Mini-symposium "technology and neurorehabilitation"

October 20th, 2017, Louvain-la-Neuve, Belgium

Auditoires Sainte-Barbe, room BARB92

Program at a glance

14:00 – Talk by **Prof. Peter Feys** (UHasselt) - https://www.uhasselt.be/UH/biomed/Principal-investigators/Peter-Feys.html

"Technology-supported rehabilitation in Multiple Sclerosis"

This presentation will discuss the current state-of-research on technology-supported assessment and rehabilitation in persons with MS. An overview will be provided on different robot and motor learning approaches that were applied and the clinical effects that were obtained. Comparisons with stroke will be made based on recent systematic reviews.

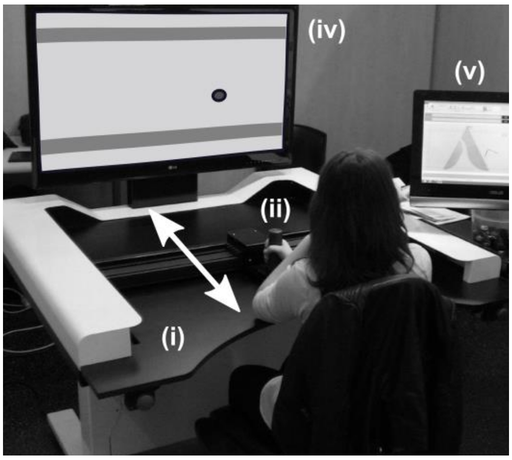
14:45 – Talk by **Prof. Heike Vallery** (TUDelft) - https://www.tudelft.nl/en/3me/organisation/departments/biomechanical-engineering/people/dr-ir-h-heike-vallery/

"Complementary technology to support human locomotion"

Future-proof therapeutic and assistive devices must be scrutinized for unique functional benefits over potential alternative solutions. This talk will argue that a major criterion to judge how likely technology will become obsolete is the degree of complementarity in function offered by it. Complementary technology is characterized by one main property, which is that it does not replicate any mechanical or control structures of the human, thereby minimizing overhead and leaving utmost possibilities for the human to use their remaining mechanics and control skills. Several examples for complementary technology will be given, for example an augmentation device that exerts moments on the upper body without duplicating human musculoskeletal structures, as well as complementary control concepts for training environments.

15:30 – Coffee break and demonstration of the REAplan robot with the rehab algorithm implemented by Patricia Leconte (see below) – /!\ The room is different: Stevin building, floor -1.

16:15 – PhD public defense of **Patricia Leconte** (UCLouvain) [talk given in French]



"Robotic assessment and rehabilitation of rhythmic upper-limb movement primitives after stroke"

After a stroke, two fundamental motor primitives are potentially impaired, i.e. discrete and rhythmic movements. Discrete movements consist of movements between successions of postures while rhythmic movements capture periodic movements like cycling. These primitives, which have been thoroughly studied in healthy subjects, are at least partially controlled by

different neural pathways. Indeed, rhythmic movements require less cortical activity than discrete ones, and few to no learning transfer is observed between both movements.

In this thesis, both primitives were compared in upper-limb movements of cortical and subcortical stroke patients. More precisely, our objective was to assess the kinematic performance of both primitives with stroke patients and with healthy subjects as a control group. We unveiled that rhythmic movements are less affected than discrete ones after a stroke, supporting the hypothesis that both movements are governed by different neural pathways.

Consequently, our second objective was to design a purely unilateral rhythmic movement therapy that could complement existing rehab protocols. A robotic rhythmic rehabilitation therapy was designed to achieve a performance-based assistance: the amount of assistance given to the patient was adapted in real-time as a function of his/her performance. In particular, this assistance relied on the use of adaptive oscillators, so that the patient kept full control of his/her movement features.

Finally, the last objective of this thesis was to study the effect of this rhythmic training on the general motor performance of a large stroke population. We observed motor improvements both in rhythmic movements, and, more surprisingly, some in specific features of discrete movements. This result opens the door for designing blended rhythmic-discrete rehab protocols that might use the least affected primitive to support the recovery of the most affected one.

In sum, this thesis offers a better understanding of the mechanisms governing upper-limb motor primitives, and provides some guidelines to improve existing rehab protocols for stroke patients.