Internship proposition : Experimental evaluation of Human-Robot negotiation of intentions in comanipulative tasks.

Supervisors:
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Duration :
5 to 6 months, starting February

General context :
Humans possess the ability to naturally and efficiently communicate information through haptics, as proven recently in the literature. This haptic communication often stays unnoticed even though used daily in multiple activities. One simple example to visualize this communication would be the following situation: imagine that you need to guide a blind and deaf person through a room, you would be able to do so by taking his hand and correcting his movements through this haptic feedback. The information communicated through touch is thus sufficient for numerous tasks that humans need to realize.

In the future, robots should be able to interact as smoothly with humans on a daily basis, which requires a pronounced development of human-robot interaction capabilities, and in particular of physical Human-Robot Interaction (pHRI), where human users are in direct physical contact with the machines.

The study of physical Human-Human Interaction (pHHI) has been proposed as a basis for the development of pHRI. The underlying idea is that to design better pHRI protocols, it is necessary to understand how humans interact when in direct contact. The main issue in the study of physical interaction between humans is the difficulty to extract reliable force information at the points of contact between humans. We believe that this interaction can be described a set of kinesthetic units.

One solution to this problem is to use coupled haptic interfaces to recreate physical interaction. Teleoperation controllers allow to recreate the sense of indirect physical contact, while keeping the interfaces (and thus the subjects) separated.

Previous work in the AGATHE team of ISIR has focused on using 1 degree of freedom (dof) teleoperated interfaces to study pHHI in various comanipulative tasks. Data from these experiments are then used to design virtual agents able to handle the role of a partner in pHRI scenarii.

While promising, the results obtained with the virtual agent would benefit from further experimental validation, especially in the tuning of the force threshold used for negotiation in conflicting situations, which is the subject of the present internship.

Internship objectives :

The aim of the internship will be to study how to develop these kinesthetic units . And more precisely the way they influence the negotiation. The focus will be made on asymetric scenarii that are representative of the blind guiding situation.

-The intern will firstly need to familiarize him(her)self with the literature of the subject, and with the experimental setup used. This will require basic knowledge of C and C++ programming, as well as notions of real-time computing.

-The second step will be to design the experimental protocol that will be used for the evaluation of the virtual agent (that will implement the kinesthetic unit), based on the different parameters that needs to be tested.

-This protocol will then be implemented in the current set-up, in order to carry on experiments with human subjects.

-Once the experiments are done, the final step will be the analysis of the data obtained, in order to confirm or reject the initial hypothesis.

-Depending on the time available, redaction or participation to the redaction of a scientific article for publication will be considered.

The work done during the internship will be a great opportunity to discover and experiment the work of experimental researchers in the field of robotics.
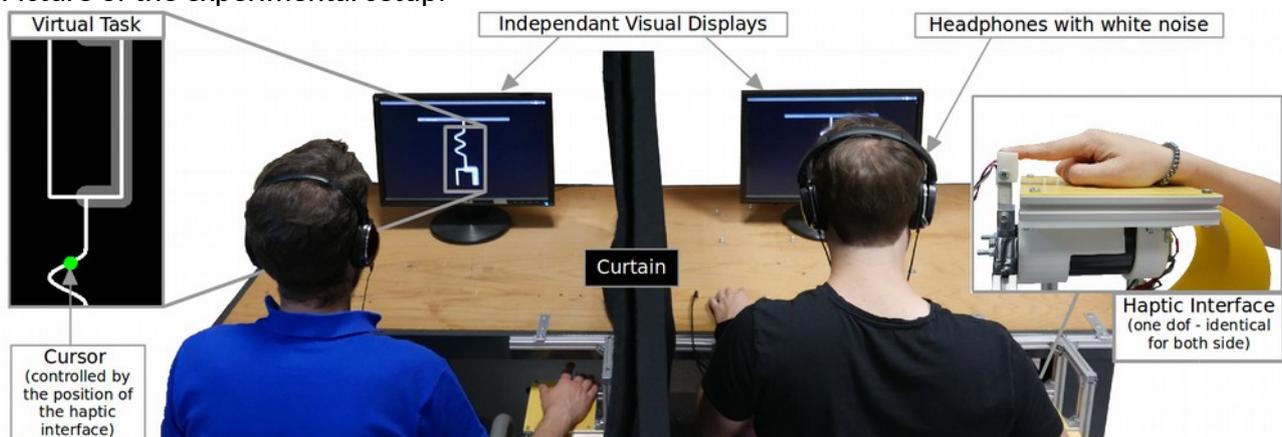
Required skills:

-Basis of C and C++ programming
-Experimental data analysis (Python or Matlab)

Additional resources :

Picture of the experimental setup:

Video of the experimental setup in Human-Human trials: https://youtu.be/uOC3QhdrINY

Article on the virtual agent (more recent articles are in the process of publication and will be available for the intern) http://ieeexplore.ieee.org/document/7759415/

Code samples of the robot: https://github.com/LudovicSaintBauzel/teleop-controller-bbb-xeno