PhD or MASc position in Haptics/Robotics
at Carleton University in collaboration with Haply Robotics

Start date: Winter 2023 or later
Duration: 4 years (PhD) or 2 years (MASc)
Location: Department of Systems and Computer Engineering, Carleton University, Ottawa, ON.

Virtual reality combined with kinaesthetic feedback is a fundamental building block of simulation training within highly specialized sectors, including education, manufacturing, and medicine. Haptic devices generate force-feedback that emulate the sensation of touching virtual objects, and such kinaesthetic stimuli have been shown to increase the retention of skills learned in virtual reality. Haptic devices are often active, that is, they use electric motors to generate feedback forces. Regrettably, motors can cause instability in haptic devices, resulting in a critical technical challenge: A trade-off exists between performance and stability, limiting the range of impedances the system can display. An alternative to motors is passive haptic devices, i.e., those that use brakes or dampers. Passive devices are stable and offer a wider impedance range than motors. However, they can only oppose the user's motion and as such, they are unable to generate forces in arbitrary directions. A configuration with hybrid actuation combining brakes and motors is a promising solution to integrate the advantages of each actuator type.

In collaboration with Haply Robotics, a Montréal-based company that specializes in the field of haptics and robotics, the objective of this project is to develop the first commercial hybrid brake/motor haptic device. The goals of this collaboration are to:

Design of a low-cost hybrid actuator: Building upon our past work, the student will design a novel low cost motor/brake hybrid actuator, characterize, and test it. An adaptive control law will be devised to control the actuator.

Create a multi-DOF hybrid haptic device: Once the actuator is designed, the next step is to incorporate it into an existing haptic device and design a force control algorithm to determine the optimal ratio between the passive and active forces.

Optimize the kinematic structure: The last stage of this project will focus on optimizing the kinematic structure of a haptic device with hybrid actuation. We will also study the use of redundant actuation to allow for better force control using passive actuators.

In addition to having strong analytical skills, the ability to work independently and proactively, and strong written and oral communication skills in English, the ideal candidate will have one or more of the following qualifications:

- A background in robotics, mechatronics, or relevant disciplines;
- Experience with CAD modelling, mechanical design, prototyping, and experimental work;
- Experience with control systems or robot control;

Occasional travel between Ottawa and Montréal may be required.

How to apply: Applicants should send a motivation letter, their CV, a copy of academic transcripts (in English or French), a list of three references, and copies of past publications, if any, to Prof. Carlos Rossa (rossa@sce.carleton.ca) and Dr. Antoine Weil-Duflos (antoine@haply.co).

More information about the position:

- Lab: https://www.biomechatronics.ca/
- Haply Robotics website: https://www.haply.co/
- Admission requirements for domestic students: here
- Admission requirements for international PhD students: here
- Applications from international MASc students cannot be accepted at this time.