# Eurohaptics 2024 Job dating

**Academic Role**

## Postdoc in “Haptic shared control for multi-robot systems at the microscale” @ CNRS (Rennes, France)

**Job Title:** Haptic shared control for multi-robot systems at the microscale

**Institution Name:** Centre national de la recherche scientifique (CNRS)

**Location:** Rennes, France

**Job Type:** Full-time

### About Us:

The work will be carried out at IRISA-CNRS in Rennes as part of the Rainbow team (https://team.inria.fr/rainbow/), which is internationally recognized for its scientific activity as well as for technology transfer experience in the field of shared control, multi-robots, haptics, sensor-based control, visual tracking, and visual servoing.

This subject is carried out within the collaborative European project REGO, which is coordinated by CNRS (our group at IRISA), in collaboration with Inria Rennes, CHU Rennes, Haption (France), the Italian Institute of Technology (Italy), Scuola Superiore Sant'Anna (Italy), University of Twente (Netherlands), and Leibniz Institute for Solid State and Materials Research (Germany). REGO’s objectives are to advance the state of the art in multi-robot systems at the microscale.

### Job Description and key responsibilities:

Untethered miniature robots have recently shown promising results in several scenarios at the microscale, such as targeted drug delivery, microassembly, and biopsy procedures. However, **the vast majority of these small-scale robots have very limited manipulation capabilities**, and none of the steering systems currently available enable humans to intuitively and effectively control dexterous miniaturized robots in a remote environment. Moreover, **most of the results reported so far concern the control of individual microrobots**. **It is only recently that the control of swarms of multifunctional microrobots has become possible.** Enabling a human user to independently and intuitively control a swarm of microrobots can indeed be beneficial in many scenarios. An example of the teleoperation of such systems is shown in Figure 1: two microrobots are controlled in 3D, providing the user with the front and side views of the environment as captured by the cameras.

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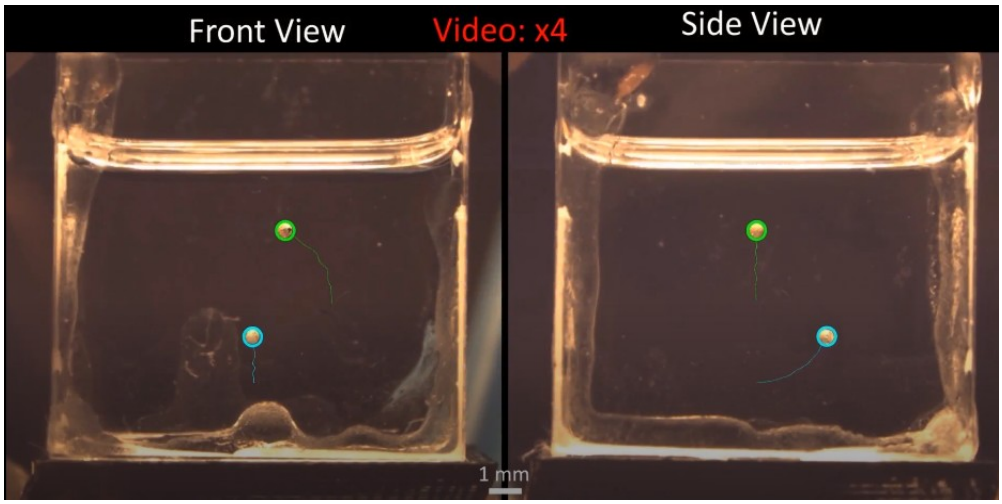


*Figure 1. Front and side views of the microscopic environment during the independent control of two micro-robots. [Ongaro et al. IEEE Trans. Robotics (2018)].*

Input information regarding, e.g., where the robot should move is usually provided by simply clicking on the screen to indicate the target reference positions. While this approach is widely employed, and it provides all the necessary information to drive the robots, it does not enable an intuitive control and visualization of the robots and their environment.

**The objective of this research work is to enable intuitive and trustworthy human control of untethered multi-robot systems at the small-scale via innovative cognitive-based interfaces and interaction techniques, exploiting multisensory feedback and AI-powered shared control.**

The work will address a few of the following points, depending on the expertise and interests of the researcher as well as the advancement of the project:

- *Cognitive shared-control*: develop shared-control methods to regulate the trade-off between following human operator's commands and autonomous control actions during the control of multi-robot systems at the micro-scale.
- *Reactive trajectory generation*: develop online trajectory generation and re-planning strategies for (semi) autonomous task execution by means of AI-based constrained optimization problems for multi-robot systems at the microscale.
- *Haptic rendering*: design haptic rendering techniques for communicating with the operators, combining kinesthetic feedback with tactile/cutaneous sensations.
- *Stability control and trustworthiness*: design stability techniques to guarantee the safety of the microrobotic system; depending on how much we know about the environment, time-domain (less knowledge) and model-based (more knowledge) passivity techniques can be interleaved or combine.
- *Applications:* evaluate such multi-robot systems in various navigation and manipulation scenarios, starting from grasping and assembly (see Fig. 2) to finally be used in endovascular medical interventions during, e.g., the coiling of aneurysms.

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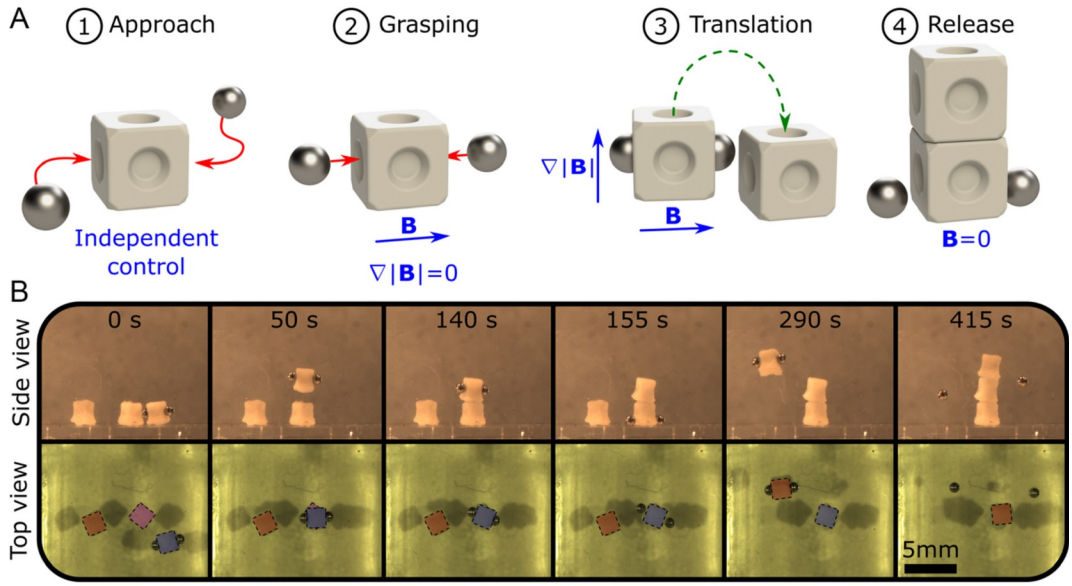


*Figure 2. Experimental collaborative grasping. The magnetic agents are 1 mm stainless steel spheres and the passive objects are 2 mm 3D printed cubes. A) The procedure consisted of four steps, approach, grasping, translation, and release. The solid red arrows represent the motion of the magnetic agents and the dashed green arrow represents the motion of the ensemble. B) Snapshots of the grasping and stacking of three cubes experiment. [Basualdo and Misra, Advanced Intelligent Systems (2023)].*

## Requirements:

- PhD degree in computer science, robotics, engineering, applied mathematics (or related fields);
- Excellent scientific track of record, scientific curiosity, large autonomy, and ability to work independently.
- Excellent communication and teamwork skills.

## How to Apply:

Interested candidates are invited to submit a resume to via the following form: https://forms.gle/5gNEpgePNdYPsh5x5

## Presence at Eurohaptics 2024 in Lille, France:

We will be participating in the job event at Eurohaptics 2024 in Lille, France. Please approach Claudio Pacchierotti for an in-depth discussion about this job opportunity.