



Department of Mechanical and Aerospace Engineering (MAE) Seminar



Dr. Victor Duenas
Mechanical and Aerospace Engineering, Syracuse University

Will present a talk titled:

Switching Control to Assist and Perturb Walking using Powered Exoskeletons

Abstract: Powered exoskeletons and wearable robotics are ubiquitous for human rehabilitation, function augmentation, and gait optimization. Fundamentally, the interaction between humans and robots poses challenges to guarantee the stability of the overall system motivating the development of smart control algorithms. Further, human-device systems are nonlinear, time-varying and have uncertain parameters that are hard to estimate. In this talk, I will discuss two applications in which powered exoskeletons achieve drastically different objectives leveraging switching closed-loop control methods. Switching control allows to engage and disengage human and robot inputs for shaping the human-robot interaction with guaranteed stability. First, I will introduce a data-based adaptive controller to assist walking by engaging a leg exoskeleton with functional electrical stimulation (FES). The adaptive controller customizes the hip-knee torque assistance by switching the control inputs between electric motors and muscles activated via FES to achieve treadmill walking, which has the potential to help individuals with paralysis during gait rehabilitation. Second, I will provide preliminary results of a switching controller that perturbs the ankle joint to target the soleus loading response within the stance phase of walking. This perturbation controller is developed to examine the underlying neurophysiology of stroke survivors to improve gait propulsion, which can increase walking speed and endurance. I will close by summarizing the next steps for translation of these approaches from the lab to the end users.

Date: Friday, April 28, 2023

Location: CAMP 176

Time: 11:00 am

ZOOM Link for virtual attendance

<https://clarkson.zoom.us/j/98947209769>



Bio: Dr. Victor Duenas is an Assistant Professor in the Department of Mechanical and Aerospace Engineering at Syracuse University. Dr. Duenas is the director of the Bionics, Systems and Control Laboratory, which focuses on the design, analysis, and experimental implementation of control systems for human-robot interaction in the context of assistive devices and lower-limb rehabilitation. Major recent topics include nonlinear and adaptive control of powered exoskeletons, wearable robotic devices, and functional electrical stimulation (FES) cycling. He received his Ph.D. (2018) in mechanical engineering from the University of Florida, in which he was awarded a MAE Department Best Dissertation Award. He was part of a research team that received the 2019 IEEE Control Systems Technology Award for their work on closed-loop FES control methods. He has active research projects funded by the Syracuse VA Medical Center, the Medical University of South Carolina, and the National Science Foundation (NSF). Lab's website: <https://vhduenas.expressions.syr.edu/research/F>
Faculty profile: <https://ecs.syracuse.edu/faculty-staff/victor-duenas>