Univ. Grenoble Alpes
Université de l'innovation

FICHE NAVETTE: DOCTORANTS IDEX

SECTOR **:** Higher Education Institution

LOCATION: France, Grenoble

RESEARCH FIELD: Computer science, Robotics, perception, automation, control

RESEARCHER PROFILE:
□ *First stage researcher,*

INSTITUTION: **Univ. Grenoble Alpes, University of Innovation**

One of the major research-intensive French universities, Univ. Grenoble Alpes**1 enjoys an international reputation in many scientific fields, as confirmed by international rankings. It benefits from the implementation of major European instruments (ESRF, ILL, EMBL, IRAM, EMFL*2). The vibring ecosystem, grounded on a close interaction between research, education and companies, has earned Grenoble to be ranked as the 5th most innovative city in the world. Surrounded by mountains, the campus benefits from a natural environment and a high quality of life and work environment. With 7000 foreign students and the annual visit of more than 8000 researchers from all over the world, Univ. Grenoble Alps is an internationally engaged university.

A personalized Welcome Center for international students, PhDs and researchers facilitates your arrival and installation.

In 2016, Univ. Grenoble Alpes was labeled «Initiative of Excellence ". This label aims at the emergence of around ten French world class research universities. By joining Univ. Grenoble Alpes, you have the opportunity to conduct world-class research, and to contribute to the social and economic challenges of the 21st century ("sustainable planet and society", "health, well-being and technology", "understanding and supporting innovation: culture, technology, organizations" "Digital technology").

* ESRF (European Synchrotron Radiation Facility), ILL (Institut Laue-Langevin), IRAM (International Institute for Radio Astronomy), EMBL (European Molecular Biology Laboratory), EMFL (European Magnetic Field Laboratory)

Key figures:

- + 50,000 students including 7,000 international students
- 3,700 PhD students, 45% international
- 5,500 faculty members
- 180 different nationalities
- 1st city in France where it feels good to study and 5th city where it feels good to work
- ISSO: International Students & Scholars Office affiliated to EURAXESS

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[1] Univ. Grenoble Alpes

MANDATORY REFERENCES:

CDP TITLE: **Circular Industrial Systems**
SUBJECT TITLE: *Cobotic in industrial environment for agile de- and re- manufacturing*
SCIENTIFIC DEPARTMENT (LABORATORY'S NAME): LIG (Laboratoire d'Informatique de Grenoble), INRIA (Institut National de la Recherche en Informatique et Automatique)
DOCTORAL SCHOOL'S: MSTII
SUPPORTER'S NAME: *Olivier Aycard (LIG), Pierre-Brice Wieber (INRIA)*

SUBJECT DESCRIPTION:

Context

Automation traditionally targets production systems are designed for large quantities of similar products. Future de- and re- manufacturing structures demand however completely different organizations and workflows, with small quantities of highly variable and customized products and precise diagnosis requirements. In this case, human-machine cooperation must be made more agile, in shared workplaces, on the contrary to traditional automation where humans and robots work in strictly separated spaces for safety reasons. In this common workspace, safety of the operators is ensured by monitoring the common workspace with a 3D sensor positioned on infrastructure and by a continuous adaptation of the robot tasks and trajectories according to the current position and motion of the operator in order to guarantee his/her safety at all time.

Subject

The PhD thesis will focus on safety of the operators when they cooperate with industrial robots in a common workspace. It will explore the different aspects related to safety of the operators and cooperation with industrial robots:

i) Regarding perception: the common workspace will be monitored with a 3D sensor in order to know the operator's and the robot's position. From this perception, we wish to build a perception model (ie, virtual safety zones, skeleton…) of the operator and the robot. This problem of perception remains open because there is no solution allowing to perceive in real time an environment with a 3D sensor. The scientific challenges associated with this perceptual problem arise from the fact that sensor data are generally noisy and imprecise. Moreover, it is impossible to perceive the whole operator at any moment, because certain parts of the body are hidden. It is also difficult to know the different parts of the body and determine their dynamics in order to predict a potential collision. Finally, there are currently no solutions computing in real time, the collisions in the space between two entities (ie, an operator and a robot) composed of many articulations;

ii) Regarding control: the robot must be able to integrate these constraints into the realization of its task. This assumes that at each moment the robot must decide if it can always carry out its task and, in this case, adapt its behavior to the constraints. Moreover, different working modes should be defined for the robot according to the operator's position in the common workspace. For instance, in the worst case, the robot must detect that it can no longer carry out its task while ensuring the safety of the operator and in this case stop its work. Finally, it must be done taking into account that the constraints change in real time and that the perception of the environment is not perfect;

iii) Finally, perception and control will be integrated on a demonstrator to show that the combination of these two streams of research will allow us to provide the necessary level of safe workspace sharing required for de- and re- manufacturing.

Methods/Deliverables:

1. **Design of an experimental setup:** During the first year, the PhD candidate will investigate the perception devices (3d laser, 3D camera…) and the industrial robot that can be used to perceive the collaborative environment and to perform collaboration between an operator and a robot while ensuring safety of the operator. He will as well study state of the art on perception techniques and control of industrial robots;

2. **First experiment focused on perception of the environment:** the PhD candidate will develop an API to perceive the collaborative environment and to determine the respective positions of the operator and of the industrial robot. In a second step, he will characterize different levels of safety for the operator according to these respective positions;

3. **Second experiment with perception and control:** the PhD candidate will extend the API to control the industrial robot according to the level of safety going from "complete stop" if the operator is very close to the industrial robot to "normal behavior" if the operator is far enough of the operator. The key point will be to determine the intermediate situations between these two extremities and to define the associated control of the industrial for each situation.

ELIGIBILITY CRITERIA
Applicants:
- must hold a Master's degree in computer science (or be about to earn one) or have a university degree equivalent to a European Master's (5-year duration),

Applicants will have to send an application letter in English and attach:
- Their last diploma
- Their CV
- A short presentation of their scientific project (2 to 3 pages max)
- Letters of recommendation are welcome.

Address to send their application: aycard@imag.fr (+ other email address)

SELECTION PROCESS
Application deadline: 30June 2018 at 17:00 (CET)
Applications will be evaluated through a three-step process:

1. Eligibility check of applications in July 2018
2. 1st round of selection: the applications will be evaluated by a Review Board in July 2018. Results will be given in august 2018.
3. 2nd round of selection: shortlisted candidates will be invited for an interview session (if necessary) in Grenoble September 2018.

TYPE of CONTRACT: temporary-3 years of doctoral contract
JOB STATUS: Full time
HOURS PER WEEK: 35
OFFER STARTING DATE: 1st October 2018
APPLICATION DEADLINE: 30 June 2018
Salary: between 1768.55 € and 2100 € brut per month (depending on complementary activity or not)

Financements de la thèse : si co-financements, préciser la durée de chacun des financements et l'organisme ou l'institution partenaire