Scientific/Educational Workshop

Workshop title

Advanced outcome metrics for upper limb sensory-motor function

Workshop responsible

Jacqueline S Hebert (University of Alberta)

Speakers

Jacqueline Hebert,
Jon Sensinger,
Paul Marasco

Workshop goals

The goal of this workshop is to share new methodologies for assessing upper limb function that apply to a spectrum of sensory-motor disorders, using prosthesis evaluation as an example. The attendees will be introduced to five scientifically based metrics that have been validated in normative populations, and can discriminate changes with advanced sensory-motor prosthesis function. This will include an understanding of technical requirements, practical administration, and sample results reporting for each metric. By the end of the workshop, the attendees will have an appreciation of how a fundamental mechanistic approach to outcome evaluation can provide insight into human sensory-motor behaviour and human-machine interaction.

Abstract

Outcome measures are essential for understanding the impact of treatment interventions. As a relevant example, existing metrics are limited in the ability to detect important changes in upper limb prosthesis performance related to advancements in myoelectric control, multi-function grasp patterns, and novel mechanisms of sensory feedback. As part of the DARPA HAPTIX Program, our team created novel metrics that were targeted towards advanced sensory-motor-integrated prostheses yet are adaptable to both current standard-of-care prostheses and upper limb sensory-motor deficits. The metrics are flexible to account for numerous systems approaches, sensitive to system performance, and reflective of requirements for quantifying different control and feedback strategies. This workshop will introduce you to the practical applications of our 5 validated metrics: Gaze and Movement Assessment (GaMA) precisely quantifies upper limb kinematics and visual gaze behavior during functional tasks; Grasping Relative Index of Performance (GRIP) measures the relative tradeoff between speed and accuracy during controlled force grasping; Prosthesis Efficiency and Profitability (PEP) objectively assesses searching, reaching, grasping, manipulating, and decision making movements; Prosthesis Incorporation (PIC) quantifies how much a prosthesis has been incorporated into the body schema; and Control Bottleneck Index (CBI) identifies system bottlenecks by evaluating the contribution of a particular control strategy, sensory feedback modality, and user experience. Together, this suite of complementary metrics cover a spectrum of evaluation strategies that map out system function to inform design, implementation, and clinical translation of prosthesis technology, but also has implications for the measurement of upper limb sensory-motor performance in many clinical populations. This workshop follows a successful international workshop presented at the Myoelectric Controls Symposium 2017; with additional refinement, validation data, and demonstrations. Particular focus on the application of our scientifically based approach to populations with upper limb sensory-motor deficits will stimulate inter-disciplinary discussion on the role of mechanistic metrics on measurement of function.