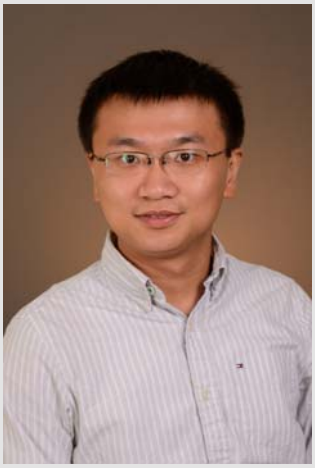
MAE Seminar SERIES

Building Human-Robot Symbiosis for Physical Assistance and Rehabilitation

Thursday, November 21

3:30 pm

Knox 14



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ABSTRACT

Wearable robots have attracted significant attention over the past decades for physical assistance, training, and rehabilitation. Robotic assistance has been shown to lower muscle efforts, reduce metabolic costs, and help regain impaired motor capabilities. However, it is challenging to quantify online the impact of robotic assistance to individual users for precise adaptation based on the nature of the tasks and roles of the robot. This talk is divided into two parts to introduce my lab's recent work on closing the human-robot loop for gait assistance and rehabilitation. The first half of the task will present the design of exoskeletons and soft exosuits, which are powered by DC motors and inflatable actuators, respectively. Both types of robots can provide assistive torques for knee flexion and extension, and an automatic impedance tuning approach will be introduced to provide personalized assistance to the user. Test results with healthy individuals and stroke patients will be presented. The second half of the talk will introduce some preliminary results on rehabilitation robot controller design by learning from therapists' demonstrations. This presentation will summarize a recent study on measuring the physical assistance from therapists while facilitating patients in gait rehabilitation. The collected data leads to new machine learning models of interaction dynamics between a therapist and patient, which can be used to augment the existing impedance-based robot controllers. This talk will conclude with some open problems and possible directions to integrate both model-based and data-driven robot control approaches with principles of human motor control for improved physical human-robot symbiosis.

BIO SKETCH

Dr. Wenlong Zhang is an Assistant Professor of Systems Engineering in the Polytechnic School at Arizona State University (ASU). He received his B.Eng. in control science and engineering from Harbin Institute of Technology, and M.S. in mechanical engineering, M.A. in statistics, and Ph.D. in mechanical engineering, all from the University of California, Berkeley. He joined ASU faculty in 2015 and has been the director of the ASU Robotics and Intelligent Systems Laboratory (RISE Lab). His research focuses on precision motion control and human-machine interaction, with applications in wearable sensors and robotics for rehabilitation, unmanned aerial and ground vehicles, and collaborative manufacturing. His work has been recognized by a Bisgrove Junior Faculty Award from Science Foundation Arizona and several best paper awards.

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