



Offer #2024-07495

PhD Position F/M Eco-design of parallel deformable manipulators using plant-based materials

Contract type : Fixed-term contract

Level of qualifications required : Graduate degree or equivalent

Fonction : PhD Position

About the research centre or Inria department

The Inria University of Lille centre, created in 2008, employs 360 people including 305 scientists in 15 research teams. Recognised for its strong involvement in the socio-economic development of the Hauts-De-France region, the Inria University of Lille centre pursues a close relationship with large companies and SMEs. By promoting synergies between researchers and industrialists, Inria participates in the transfer of skills and expertise in digital technologies and provides access to the best European and international research for the benefit of innovation and companies, particularly in the region. For more than 10 years, the Inria University of Lille centre has been located at the heart of Lille's university and scientific ecosystem, as well as at the heart of Frenchtech, with a technology showroom based on Avenue de Bretagne in Lille, on the EuraTechnologies site of economic excellence dedicated to information and communication technologies (ICT).

Context

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This thesis is part of the French ANR project PEPR O2R (Flagship project named Organic Robotic, 37.5 Million Euros), more particularly the work-package "Softness and Sustainability" of the Structuring Action 1 (AS1) which questions the environmental impact of robotics and tries to find innovative solutions to lower it.

Objectives

With the current environmental crisis, there is a necessity to reduce the ecological impact of mechatronic systems, such as robotic manipulators. Indeed, these manipulators consist mostly of articulated arms composed of metallic rigid segments. The fabrication of these segments requires the extraction of metallic ore from the earth, energy to refine it in exploitable alloys, the emission of greenhouse gasses during their transport, and additional resources to shape the robot link. Fabricating the entirety of part of the links with wood reduces significantly the environmental footprint, as demonstrated in [1], [2]. However, this reduction is limited by the need to use enough wood material and energy to shape it and obtain the desired link rigidity, plant materials being intrinsically flexible. Moreover, the mechanical joints at the articulations still need to use metallic materials. In the Structuring Action 1 of the PEPR O2R project, instead of compensating for the plant material compliance, we propose to exploit it in the design of manipulators with soft and continuum robotics methodologies. The use of materials the least transformed possible, coupled with the absence of joints, will certainly lead to a strong decrease of the environmental footprint. In addition, we propose to investigate the use of parallel continuum structures, composed of several flexible legs controlling an end-effector platform, to reach a level of performance in terms of accuracy and payload for example compatible with applications like co-manipulating a load with an operator

In addition to contributing to answering a big challenge of our society today, and pursuing groundbreaking research in soft robot design by participating in a French Flagship project (PEPR O2R), the PhD candidate will have the opportunity to work with two research teams leaders in robot eco-design and soft robotics, the Armen Team, LS2N in Nantes and the Defrost Team, Inria, in Lille. They will also interact closely with an anthropologist working on evaluating the environmental footprint of robotic manipulators. The PhD student will mainly be based in Lille with several stays in Nantes, with a brut salary of 120k for the 3 years. They will work under the direct supervision of Dr. Sebastien Briot (CNRS, LS2N) and Quentin Peyron (Inria).

Assignment

The goal of this PhD is to conduct research on the following questions:

- What raw (or transformed) plant-based materials can be suited for deformable manipulators?

- How to model their sometimes complex mechanical behavior, with its dependency on external factors such as individual variability, humidity, temperature, and aging?
- How to design a parallel deformable manipulator with robust behavior with respect to these variations of properties?
- How to design and fabricate structures with rawplant-based materials ?

Main activities

Main activities (5 maximum) :

- Reading state-of-the-art papers and writing bibliography reviews
- Designing prototypes and conducting experiments
- Deriving theoretical models based on theory and experiments
- Writing scientific papers and reports
- Presenting the progress and results to the research teams and the scientific community

Additional activities (3 maximum) :

- Participating in the research team and laboratories life
- Attending to and participating in scientific vulgarization events
- Working with undergrad and master interns

Skills

Technical skills:

- Fundamentals in Robotics
- Fundamentals in continuum mechanics and/or material science
- Training in mechanical design and engineering
- Experiences in prototyping and fabrication

Languages :

- A good level of English, written and spoken, is required

Relational skills :

- Ability to work in a team and will to participate in the research teams' life

Benefits package

- Subsidized meals
- Partial reimbursement of public transport costs
- Leave: 7 weeks of annual leave + 10 extra days off due to RTT (statutory reduction in working hours) + possibility of exceptional leave (sick children, moving home, etc.)
- Possibility of teleworking and flexible organization of working hours
- Professional equipment available (videoconferencing, loan of computer equipment, etc.)
- Social, cultural and sports events and activities
- Access to vocational training
- Social security coverage

General Information

- **Theme/Domain** : Robotics and Smart environments
Instrumentation et expérimentation (BAP C)
- **Town/city** : Villeneuve d'Ascq
- **Inria Center** : [Centre Inria de l'Université de Lille](#)
- **Starting date** : 2024-10-01
- **Duration of contract** : 3 years
- **Deadline to apply** : 2024-06-08

Contacts

- **Inria Team** : [DEFROST](#)
- **PhD Supervisor** :
Peyron Quentin / quentin.peyron@inria.fr

About Inria

Inria is the French national research institute dedicated to digital science and technology. It employs 2,600 people. Its 200 agile project teams, generally run jointly with academic partners, include more than 3,500 scientists and engineers working to meet the challenges of digital technology, often at the interface with other disciplines. The Institute also employs numerous talents in over forty different professions. 900 research support staff contribute to the preparation and development of scientific and

entrepreneurial projects that have a worldwide impact.

The keys to success

- A natural curiosity and appetite for robotics, plant materials, and more generally science
- The will and ability to conduct multi-disciplinary work, in particular at the junction of eco-design, robotics and material science
- A sensibility to and interest in the current ecological problems
- The will to learn the job of a researcher
- A critical but positive mindset

Warning : you must enter your e-mail address in order to save your application to Inria. Applications must be submitted online on the Inria website. Processing of applications sent from other channels is not guaranteed.

Instruction to apply

Please apply with your CV and cover letter.

Defence Security :

This position is likely to be situated in a restricted area (ZRR), as defined in Decree No. 2011-1425 relating to the protection of national scientific and technical potential (PPST). Authorisation to enter an area is granted by the director of the unit, following a favourable Ministerial decision, as defined in the decree of 3 July 2012 relating to the PPST. An unfavourable Ministerial decision in respect of a position situated in a ZRR would result in the cancellation of the appointment.

Recruitment Policy :

As part of its diversity policy, all Inria positions are accessible to people with disabilities.