Real-time Ultrasound Assessment of a Human Muscle to Optimize Shared Control in a Wearable Exoskeleton

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Key Challenge:

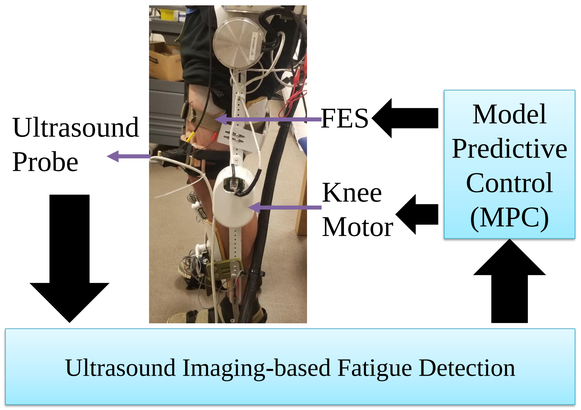
- Lack of a sensing modality to detect muscle fatigue state and thus difficult to coordinate exoskeleton and functional electrical stimulation (FES) use
- Excessive muscle fatigue caused by FES

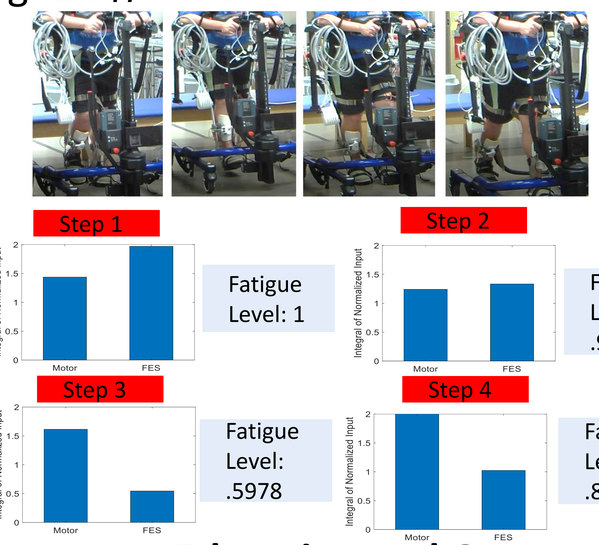
Scientific Impact:

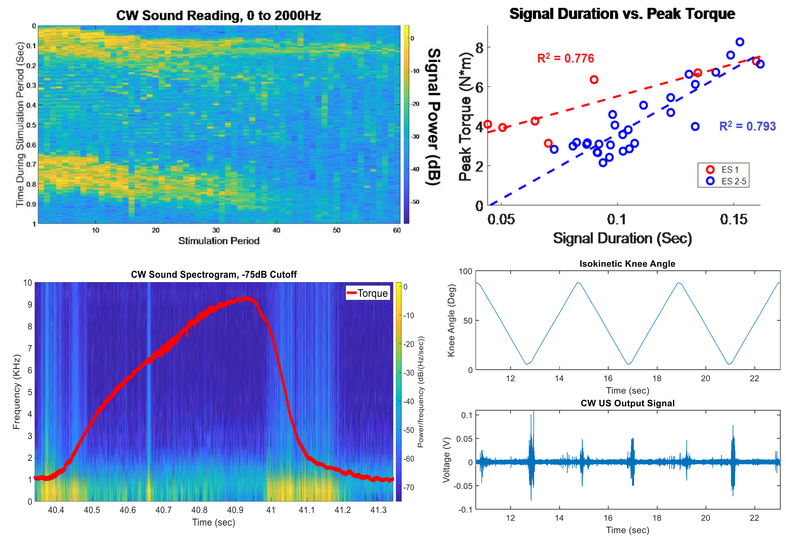
- Improved human machine interface
- Better evaluation metrics to better control functional electrical stimulation

Solution:

- Use ultrasound (US) imaging to measure muscle fatigue and incorporate US-derived muscle fatigue signal as a feedback in hybrid exoskeleton control
- Develop wearable markers of muscle activity and fatigue







Who Benefits from this Research:

- Persons with
  - Stroke
  - Spinal cord injury
- Rehabilitation clinics and physical therapists

Education and Outreach:

- Public demonstrations of
  - Ultrasound imaging
  - Powered exoskeleton
- Mentoring of undergraduate students
- Multiple graduate students supported

Broader Impact by the Numbers:

- Approximately 800,000 people in the united states suffer from stroke
- 17,000 new cases of spinal cord injury each year on average

Source: Spinal cord injury: NSCISC National Spinal Cord Injury Statistical Center, Annual Report, 2016

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