Université catholique de Louvain **UCL** SECTEUR DES SCIENCES ET TECHNOLOGIES

INSTITUTE OF MECHANICS, MATERIALS AND CIVIL ENGINEERING

Invitation à la soutenance publique de thèse

Pour l'obtention du grade de Docteur en Sciences de l'Ingénieur

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European Master in Advanced Robotics

Bio-Inspired motor primitives for controlling leg exoskeletons

Locomotion assistive devices have gained increasing attention during the last years. In order to enhance the control of these devices, an emerging approach deals with capturing biological principles to emulate desirable features of human locomotion.

In this thesis, a novel assistive controller based on the bio-inspired concept of motor primitives is presented. Motor primitives are seen as fundamental units of action, which through proper recombination can generate a high-dimensional set of stimulations. These stimulations activate the body muscles and thus generate movements. This work focuses on the particular use of primitives for assisting rhythmic locomotion tasks. Also, other bio-inspired locomotion mechanisms based on feedback are explored: short-loop reflexes and torso-balance control.
In simulation, a bipedal walking model is developed by combining these different sources of muscular stimulation. This tool allows to explore the relative contributions of these mechanisms in human locomotion.

Next, this thesis focuses on the validation of the controller for delivering assistance using artificial primitives during different experiments. The first one illustrates that the controller is able to work in real-time while providing assistance. The second set of experiments tests the controller performance when being used with a gait-impaired subject. Finally, the last set of tests aims at challenging the full capability of the controller by assisting healthy subjects during different locomotion tasks.

These experiments highlight the capacity of volunteers to naturally interact with the device and generally benefit from the assistance. Importantly, when assisting different locomotion tasks, the controller is able to effectively handle the transitions between them without needing to stop in between.

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Auditoire BARB 91
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