# Wearable Sensors in Rehabilitation: Tracking for the Future

October 26-27, 2021
Online Course

Shirley Ryan
Abilitylab

Northwestern
University

## WEARABLE SENSORS IN REHABILITATION: TRACKING FOR THE FUTURE

The *Academy* is the not-for-profit educational arm of Shirley Ryan AbilityLab, formerly the Rehabilitation Institute of Chicago (RIC). We are dedicated to advancing the ability of healthcare professionals by sharing the latest scientific discoveries and clinical practices that accelerate outcomes for patients.

The Center for Smart Use of Technologies to Assess Real World Outcomes (C-STAR), a joint grant between Northwestern University and Shirley Ryan AbilityLab, is one of six national resource centers comprising the Medical Rehabilitation Research Resource network (MR3) of the National Institutes of Health. C-STAR was conceived out of a need to equip investigators with the skills and know-how to accurately employ technologies to measure and interpret data relevant to sensorimotor and cognitive function in the lab, clinic and real world.

Our mission is to connect researchers with the right tools to develop and accurately assess technologies in the field of rehabilitation science. Leveraging the collective experience of clinicians, scientists, engineers and patients, our center provides the expertise, instruction and mentorship to empower researchers on the meaningful use of the vast array of technologies that are readily available but notoriously difficult to implement consistently across diverse patient populations.

## COURSE DESCRIPTION

A variety of wearable sensors are available to measure data from individuals needing or who will need rehabilitation. These data may be used to measure outcomes associated with movements, muscle activation, vital signs, and more. While there is no shortage of devices, it is confusing to know when and how to use them in clinical populations to answer clinical and research questions. To use wearable sensors effectively to obtain data that is meaningful and relevant, judgments must be made about which devices to use, where to place them, how to configure them, what types of data to collect, and when to make the measurements.

This course will explore basic principles of using wearable sensors to effectively measure biometrics such as muscle health, movement, and vital signs in a rehabilitation population. First, we will review how common wearable sensors work and what they measure. Next, we will explore 3 research/clinical applications where wearable sensors were actively employed using IMU or EMG features. Finally, participants will have the opportunity to discuss potential approaches to using wearable devices to answer their own clinical or research questions with our esteemed faculty and peers.

*Successful completion*:
In order to receive contact hours, daily sign-in and completion of an online evaluation are required. Participants will attend live online lectures that provide a foundation for the online interactive sessions.

## WHO SHOULD ATTEND

Engineers, Data Scientists, Physical Therapists, Physical Therapist Assistants, Occupational Therapists, Occuapational Therapy Assistants, Speech-Language Pathologists, and Physicians

## COURSE OBJECTIVES

Upon completion of this course, participants will be able to:

- Identify common wearable sensors (EMG, Goniometers, IMU and Accelerometers) that can help answer rehabilitation research and clinical question/s.
- Recall considerations surrounding common wearable sensors such as placement, type, interface and software elements.
- Discuss approaches to overcome the challenges in measuring data from patients in the lab, clinic, and community settings.
- Develop strategies for comparing technologies prior to selection.
- Identify pros and cons of technologies prior to implementation.
- Outline commercially available wearable sensor technology to evaluate when to use it, and how to collaborate with commercial entities to do so.

## COURSE CHAIRS

*Levi Hargrove PhD*
*Scientific Chair of The Regenstein Foundation Center for Bionic Medicine and of the Neural Engineering for Prosthetics and Orthotics Laboratory, Shirley Ryan AbilityLab; Associate Professor, Feinberg School of Medicine and McCormick School of Engineering, Northwestern University*

A major goal of Dr. Hargrove's research is to develop clinically realizable myoelectric control systems that can be made available to persons with limb loss in the near future. His research addresses all levels of amputation and has been published in the Journal of the American Medical Association and the New England Journal of Medicine and multiple patents. Key projects include the development of advanced and adaptive control systems for prosthetic legs, improving control of robotic hand prostheses, and intramuscular EMG signal processing. In 2012, Dr. Hargrove co-founded Coapt, a company to transition advanced rehabilitation technologies from the research lab to patients' homes.

*Arun Jayaraman, PT, PhD*
*Director, Max Näder Center for Rehabilitation Technologies & Outcomes Research; Executive Director Technology and Innovation Hub (tiHUB), Associate Professor of PM&R, Medical Social Science, PTHMS, Northwestern University*

Dr. Arun Jayaraman's work primarily focuses on developing and executing both investigator-initiated and industry-sponsored research in prosthetics, orthotics, rehabilitation robotics, and other assistive and adaptive technologies to treat physical impairments. He conducts all of his outcomes research using advanced wearable patient monitoring wireless sensors and novel machine learning techniques, in addition to the traditional performance-based and patient-reported outcome measures. He collaborates both nationally and internationally with many academic and industrial organizations and is internationally recognized in the field of rehabilitation robotics.

## COURSE FACULTY

**Scott Delp, PhD -** Director, James H. Clark Professor in the School of Engineering, Stanford University; Professor of Bioengineering, Mechanical Engineering, and Orthopaedic Surgery, Stanford University

**Dario Farina, PhD -** Chair in Neurorehabilitation Engineering, Department of Bioengineering, Imperial College London

**Joy Ku, PhD -** Director of Communications and Engagement, Mobilize Center, Stanford University**;** Director of Didactic Interactions, Restore Center, Stanford University

**Megan O'Brien, PhD -** Research scientist, Max Nader Center for Rehabilitation Technologies and Outcomes Research, Shirley Ryan AbilityLab

**Carmichael Ong, PhD –** Research Engineer, Stanford University

**Dave Reinkensmeyer, PhD -** Professor of Mechanical and Aerospace Engineering**;** Professor of Anatomy and Neurobiology, Professor of Biomedical Engineering; Professor of Physical Medicine and Rehabilitation, The Henry Samueli School of Engineering, University of California, Irvine

**W. Zev Rymer, MD, PhD -** Director, Single Motor Unit Laboratory, Shirley Ryan AbilityLab**;** Professor, Departments of Physical Medicine and Rehabilitation, Physiology, and Biomedical Engineering, Northwestern University

**Matthew Smuck, MD -** Chief, Physical Medicine and Rehabilitation, Stanford**;** Professor of Orthopaedic Surgery, Stanford University**;** Medical Director of Rehabilitation Services, Stanford University Hospital and Clinics**;** Director and Founder, Wearable Health Lab

**Kat Steele, PhD -** Professor, Mechanical Engineering at University of Washington

## AGENDA

**Tuesday, October 26, 2021**

9:00 Welcome and Review of Course Objectives & Expectations

9:15 Sensor Basics: Accuracy, Precision, Sampling
**Joy Ku, PhD & Carmichael Ong, PhD**

9:45 Overview of Common Sensors and Data Used in Rehabilitation
**Levi Hargrove Ph,D**

10:15 Break

10:45 Real-World Monitoring of Movement
**Scott Delp, PhD**

11:30 Applying Sensors to Research: Practical Considerations
**Arun Jayarman, PT, Ph.D.** & **Megan O'Brien PhD**

12:15 **Lunch**

1:00 Case Study #1: EMG for Stroke
**Zev Rymer, PhD**

1:45 Case Study Problem Solving + Goal Setting

2:15 Case Study #2: Accelerometry for Musculoskeletal Rehabilitation
**Matthew Smuck, MD**

3:00 Case Study Problem Solving + Goal Setting

3:30 End of Day Reflection and Learning Summary

3:45 End of Day 1

**Wednesday, October 27, 2021**

9:00 Welcome - Review of Course Objectives & Expectations for Day 2

9:15 Small group discussions of sensor applications in Your Research

10:00 Tracking Home Rehabilitation Engagement Through Sensor-Based Systems
**Dave Reinkensmeyer, PhD**

10:45 Case Study Problem Solving + Goal Setting

11:15 Lunch

12:15 Use of Sensors for Pediatric Rehabilitaiton
**Kat Steele, PhD**

1:00 Break

1:15 Using EMG to Determine Common Drive of Motor Control
**Dario Farina, PhD**

2:00 Networking and Small Group discussions about your own research

2:45 Final Debrief

3:00 End of Day Two

## LOCATION

The program will be held online. All programming will be shared through an online meeting platform, Zoom, and the Academy Learning Portal.

## TECHNOLOGY REQUIREMENTS

To participate, you will need the following:

- Access to a computer with an Internet connection. High-speed broadband access (LAN, Cable or DSL) is highly recommended.
- Phone
- Internet connection
- Web browser: Latest stable version of Apple Safari, Google Chrome, or Mozilla Firefox
- JavaScript and Cookies enabled
- Speaker or headset to listen to audio files and participate in conference calls
- **Do NOT** use Internet Explorer or Microsoft Edge, as they are not supported.

## ACCESSIBILITY

Please contact the Academy if you require special accommodations for this course.

## CONTINUING EDUCATION CREDIT

**Physicians**

This activity has been planned and implemented in accordance with the accreditation requirements and policies of the Accreditation Council for Continuing Medical Education (ACCME) through the joint providership of the Illinois State Medical Society and Rehabilitation Institute of Chicago DBA Shirley Ryan AbilityLab. The Illinois State Medical Society is accredited by the ACCME to provide continuing medical education for physicians.

The Illinois State Medical Society designates this live activity for a maximum of 10.0 *AMA PRA Category 1 Credits™*. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

**Physical Therapy**

This online course has been approved by the Illinois Physical Therapy Board for 10.0 contact Hours.

The Shirley Ryan AbilityLab is recognized by the New York State Education Department's State Board of Physical Therapy as an approved provider of physical therapy and physical therapist assistant continuing education. This course has been approved by the New York Physical Therapy Board for 10.0 Contact Hours.

The following states require continuing education units or contact hours with no state specific approval: CT, IA, and WA

Occupational Therapy

The Shirley Ryan AbilityLab is an AOTA Approved Provider of professional development. Course approval ID# 02703. This distance learning – independent and interactive webinar is offered at 1.0 CEUs [intermediate, OT service delivery/ Professional Issues]. AOTA does not endorse specific course content, products, or clinical procedures.

Speech-Language Pathology

**Rehabilitation Institute of Chicago dba Shirley Ryan AbilityLab** is approved by the Continuing Education Board of the American Speech-Language-Hearing Association (ASHA) to provide continuing education activities in speech-language pathology and audiology. **See course information for number of ASHA CEUs, instructional level and content area.** ASHA CE Provider approval does not imply endorsement of course content, specific products or clinical procedures.

This course is offered for up to 1.00 ASHA CEUs (Introductory level, Related area)

## FACULTY DISCLOSURES

All faculty disclosures for ASHA can be found here:
https://ricacademy.sharefile.com/d-s5a2535b9ea854ff3bcfb6736de20502e

# SPECIAL THANK YOU!

The Academy at the Shirley Ryan AbiltyLab would like to thank the Restore Center at Stanford University for assisting with marketing this course and allowing members of their team to teach in this course.

**The Restore Center (the Center for Reliable Sensor Technology-Based Outcomes for Rehabilitation)** is an NIH MR3 Resource Center focused on enabling real-world assessments in rehabilitation. Based at Stanford University, we provide research infrastructure and training to enable rehabilitation scientists to use mobile sensors and video technology to assess movement and factors affecting movement.

Our Center brings together expertise from statistics, computer science, bioengineering, mobile health, and clinical rehabilitation. Together, we are developing software tools and easy-to-use, standardized workflows for real-world monitoring in rehabilitation. These resources, along with programs such as pilot project grants and virtual office hours, will establish a vibrant research community to achieve the potential of mobile technology to improve our knowledge and care of individuals with impaired movement.