patients receiving this therapy cannot only stand independently and make some voluntary movements (after being in a wheel chair for over 3 years), but more importantly, can expect to make significant gains in cardiovascular health, muscle tone, as well as improved autonomic function such as bladder, bowel, blood pressure, and temperature regulation. After reviewing these first efforts, current research in electrophysical modeling of the epidural stimulation process and new algorithms for automated tuning of the stimuli parameters will be reviewed, as well as ongoing efforts in the development of new electrode technologies.

This lecture is named in memory of Professor Henry M. Paynter. Prof. Paynter held six patents on tension actuator-based robotics technology and was known for his contributions to the analysis, design and control of complex multimedia systems and for developing the Bond graph modeling language. Bond graphs are a unique way of describing dynamic models. Prof. Paynter was a member of the MIT faculty from 1946 to 1985. He was elected to the National Academy of Engineering in 1997, one of the highest professional distinctions accorded to an engineer. He received the S.B. in civil engineering in 1944, S.M. in mathematics and science in 1949, and Sc.D. in hydroelectric engineering in 1951, all from MIT. Paynter joined the Department of Civil Engineering in 1946 and became an assistant professor in 1951. He joined the Department of Mechanical Engineering in 1954 on a half-time basis to initiate a systems engineering curriculum. He became full time in 1959, associate professor the following year, and full professor in 1964. After he retired, he was a senior lecturer in mechanical engineering.

Refreshments will be served before the seminar.
Please contact Tony Pulsone at pulsone@mit.edu with any questions.

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