Graduate Student Research Seminar

Fall 2022

Task Invariant Centroidal Momentum Shaping for Lower-Limb Exoskeletons

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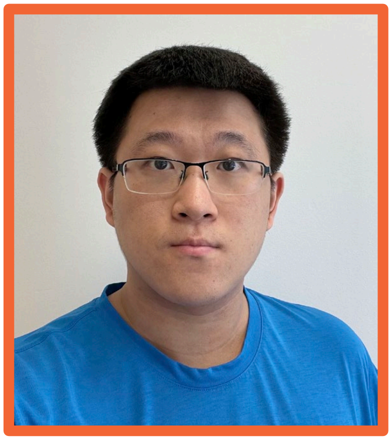

Monday, November 28th

3:00 pm (EST) – 132 Fluor Daniel Building

Abstract

Task-invariant approaches are desirable in exoskeleton control design as they have the potential of providing consistent assistance across locomotor tasks. Different from traditional trajectory-tracking approaches that are specific to tasks and users, task-invariant control approaches do not replicate normative joint kinematics, which could eliminate the need for task detection and allow more flexibility for human users. In this presentation, we will introduce a task-invariant control paradigm for lower-limb exoskeletons to alter the human user's centroidal momentum, i.e., a sum of projected limb momenta onto the human's center of mass. We design a virtual reference model based on human user's self-selected gaits to provide a reference centroidal momentum for the exoskeleton to track and make it adaptable to changes in gait patterns. Mathematically, the proposed approach reduces the control design problem into a lower-dimensional space. With the number of actuators being greater than the dimension of the centroidal momentum vector, we can guarantee the existence of a centroidal momentum shaping law for underactuated systems through optimization. Simulation results on a human-like biped will be provided to show that the proposed shaping strategy can produce beneficial results on assisting human locomotion, such as metabolic cost reduction.

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