Robotic Human Enhancement Enabled through Wearable Hip Exoskeletons Capable of Community Ambulation

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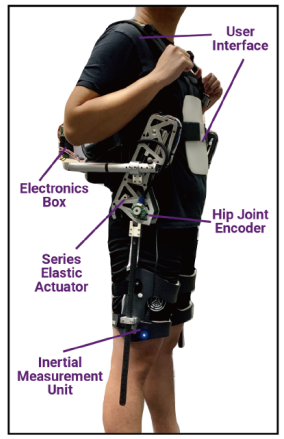
Challenge

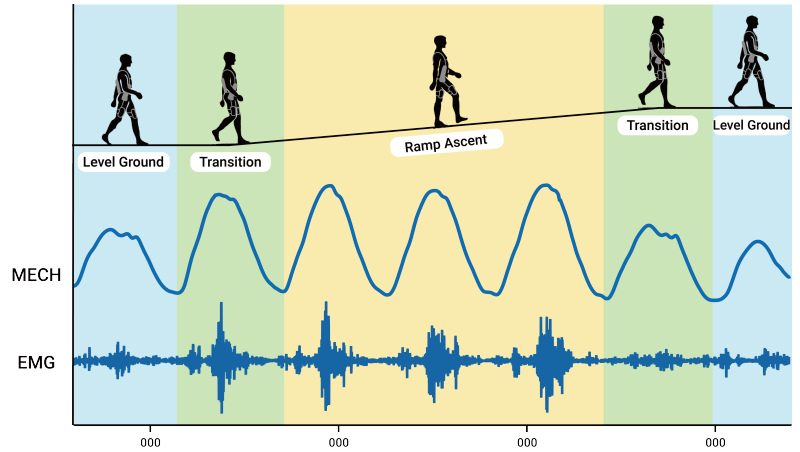
- Difficult to create exoskeleton controllers that generalize across a wide range of tasks (i.e. locomotion modes)
- Syncing exoskeleton assistance with muscle force generation is challenging with mechanical sensors alone

Solution

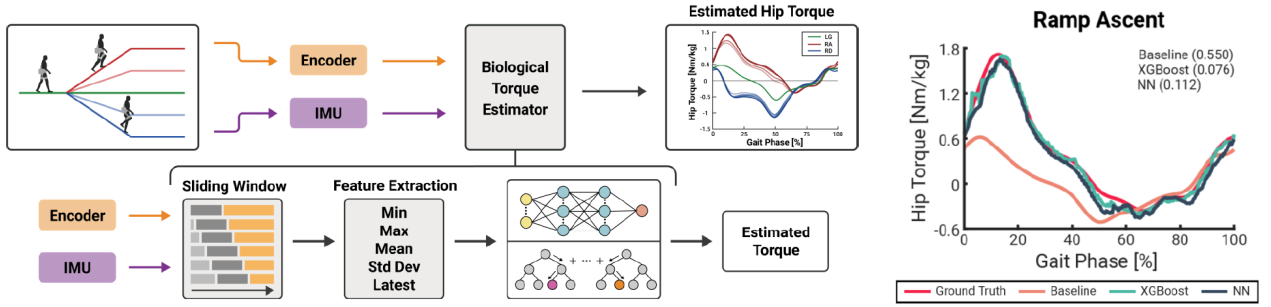
- Sensor fusion (mechanical and biological) approach of developing a machine learning model to estimate user state information
- Estimated user state variables includes both high level task (locomotion mode) and internal (joint kinetics) information



Robotic hip exoskeleton



Sensor fusion-based approach for continuous mode classification



The workflow used to estimate the user's biological hip torque

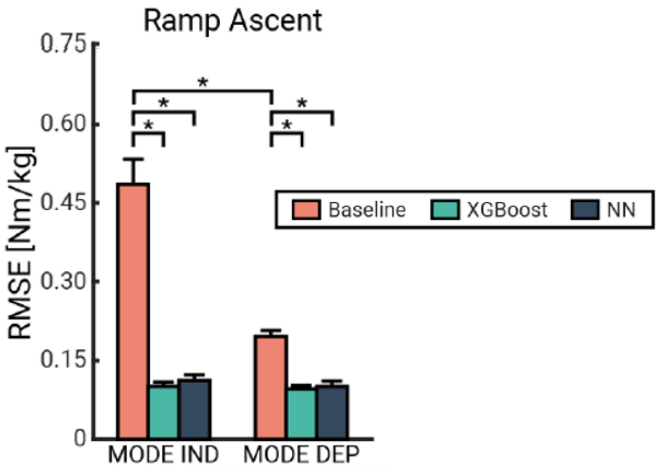
Scientific Impact

- Intent recognition systems for human-robot interaction
- Novel strategies for estimation human internal joint torques for prosthetic/exoskeleton applications

Broader Impact

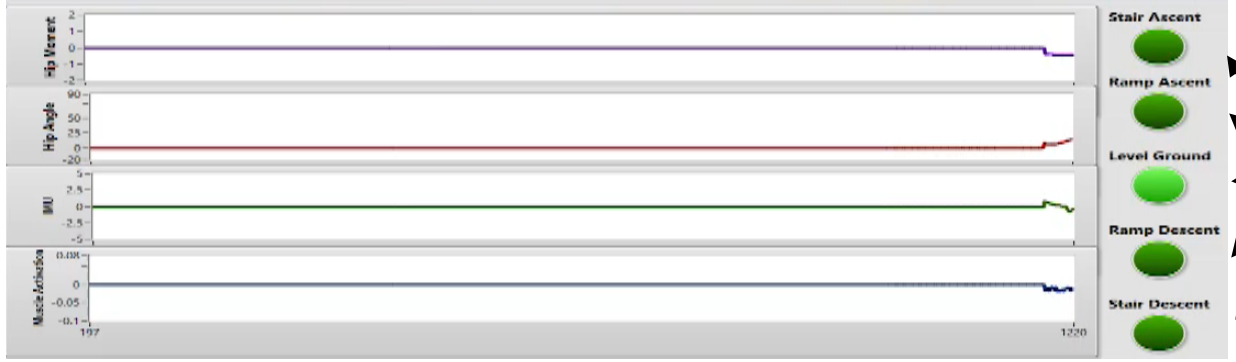
- New NSF robotics summer camp for high school students created

EMG & mechanical sensor fusion to predict user's locomotion mode and hip joint moment for a robotic hip exoskeleton



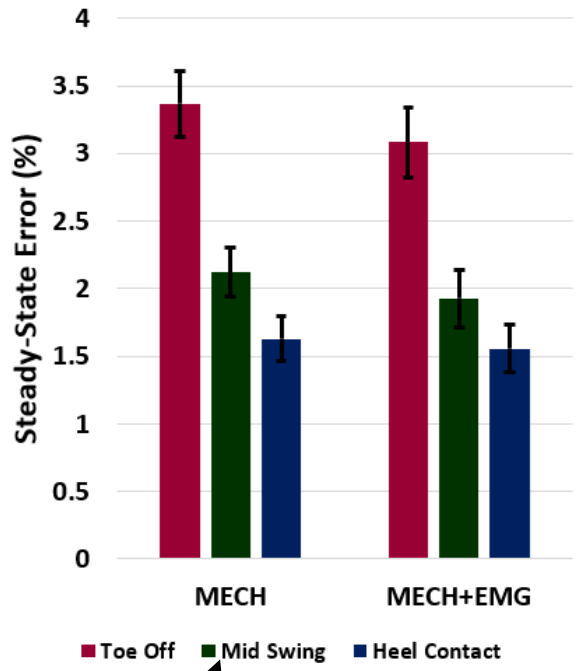
Comparison to Ground Truth

Estimated Biological Hip Torque



Multi-modal Sensory Data Inputs (Hip angle, IMU, EMG)

Classifier Real-Time Decisions



Comparison to Ground Truth