Offer #2025-08980

Post-Doctoral Research Visit F/M Sensors-based Control of an Aerial Manipulator for Complex Manipulation of Articulated Objects

Contract type : Fixed-term contract

Renewable contract : Yes

Level of qualifications required : PhD or equivalent

Fonction : Post-Doctoral Research Visit

Level of experience : From 3 to 5 years

About the research centre or Inria department

The Inria Centre at Rennes University is one of Inria's eight centres and has more than thirty research teams. The Inria Centre is a major and recognized player in the field of digital sciences. It is at the heart of a rich R&D and innovation ecosystem: highly innovative PMEs, large industrial groups, competitiveness clusters, research and higher education players, laboratories of excellence, technological research institute, etc.

Context

- The work will be carried in English at the Inria Centre at Rennes University.
- The position is full-time for 1 year. The position will be paid according to the French salary regulations for Post doctoral researchers.
- We do high quality and impactful research in robotics, publishing on the major journals and conferences.
- We often collaborate with other top researchers in europe and worldwide.
- You will have access to a well established laboratory including:
    - two flying arenas equipped with motion tracking system, several quadrotors, and a few fully-actuated manipulators,
    - one robotic manipulation lab equipped with several robotic arms, like the Franka Emika Panda.
- You will be part of an international and friendly team. We organize several events, from after works, to multi-day lab retreat.
- Regular visits and talks by internationally known researchers from top research labs.

Assignment

Short abstract:
Researchers are trying to make aerial robots perform physical work for new applications like construction, inspection, maintenance, etc. Current methodologies show promising results, but they are limited to very simple tasks only performed in lab environments. In this Thesis we want to go beyond this limited scenario. By the investigation of new sensors-based control methods, we want to make aerial manipulators able to perform much complex tasks using onboard sensors only, especially considering manipulation of articulated objects.

Description:
current investigations and applications are still limited to very simple interaction tasks, involving limited contact behaviors with static and rigid surfaces, and more-over often performed in known/controlled and structured environments (i.e., in ideal lab conditions). Most achieved tasks belong to the family known as push & slide paradigm, which consists in simply touching a wall at different locations with a single point contact end- effector while controlling the interaction force [1, 2]. Moreover, most works performed such a task in indoor controlled environments where the robot position is measured with accurate motion capture systems (MOCAPs) and the environment is perfectly known [3].

This project aims at pioneering this still mostly unexplored domain, pushing further the boundaries of Aerial Physical Interaction (APhI). In contrast to the current state of the art, our goal is to enhance aerial robotic physical interaction capabilities of highly dynamical aerial manipulators (AMs) by considering almost unexplored directions:

- manipulations tasks of articulated and dynamic objects;
- real scenarios requiring the use of onboard sensors only.

The project will focus on the design of sensor-based control algorithms to make aerial robots much more precise, robust and safe while performing physical interaction tasks involving articulated objects, in real environments. As a final demonstrator we want to show an aerial robot equipped with an articulated arm capable to open a door with onboard sensors only.

Main activities

The project will address the following points:

- **Reactive manipulation planner**: Develop a reactive manipulation planner which makes the robot able to perform complex manipulation tasks while quickly reacting to external disturbances and unexpected events (like wind or loss of contact). For this we will rely on fast re-planning concepts similar to MPC methods and Model Predictive Path-Integral Control (MPPI) [4].
- **Sensors-based manipulation planner**: Integrate a sensing framework such that the system will rely on onboard sensors only. We also want to formally consider the constraints imposed by the sensing framework in the motion planning problem.
- **Robust manipulation planner**: Improve the manipulation planner planner such that it generates motions that are intrinsically robust to model

uncertainties. For this we will rely on the concept of sensitivity, as well as on deep reinforcement learning methods..
- **Experimental validation**: All previous tasks will be validated with real experiments. As a final demonstrator we want to show an aerial robot equipped with an articulated arm capable to manipulate articulated objects, e.g., open a door, using onboard sensors only.

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 (after 6 months of employment) 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

Remuneration

Monthly gross salary from 2 788 euros.

General Information

- **Theme/Domain :** Robotics and Smart environments
  Instrumentation et expérimentation (BAP C)
- **Town/city :** Rennes
- **Inria Center :** Centre Inria de l'Université de Rennes
- **Starting date :** 2025-09-01
- **Duration of contract :** 12 months
- **Deadline to apply :** 2025-08-04

Contacts

- **Inria Team :** RAINBOW
- **Recruiter :**
  Tognon Marco / marco.tognon@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

- PhD degree in mechatronics, robotics, engineering, computer science (or related fields)
- Excellent publication records
- Excellent written and spoken English skills
- Good experience in C/C++ , ROS, Matlab/Simulink, CAD
- Good experience with numerical trajectory optimization tools for robotics (e.g., use of CaSaDi, Acado, Autodiff, Crocoddyl, etc.)
- Scientific curiosity, large autonomy and ability to work independently
- Experience with robotic systems and/or aerial robots is a plus

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 submit online : your resume, cover letter and letters of recommendation eventually

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.