Joint Department of

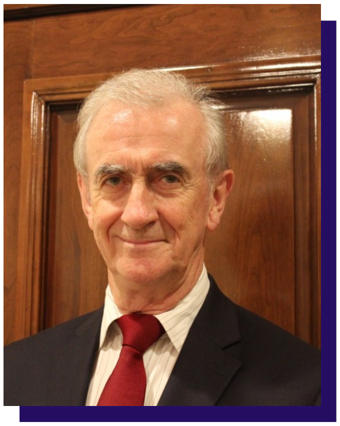
BIOMEDICAL ENGINEERING

UNC CHAPEL HILL | NC STATE UNIVERSITY

Coulter Seminar Series Presents

Rehabilitation Engineering

Towards a Science of Technology-Enabled Neuro-Recovery



Neville Hogan, Ph.D.

Sun Jae Professor of Mechanical Engineering

Professor of Brain and Cognitive Sciences

Neville Hogan is Sun Jae Professor of Mechanical Engineering and Professor of Brain and Cognitive Sciences at the Massachusetts Institute of Technology. He earned a Diploma in Engineering (with distinction) from Dublin Institute of Technology and M.S., Mechanical Engineer and Ph.D. degrees from MIT. He joined MIT's faculty in 1979 and presently Directs the Newman Laboratory for Biomechanics and Human Rehabilitation. He co-founded Interactive Motion Technologies, now part of Bionik Laboratories. His research includes robotics, motor neuroscience, and rehabilitation engineering, emphasizing the control of physical contact and dynamic interaction. Awards include: Honorary Doctorates from Delft University of Technology and Dublin Institute of Technology; the Silver Medal of the Royal Academy of Medicine in Ireland; the Henry M. Paynter Outstanding Investigator Award and the Rufus T. Oldenburger Medal from the American Society of Mechanical Engineers, Dynamic Systems and Control Division; and the Academic Career Achievement Award from the Institute of Electrical and Electronics Engineers, Engineering in Medicine and Biology Society.

ABSTRACT

The emergence of therapeutic and assistive robots promises new and better ways to aid and assess recovery after neurological injury. To fully realize that promise, we need a quantitative scientific theory of recovery. That theory should be based on unimpaired motor behavior, at least its main features. Despite much slower actuators, communication, and computation than contemporary robots, humans exhibit superior dexterity and agility. They also exhibit surprising limitations: moving slowly and smoothly is hard for humans. These observations support a theory that human motor control is based on dynamic 'building blocks', including at least three classes: submovements, oscillations and mechanical impedances. Stereotyped submovements are evident in the earliest actions of persons recovering after stroke. Re-organization of these submovements quantifies the progress of recovery. Conversely, oscillatory performance does not support robust learning and transfers poorly to discrete actions. Multi-variable stiffness influences motor synergies. Abnormal synergies may reflect abnormal muscle stiffness, in turn due to abnormal muscle tone. We recently showed that humans can identify limb stiffness from purely visual observation. Remarkably, our best subject was a highly-skilled physical therapist.

This theory of recovery—re-assembly of dynamic 'building blocks' of unimpaired behavior—suggests new therapeutic technologies. Actuators may be re-imagined as means to provide energy-efficient stiffness modulation and/or programmed into 3D-printed fabrics. These technologies enable 'smart braces' to provide permissive assistance, supporting patient actions as needed but without opposing expression of natural actions.

CLEAR Core
Closed Loop Engineering
for Advanced Rehabilitation
http://clear.bme.unc.edu

Friday, April 3rd @ 12:00 Noon

Presentation Details:

WebEx Link: https://uncsom.webex.com/uncsom/j.php?MTID=m837316bb1a1f211e1629dc92ad639a99
Meeting number: 734 491 944
Meeting password: BME!