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Control Seminar

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The Hidden Mechanics of Locomotion: A New Perspective on Wearable Robotics and Human Locomotor Control

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3:30 – 4:30 pm • 1500 EECS

ABSTRACT: To date, wearable robotic systems have not yet realized their full potential, and their impact on the lives of people with disabilities has been limited. One cause for these challenges is that the blueprint used to develop these technologies is flawed. Kinetics and kinematics of locomotion form the basis for the development of wearable robotic systems, and the underlying dynamic mechanical properties--collectively known as mechanical impedance--of human joints is not included in the design and control process. In this talk, I will discuss our approach to identify and incorporate the regulation of mechanical impedance into the development of wearable robots. The identification of ankle impedance during the stance phase of walking was recently completed, and these data have been used to develop novel prosthetic technologies. The design of a variable-stiffness prosthetic ankle will be introduced, with preliminary data from testing with an amputee subject. In addition, I will discuss basic studies on the human sensorimotor system that provide support for the role of mechanical impedance in the control of gait. The accuracy and 'just noticeable difference' of joint impedance at the ankle and knee joints have been quantified, which provides novel insight into how these properties relate to locomotor control, and potential benchmarks for the behavior of a new generation of wearable robotic systems.

BIO: Elliott Rouse is an Assistant Professor in the Department of Mechanical Engineering, and Core Faculty of the Robotics Institute at the University of Michigan. He directs the Neurobionics Lab, whose vision is to discover the fundamental science that underlies joint impedance regulation during human locomotion. The intent is to incorporate these discoveries in a new class of wearable robotic technologies, including exoskeletons and robotic prostheses. He is a member of the IEEE EMBS Technical Committee on Biorobotics, and is on the Editorial Board of RESNA's Assistive Technology journal. Dr. Rouse received the BS degree in mechanical engineering from The Ohio State University in 2007, and the MS and PhD degrees in biomedical engineering from Northwestern University in 2009 and 2012, respectively. Subsequently, he joined the Massachusetts Institute of Technology as a Postdoctoral Fellow, working with the Biomechatronics Group in the MIT Media Lab. Prior to joining the University of Michigan, he was faculty in the Schools of Medicine and Engineering at Northwestern University, and a faculty research scientist at the Shirley Ryan AbilityLab. Dr. Rouse and his research have been featured at TED, on the Discovery Channel, CNN, National Public Radio, Wired Magazine UK, and Business Insider.

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