From EMG to Motor Units: Assessing the Neural Control of Movement

Bhawna Shiwani
Research Engineer
WPI Alumni, Robotics Engineering

Michael D. Twardowski
Research Engineer
PhD Student, Robotics Engineering

Synergy of Human and Robotic Systems
## CLASS SCHEDULE

**PART I • OCT 1\textsuperscript{st} • 13:00-14:20**
- **Paola Contessa**
  - Sensing Physiological Signals for Human-Robotics Interaction

**PART II • OCT 3\textsuperscript{rd} • 13:00-14:20**
- **Bhawna Shiwani**
  - Processing Physiological Signals for Human-Robotics Interaction

**PART III • OCT 8\textsuperscript{th} • 13:00-14:20**
- **Bhawna Shiwani**
  - From EMG to motor units: Assessing the Neural Control of movement
    - 10 min How does the brain control movement?
    - 10 min Decomposition of sEMG Signals
    - 30 min dEMG Analysis demo - Q&A
    - 30 min Measuring how the brain controls movement

**PART IV • OCT 10\textsuperscript{th} • 13:00-14:20**
- **Michael Twardowski**
  - Improving neural interfaces for robotics/prosthetic control
How does the brain control movement?

Understanding the Physiology behind EMG
How Do We Move?

Brain Command

Neural Activation

Motor Unit Action Potential Train

“Run”
How Do We Move?

Brain Command

Neural Activation

Motor Unit Action Potential Trains

“Run”
How Do We Move?

Brain Command

Neural Activation

Electromyographic Signal

Run
Decompose sEMG Signals

How does dEMG work?
dEMG Analysis Demo

Track motor unit firings, body kinematics, muscle force and more

Statistical analysis of motor unit action potentials and firing behavior

Comparative correlations across muscles, intervals and subjects
Beyond EMG

Measuring How the Brain Controls Movement
Video demos of functional activities:
https://www.delsys.com/products/trigno-galileo/

View Webinar:
Biomarkers of Clinical Neurophysiology
BIOMARKERS

Clinical Neurophys.

Healthy sEMG

Myopathy sEMG

Healthy MUAP Range

Myopathy MUAP Range
Clinical Neurophys

Motor unit biomarkers of diseases

Noninvasive format for out-of-clinic assessments
Neural Interfaces for Robotic Rehabilitation
New Interfaces for Neural Control

- Amplitude-based measures
- Variable precision
- Poor estimate of intent
New Interfaces for Neural Control

- Removes control information from electrical recording
- Natural increments that regulate force and movement
Acknowledgements

National Institute of Neurological Disorders and Stroke
(1R43NS077526)(R43NS09365)
(R43NS093651) (R44NS077526)
(2R44NS07752603)

Eunice Kennedy Shriver National Institute of Child Health and Human Development
(R44HD094626)

Deluca Foundation
ALTEC RESEARCH

Thank you

Website
http://www.altecresearch.com/

Publications
http://www.altecresearch.com/projects.html

Learn More About dEMG

Support
support@delsys.com