MECHANICAL ENGINEERING SEMINAR

"Adaptive Control Strategies and Hybrid Actuation Systems for Robotic Leg Prostheses"

Dr. Tomasso Lenzi
Research Scientist at the Center for Bionic Medicine of the Rehabilitation Institute of Chicago

•**Abstract:** Intelligent robotic prostheses and orthoses could significantly improve the quality of life for nearly a million American amputees and even more stroke and traumatic brain injury survivors, whose ambulation is slower, less stable, and less efficient than that of able-bodied individuals. Robotic leg prostheses can actively regulate joint torque to emulate the full biomechanical functionality of the healthy limb. However, proper emulation of the healthy limb requires the prosthesis controller to synchronize the movement of the leg with the movement of the user, seamlessly adapting to the desired ambulation mode while dealing with environmental constraints such as obstacles and uneven terrains. In this talk I will present a novel adaptive control strategy for robotic prostheses that can match for the first time the healthy limb function for any speed, cadence, or terrain. I will then introduce a novel hybrid design concept for a prosthetic knee, which can deliver physiological torque and energy in half the weight of a traditional actuation system. Finally, I will discuss the scientific and technology foundations of a new class of assistive device—namely exoprosthesis, the fusion of exoskeleton with prosthesis—that could provide amputees with robotic assistance without the typical mass burden of a powered prosthesis.

Biosketch: Dr. Lenzi completed his Ph.D. in Bio-Robotics at Scuola Superiore Sant'Anna in Italy in 2012. His doctoral dissertation, focused on novel actuation and control strategies for wearable robots, received the Italian Bioengineering Group (GNB) award in 2013. Dr. Lenzi is currently a Research Scientist at the Center for Bionic Medicine of the Rehabilitation Institute of Chicago. From August 2011 to February 2012 he was Visiting Research Scientist at University of Delaware. From November 2012 to April 2015, he was Postdoctoral Fellow at the Physical Medicine and Rehabilitation Department of Northwestern University under Dr. Todd Kuiken. Dr. Lenzi has co-authored 18 papers on ISI-ranked journals, 31 papers on peer-review conference proceedings, 2 book chapters, and 7 patents (3 internationally granted, 4 pending). His primary research interests lie at the intersection of robotics, mechatronics, neural engineering, and rehabilitation. Dr. Lenzi's goal is to leverage robotics technologies to discover fundamental aspects of human movement ability, and use this knowledge to develop novel intelligent machines that improve the quality of life of individuals with disability at home and in the community.

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