Joint impedance and the future of wearable robotics design and control
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Previous research in lower-extremity prostheses and exoskeletons has produced devices that are intelligent and can emulate biologically accurate joint kinetics and kinematics in the sagittal plane. However, these devices have been unable to improve the locomotory metabolic burden of the disabled—an unacceptable shortcoming affecting clinical impact. In this talk, I will present a strategy for the design and control of future wearable robotic technologies that may address this discrepancy. A powered knee prosthesis, developed in the Biomechatronics Group at the MIT Media Lab, will be discussed and how such work motivates the need for a new perspective. Namely, I propose a paradigm shift, where the joint mechanical impedance is considered in the design process in addition to the task dependent torque-angle profile. I will discuss how my previous work estimating joint impedance at Northwestern University provided novel insight into the mechanical impedance of the ankle during walking and highlight how such information can be used to improve future prosthesis and exoskeleton design. Through the development of biologically inspired wearable robotic technology, I seek to not only restore the performance of the disabled, but also eventually enable these individuals to outperform their able-bodied counterparts.

Dr. Rouse received his B.S. degree in mechanical engineering from The Ohio State University in 2007, and his M.S. and Ph.D. degrees in biomedical engineering from Northwestern University in 2009 and 2012, respectively. At Northwestern University, he studied at the Center for Bionic Medicine in the Rehabilitation Institute of Chicago, under Dr. Todd Kuiken. Currently, he is a postdoctoral associate at the MIT Media Lab working with Dr. Hugh Herr in the Biomechatronics Group. His goal is to disrupt the traditional design and control process for wearable robotic technologies by including novel information about human locomotion. Dr. Rouse and his research have been featured on the Discovery Channel, CNN, National Public Radio, Wired Magazine UK and Business Insider.