

## PhD position: Human-robot collaboration and coadaptation in shared tasks

The CRISSP Team (Cognitive Robotics, Interactive Systems & Speech Processing) of the GIPSA-Lab at UGA (University Grenoble Alpes) is looking for a PhD student to reinforce research on *cognitive robotics and machine learning*. This work will be conducted in close partnership with the MARVIN team of the LIG-Lab from the same university.

The position is granted by MIAI@UGA, one of the four AI institutes<sup>1</sup> selected in France.

### Context: cobotics

An important challenge of collaborative robotics is to preserve the health and comfort of industrial operators while improving their productivity. Indeed, their expertise and know-how are essential to the competitiveness of high value-added production. The human being is an essential vector of flexibility for the versatility objectives of production, assembly but also plant maintenance. Collaborative robotics is a well-identified solution that allows, through appropriate assistance, to focus the operators on the tasks of which they have the expertise, while delegating loads and constraints to an intelligent tool. For the moment, this solution is not very widespread in companies, where it is enough to "take the industrial robot out of its protective cage" to make it work close to human operators.

One of the key points to promote collaborative work and human-robot interaction, and which motivates this subject, is to respect the way humans manage their behaviors, their ability to improve them while saving their health. In fact, professionals have their own interaction style and habits and change their behaviors during the course of a working day because of numerous factors: training, mental or physical fatigue, etc. The challenge is then to choose, synchronize and coordinate the tasks distributed between the humans and the robot in order to preserve the operator's health and expertise, while guaranteeing their safety and performance. The objective here is that humans keep a great freedom of movement (preserving the motor strategies of the human) and decision making (considering short- and long-term changes of behavior) to achieve a common shared task.

### Objectives: coadaptation & human-aware planning

In this context, the doctoral student recruited will have to:

- (1) Identify the determinants of individual variability and cognitive overload in a collaborative work of one or two human coworkers with a humanoid robot;
- (2) Propose methods to detect and analyze the dimensions at the origin of these situations;
- (1) Integrate these dimensions in the planning and control algorithms [1] of the robot in order to allow the system to anticipate human behaviors and generate proactive behaviors — namely verbal, co-verbal as well as performative gestures — so as to improve safety and performance of the symbiotic group at work.

The PhD student will demonstrate the feasibility of this approach on an industrial case study of part assembly. The robot will be able to perform both physical and verbal actions in order to complete the task with the human partners. The developments and experiments will be performed<sup>2</sup> using Ninafor verbal supervision [2] and Yumi for joint manipulations [3].



<sup>1</sup> <https://www.gouvernement.fr/en/ai-research-institutes-established-in-grenoble-nice-paris-and-toulouse>

<sup>2</sup> see [www.gipsa-lab.fr/projet/NINA](http://www.gipsa-lab.fr/projet/NINA) and <https://new.abb.com/products/robotics/fr/robots-industriels/yumi>

You will be supervised by Prof Gérard Bailly ([www.gipsa-lab/~gerard.bailly](http://www.gipsa-lab/~gerard.bailly)) together with Dr. Damien Pellier ([lig-membres.imag.fr/PPerso/membres/pellier](http://lig-membres.imag.fr/PPerso/membres/pellier)) and Dr. Frédéric Elisei ([www.gipsa-lab.fr/~frederic.elisei](http://www.gipsa-lab.fr/~frederic.elisei)). You will be part of an interdisciplinary research team, focusing on "Collaborative Intelligent Systems" (<https://miai.univ-grenoble-alpes.fr/recherche/chaieres>) as part of the MIAI@UGA AI institute.

Global Shanghai Ranking for Academic Subjects 2018 places UGA ([www.univ-grenoble-alpes.fr/english/](http://www.univ-grenoble-alpes.fr/english/)) as the no. 1 French university in 11 subjects, and internationally ranks 31st in Computer Sciences & Engineering. With 46,000 students and 5,800 staff, the university hosts 80 laboratories in a landscaped campus of 175 hectares surrounded by mountains. You will join the CRISSP team which is part of GIPSA-Lab, a research lab of more than 350 persons developing today the tech of tomorrow.

### **Profile of the candidate**

You must have an MSc degree in computer science, electrical engineering, cognitive engineering or areas relevant to the research topic. Good programming skills are required (C++, Python, or other), as well as training in machine learning (in particular PyTorch). English (spoken as well as written) is mandatory. Being fluent in French language is a plus. The PhD position is highly interdisciplinary and requires an understanding and/or interest in psychology and social sciences.

### **Further details:**

- The position is now open but preferably will start on 1st October 2020. It is fully funded by MIAI@UGA for 3 years. Be aware that recruitment of non EU-students may delay this taking up
- The net salary will be approximately 1700€ per month. The salary may be raised to 1950€ with a complementary teaching service. You will also receive a holiday allowance and will enjoy full social security cover. Additional financial support is available for attending conferences and workshops.
- You will be affiliated with the GIPSA-Lab. While the research will be based in Grenoble, occasional travel to international schools, conferences or workshops will be required.
- You will be enrolled in the doctoral training programme offered by the Doctoral School of Engineering.
- University encourages equal opportunities and will consider applications only based on your potential as an early career researcher.

### **How to apply**

For informal queries, do not hesitate to contact Gérard Bailly ([gerard.bailly@gipsa-lab.fr](mailto:gerard.bailly@gipsa-lab.fr)). Your application should include:

- a letter motivating your application
- a CV, copies of relevant exams, grades, master thesis work or publications
- the names and contact details of at least 2 referees. Recommendation letters should be included with your application

Applicants should send their application to [gerard.bailly@gipsa-lab.fr](mailto:gerard.bailly@gipsa-lab.fr) (cc. [damien.pellier@imag.fr](mailto:damien.pellier@imag.fr) and [frederic.elisei@gipsa-lab.fr](mailto:frederic.elisei@gipsa-lab.fr)). The application is open until the position is fulfilled. Selected candidates will be invited for interview, which can be organised over Skype if necessary.

### **References**

[1] Ghallab M., D. Nau and P. Traverso, "Automated Planning", Morgan-Kaufman, 2017.

[2] Bailly, G. & F. Elisei (2018) Demonstrating and learning multimodal socio-communicative behaviors for HRI: building interactive models from immersive teleoperation data, AI-MHRI: AI for Multimodal Human Robot Interaction Workshop at the Federated AI Meeting (FAIM), Stockholm - Sweden: pp. 39-43.

[3] Liang, Y. S., Pellier, D., Fiorino, H., & Pesty, S. (2019). End-User Programming of Low-and High-Level Actions for Robotic Task Planning. IEEE International Conference on Robot and Human Interactive Communication (RO-MAN) (pp. 1-8).