Sensing Physiological Signals for Human-Robotics Interaction

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Synergy of Human and Robotic Systems
Altec Inc. founded by Prof. Carlo J. De Luca


A COMMITMENT TO FORWARD THINKING & TRANSLATIONAL INNOVATION

1997
Altec Inc. founded by Prof. Carlo J. De Luca

First fixed-spacing sensor for high-fidelity EMG
- From research studies of fatigue and muscle activation monitoring

1997-2003
First fully wireless sEMG system
- From research studies of movement disorders monitoring

2003-2006
First fully wireless sEMG system
- From research studies of motor control in health, aging, and disease

Avanti, Bluetooth, Mini, and Galileo Wireless Sensors
- From research studies of prosthetic control, vigorous activities, subvocal EMG-voice, control of dynamic tasks

2006-2010
First non-invasive system for extracting neural information
- From research studies of motor control in health, aging, and disease

2018
Conceptualize new EMG technology

Development of EMG products

Scientific/Research Questions

Advance understanding of human movement

Enabling new research applications

Human Machine Interfaces • Assistive Devices • Rehabilitation • Robotics • Ergonomics • among other fields
AREAS OF FOCUS THAT WILL SHAPE OUR FUTURE

Learn more at www.delsys.com/altec/

Engineering the Next-generation Neural Interface

EMG-based Silent Speech Recognition

Next-generation sensor technology

Tracking Movement Disorders
## CLASS SCHEDULE

**PART I • OCT 1\(^{st}• 13:00-14:20**

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<tr>
<th>Time</th>
<th>Activity</th>
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<tr>
<td>10 min</td>
<td>Introduction</td>
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<tr>
<td>30 min</td>
<td>Sensing EMG and biomechanics signals - Q&amp;A</td>
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<tr>
<td>30 min</td>
<td>Demo – Q&amp;A</td>
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<td>10 min</td>
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**PART II • OCT 2\(^{nd}• 13:00-14:20**

- Bhawna Shiwani: Processing Physiological Signals for Human-Robotics Interaction

**PART III • OCT 8\(^{th}• 13:00-14:20**

- Bhawna Shiwani: From EMG to motor units: accessing the neural control of movement

**PART IV • OCT 10\(^{th}• 13:00-14:20**

- Michael Twardowski: Improving neural interfaces for robotics/prosthetic control
What is in the EMG signal?

Electro | Electric
Myo    | Muscle
Graphy | Graph

Electromyography is the study of muscle function through the inquiry of the electrical signal the muscles emanate.

MUSCLES ALIVE
Basmajian & De Luca, 1985
What is in the EMG signal?

1. Control signal from brain
2. Motor Unit Firings
3. Motor Unit Electrical Signal
4. Muscle Electrical Signal

Muscle Force Output

Spinal Cord
- Motor Unit 1
- Motor Unit 2
- Motor Unit 3

Muscle Fibers

EMG Signal

Muscle Force
Record Good Quality EMG Signals

- **Low Baseline Noise**
  Quality and stability of the skin-electrode interface.

- **Low Line Interference and Other Contaminants**
  Low power line 50/60 Hz noise, no clipping.

- **High Signal-Noise Ratio**
  High-amplitude EMG signal and low baseline noise.
Record Good Quality EMG Signals

View Webinar

WHAT SHOULD BE IN AN **EMG System**

- Full Bandwidth Signal
- Low Noise Electronics
- Synchronized Signals
- Fixed Spacing
- Reduced Crosstalk
- Suppressed Artifacts
- High-Fidelity
- Integration Options

Stable
Reliable
Adaptable
Research-Centric

Wearable Sensors for Movement Sciences
Record Good Quality EMG Signals

**APPLICATION**

- **Sensor Location:**
  Place on muscle belly for high-amplitude sEMG signal

- **Skin Preparation:**
  Clean and shave skin to improve skin-electrode contact

**SENSOR POSITION & SKIN PREPARATION**

1. Clean skin with alcohol swab.
2. Firmly apply the sensor to skin.
Acknowledgements