Call for postdoc application

Topic: Biomimetic control of a robotic arm using machine learning based on residual movements of amputees and contextual information

Host and location: INCIA team HYBRID, Bordeaux, France

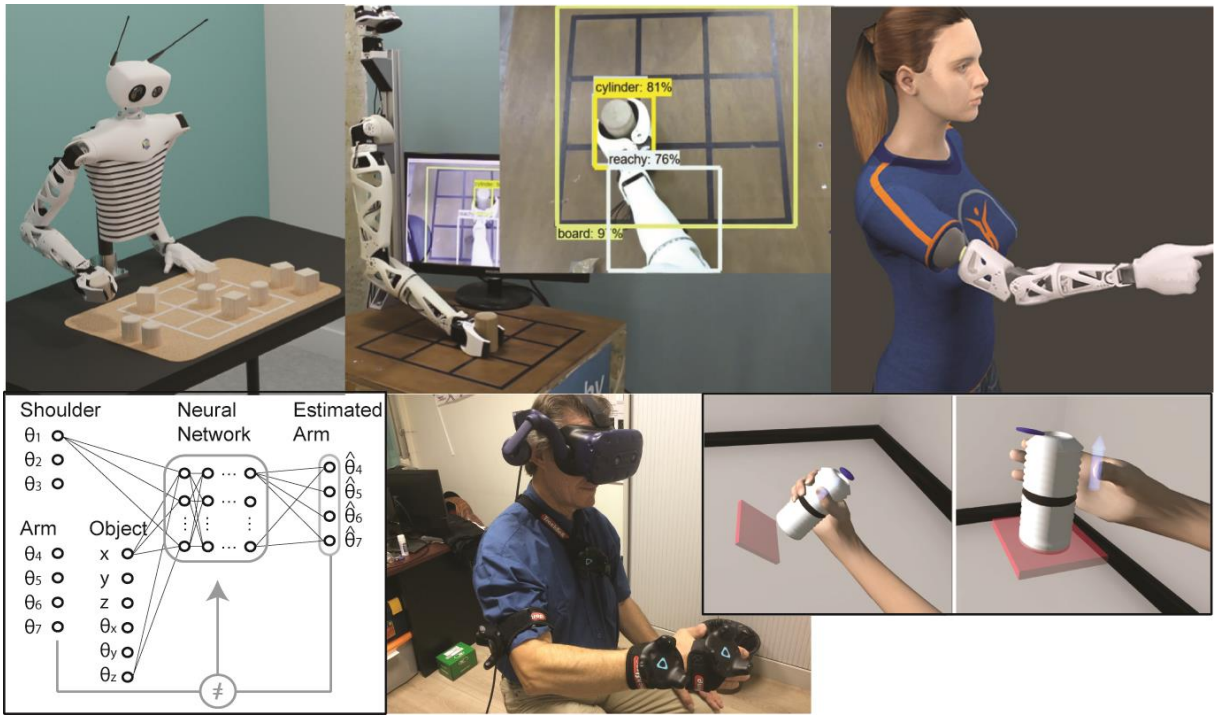
Supervision: Aymar de Rugy (INCIA team HYBRID)

Collaborations: Pierre-Yves Oudeyer (Flowers team, Inria and Ensta ParisTech)
Fréderic Alexandre (Mnemosyne team, Inria and IMN)
Matthieu Lapeyre (Pollen Robotics)

Duration: 1 year repeatable two times (funds available for 3 years total)

Salary: from 2596€ (2086€) to 2867€ (2304€) Gross (Net) per month depending on experience.

Deadline for application: applications should be sent ASAP for selection in Oct/Nov 2020 and start in January 2021.



This postdoc is funded by an ANR-DGA ASTRID project aiming at exploiting natural human arm coordination to improve human-in-the-loop robotic arm control for prosthesis application. Whereas most researches in prosthesis control focusses on myoelectric strategies based on residual muscle activities, a promising alternative aims at exploiting residual movements that are far more reliable and easier to interpret than muscle signals. Our preliminary results in virtual reality (Mick et al., submitted) proved the efficiency of this approach, which enables subjects to grasp bottles of various positions and orientations with performance comparable to that with their true arm, whereas multiple distal joints were controlled on the basis of shoulder movement and contextual knowledge about the movement goal (ie the object to grasp). This project builds upon this initial proof of concept to develop more complex and relevant tasks for amputees, and apply these to the control of an existing robotic arm platform (Reachy, Mick et al 2019, 2020). In addition to applying biomimetic control principles on the open source 3D printed robotic platform Reachy, the overall project involves development of coadaptation strategies between the user and the applied artificial control (Couraud et al., 2018), as well as links to contextual information extraction from gaze-assisted computer vision (Gonzalez-Diaz et al 2019, Pérez De San Roman et al., 2017).

Keywords: Robotic Arm Control, Human Movements, Artificial Neural Network, AI/Machine Learning, Motor Control, Biomechanics.

Required knowledge and background:

- Strong experience and achievements in (humanoid) robotics, and/or in the field of human-robot interaction
- Experience in AI / Machine learning and Artificial Neural Networks
- Good programing skills (Python, C#, Tensor Flow, Keras, ..)

Other requirements:

- Interest for sensorimotor control in humans (including neuroscience and biomechanical aspects)
- Good writing skills + record of scientific publications
- Motivation to work in interdisciplinary project

Contact and application: Send CV and letter of motivation to aymar.derugy@u-bordeaux.fr

Web: INCIA team HYBRID: http://www.incia.u-bordeaux1.fr/spip.php?article340
Inria flowers: https://flowers.inria.fr/
Inria Mnemosyne: https://team.inria.fr/mnemosyne/
Pollen Robotics: https://www.pollen-robotics.com/

References :

1. Mick S, Segas E, Dure L, Halgand C, Benois-Pineau J, Loeb GE, Cattaert D, de Rugy A (Submitted) Shoulder kinematics plus contextual target information enable control of multiple distal joints of a simulated prosthetic arm and hand. *Journal of NeuroEngineering and Rehabilitation*.
2. Mick S, Badets A, Oudeyer P-Y, Cattaert D, de Rugy A (2020) Biological plausibility of arm postures influences the controllability of robotic arm teleoperation. *Human Factors*
3. Mick S, Lapeyre M, Rouanet P, Halgand C, Benois-Pineau J, Paclet F, Cattaert D, Oudeyer P-Y, de Rugy A (2019) Reachy, a 3D-printed human-like robotic arm as a test bed for prosthesis control strategies. *Frontiers in NeuroRobotics* 13: 65.
4. Gonzalez-Diaz I, Benois-Pineau J, Domenger J-P, Cattaert D, de Rugy A (2019) Perceptually-guided deep neural networks for ego-action prediction: Object grasping. *Pattern Recognition*. 88: 223-235.
5. Couraud M, Cattaert D, Paclet F, Oudeyer PY, de Rugy A (2018) Model and experiments to optimize co-adaptation in a simplified myoelectric control system. *Journal of Neural Engineering* 15(2):026006, doi: 10.1088/1741-2552/aa87cf.
6. Mick S, Cattaert D, Paclet F, Oudeyer P-Y, de Rugy A (2017) Performance and Usability of various Robotic Arm Control Modes from Human Force Signals. *Frontiers in NeuroRobotics*. 11: 55.
7. Pérez De San Roman P, Benois-Pineau J, Domenger J-P, Cattaert D, Paclet F, de Rugy A (2017) Saliency Driven Object Recognition in Egocentric Videos with Deep CNN: toward application in assistance to Neuroprostheses. *Computer Vision and Image Understanding.* 164, 82-91.