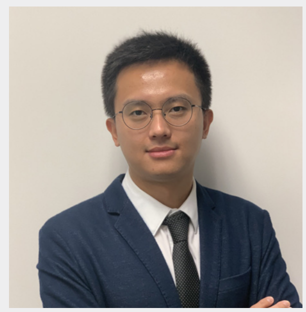
PAGE MORTON HUNTER DISTINGUISHED SEMINAR SERIES

FROM KINEMATIC TO ENERGETIC CONTROL OF WEARABLE ROBOTS FOR AGILE HUMAN LOCOMOTION

Even with the help of modern orthotic devices, stroke survivors often struggle to walk in the home and community. Emerging powered exoskeletons could actively assist stroke survivors to enable greater mobility, but these devices enforce a small set of predefined kinematic patterns, which cannot adjust to continuously varying activities or changes in user behavior associated with learning during gait rehabilitation. Tracking different kinematic trajectories also results in excessive control-parameter tuning, which usually takes hours to finish for a single subject and task. A paradigm shift from a kinematic-based, task-specific to a kinematic-free, task-invariant approach is desirable for exoskeletons that assist or enhance existing joint motion. This talk will first introduce a task-invariant, energetic control paradigm for exoskeletons to alter the human body's dynamics without prescribing joint kinematics, e.g., reducing the perceived weight and inertia of the human limbs. The proposed control approach is then implemented on exoskeletons with high-torque, low-impedance actuators, which provide the necessary backdrivability for volitional human control. While this proposed control approach has shown promising results, the choices of control parameters that render the optimal outcome remains unclear. In the second part of the talk, I will focus on a task-invariant learning framework for optimizing control policies. Through rapid on-line learning techniques, optimal control parameters can be obtained to provide customized assistance that renders the best outcome such as metabolic cost reduction.

Ge Lv, Ph.D.



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Ge Lv is an assistant professor in the Department of Mechanical Engineering at Clemson University. He received B.S. and M.S. degrees from Northeastern University (China) in 2011 and 2013, respectively. He then received his Ph.D. degree in electrical engineering from the University of Texas at Dallas in 2018. Prior to joining Clemson, he was a postdoctoral fellow in the Robotics Institute at Carnegie Mellon University. His research concerns the control and learning techniques for bipedal locomotion with application to wearable robots, including exoskeletons and prostheses. Dr. Lv is the recipient of the Best Student Paper Award at the 54th IEEE Conference on Decision and Control. He is a Member of the IEEE Control Systems Society and the IEEE Robotics & Automation Society.

Nov. 5, 2020 • 3:30 p.m.

Virtual seminar

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