

## **Using Digital Health Technology to Enable Tele-Rehabilitation Interventions**

Paolo Bonato, PhD

Department of Physical Medicine and Rehabilitation, Harvard Medical School

Wyss Institute at Harvard University

This lecture will review recent advances in the application of digital health technologies to the field of tele-rehabilitation. We will show how relying on digital health technologies and on machine learning algorithms, researchers have developed approaches suitable to derive accurate estimates of clinical scores via the analysis of data collected during the performance of functional movements. Examples provided during the lecture will include techniques to assess motor impairments and functional limitations from sensor and video data. We will discuss how digital technologies can be used to collect data to generate feedback during the performance of rehabilitation exercises outside of the clinic. Finally, we will discuss how these technologies can transform the way rehabilitation interventions are designed and implemented as they enable tracking individual responses to clinical interventions.

## **mHealth Technology for the Clinical Management of Patients with Parkinson's Disease**

Paolo Bonato, PhD

Department of Physical Medicine and Rehabilitation, Harvard Medical School

Wyss Institute at Harvard University

The development of unobtrusive wearable sensors and advances in mhealth technology have enabled tracking PD symptoms and motor complications in the home and community settings. An important application of these technologies is monitoring individuals who experience motor fluctuations. Estimates of the severity of tremor, bradykinesia, and dyskinesia can be derived from recordings obtained using inertial sensors, though with different levels of accuracy across symptoms and motor complications. An emerging area of application of wearable technology in PD is the detection of early symptoms as a potential screening tool to facilitate the diagnosis of PD. Preliminary results suggest that gait parameters could be utilized in this context. Deriving clinically relevant information from wearable sensor data is a challenging task. Recent advances in machine learning have enabled unprecedented capabilities to analyze large datasets. These techniques are needed when one analyzes data collected using wearable technology in the home and community settings as the datasets are typically very large and of complex interpretation.

## **A Precision Medicine Approach to Robot-Assisted Rehabilitation**

Paolo Bonato, PhD

Department of Physical Medicine and Rehabilitation, Harvard Medical School

Wyss Institute at Harvard University

In this talk, we will review the use of robotics in rehabilitation with a focus on retraining motor function in patients with neurological conditions ranging from stroke to cerebral palsy. We will argue that the prediction of patients' response to robot-assisted motor training should account for the mechanisms underlying the short-term and long-term response of each individual patient to the forces generated by the robot. We will demonstrate how modeling the human-machine mechanical interaction and studying changes in muscle synergies in response to the forces generated by the robot could shed light on the ability of individual patients to display a positive response to the rehabilitation intervention.