Offer #2025-08805

Post-Doctoral Research Visit F/M Postdoctoral Research Position - Shared control in haptic teleoperation, toward dynamic authority distribution

Contract type : Fixed-term contract

Level of qualifications required : PhD or equivalent

Fonction : Post-Doctoral Research Visit

About the research centre or Inria department

The Inria center at the University of Bordeaux is one of the nine Inria centers in France and has about twenty 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 SMEs, large industrial groups, competitiveness clusters, research and higher education players, laboratories of excellence, technological research institute...

Context

About the centres

The **Inria center of the University of Bordeaux** is a public scientific institute located in Talence (France). It gathers together about twenty research teams in digital sciences, computer sciences, mathematics, robotics, and machine learning, with different academic and industrial partners.

KAIST, also known as the Korea Advanced Institute of Science and Technology, is a public research university located in Daejeon, South Korea. It is considered one of the top universities in Korea and is renowned for its excellence in science,

engineering, and technology. The research areas at KAIST cover a wide range of fields, including physics, chemistry, materials science, engineering, computer science, and biology. The university has a particular strength in artificial intelligence and robotics, with world-class research teams in these areas.

Context

Every year Inria International Relations Department has a few postdoctoral positions **in order to support Inria international collaborations**.

The postdoctoral contract will have a duration of **12 to 24 months**. The default start date is **November 1st, 2025 and not later than January, 1st 2026**. The postdoctoral fellow will be recruited by the Inria center of the University of Bordeaux (Auctus team) in France, but the project time will be **shared between France and South Korea**, with exchange periods at KAIST (IRiS lab) to share the works and progresses (please note that the postdoctoral fellow has to start his/her contract being in France and that the visits have to respect Inria rules for missions).

The proposed postdoctoral project is part of the Inria-KAIST partnership, and specifically of the **SHAARE associate team**, initiated between the **Auctus** team at Inria and the **IRiS** lab at KAIST. The associate team focuses on **haptics and shared teleoperation**. Together, we aim at developing **shared-control approaches** that, either, better guide the human through adaptive haptic guidance, or adjust the robot behavior according to the human gestures.

Assignment

Candidates for postdoctoral positions are recruited **after the end of their Ph.D. or after a first post-doctoral period**: for the candidates who obtained their PhD in the **Northern hemisphere, the date of the Ph.D. defense shall be later than September 1, 2022; in the Southern hemisphere, later than April 1, 2022**.

In order to encourage mobility, the postdoctoral position must take place in a scientific environment that is truly different from the one of the Ph.D. (and, if applicable, from the position held since the Ph.D.); particular attention is thus paid to French or international candidates who obtained their doctorate abroad.

Main activities

Humans can perform remote tasks in haptic teleoperation of a robot, which is particularly beneficial in confined, unsafe, or sensitive environments such as hazardous sites, underwater or space. This interaction modality naturally combines human high-level intelligence and robot physical capabilities while maintaining the safety and comfort required for the Human. Unfortunately, conventional teleoperation methods do not leverage the robot assistance and collaborative ability to its fullest, since the operator fully controls the remote task, with a high mental workload and poor performances.

Recent shared-autonomy controllers have been proposed in the literature to transfer part of the task from the human to an automatic execution by the robot. These approaches range from complementary and predefined sub-task allocations to **adaptive shared-control methods** [1]. Focusing on this second paradigm, an important challenge lies in how the control input of the robot is shared between human control and some assistance. The human motion is usually analyzed to infer the operator goal (such as the target object in a pick-and-place task) and consequently plan the robot assistance. While the assistance tries to predict the intent and adapt

to the human actions, the human and assistance behaviors may differ due to their own physical capabilities, different task strategies, or incomplete models of the environment. Therefore, we want the resulting robot behavior to minimize the conflicts between the human and the assistance.

In the shared control community, this problem is described as an **arbitration problem**, which consists in correctly adjusting the level of control authority between the human and the assistance. The authority level defines the influence of each agent on the shared action. In conventional approaches, it is computed as a function of some task-oriented criteria (e.g. proximity to target [2]) or human-based metrics (expertise [3], human activity [4]). This postdoctoral project aims at developing **methods that dynamically adapt the authority level during the activity**, as the human may need to take over the assistance, for example when there is an unexpected obstacle or a change of target. The developed approach should also be extended to a global problem that captures task, human, and environment factors to online shift the authority level.

To solve this dynamic arbitration problem, **approaches based on control theory, optimization and machine learning** [5] [6] will be explored and evaluated on robotic manipulation scenarios (pick-and-place, assembly…), both in simulation and on a real teleoperation system. The developed approaches should be able to generalize to a variety of scenarios and human-assistance interactions, while accounting for the variability of human behaviors. A key challenge consists in identifying relevant task or interaction-based criteria (such as distance to target or differences between the human and assistance trajectories) and exploiting this information to continuously infer the adapted authority level. By assessing the performances of each of the proposed methods, this study should show whether it can find the complex relationship between human-assistance interaction and the authority level, how well it can be transferred to different tasks or environment configurations, and if it is compatible with different teleoperation control modalities.

The authority-distribution approaches will be tested with the predictive shared controller [7] developed in the Auctus team. This controller computes the robot command by solving a Model Predictive Control problem on a time horizon, given both the human and robot assistive trajectories and under safety, task, human, and environment constraints.

[1] S. Music, S. Hirche. Control sharing in human-robot team interaction. *Annual Reviews in Control*, 2017, vol. 44, p. 342-354.

[2] V. K. Narayanan, A. Spalanzani, and M. Babel, A semi-autonomous framework for human-aware and user intention driven wheelchair mobility assistance, *in 2016 IEEE/RSJ International Conference on Intelligent Robots and Systems, IROS*, 2016, pp. 4700–4707, IEEE, 2016

[3] C. E. Mower, J. Moura, and S. Vijayakumar, Skill-based shared control, *in Robotics: Science and Systems XVII, Virtual Event*, D. A. Shell, M. Toussaint, and M. A. Hsieh, eds., 2021

[4] USMANI, Naveed Ahmed, KIM, Tae-Hwan, et RYU, Jee-Hwan. Dynamic authority distribution for cooperative teleoperation, in *2015 IEEE/RSJ International Conference on Intelligent Robots and Systems, IROS*, p. 5222-5227, IEEE, 2015.

[5] Dragan, A.D. and Srinivasa, S.S. (2013) 'A policy-blending formalism for shared control', *The International Journal of Robotics Research*, 32(7), pp. 790–805.

[6] Chatzilygeroudis, K. *et al.* (2020) 'A Survey on Policy Search Algorithms for Learning Robot Controllers in a Handful of Trials', *IEEE Transactions on Robotics*, 36(2), pp. 328–347.

[5] E. Jabbour, M. Vulliez, C. Préault, V. Padois. A Model Predictive Control Approach To Blending In Shared Control, preprint, 2024.

Skills

The candidate should have graduated with a PhD in robotics.

He/she should have solid skills in robotic control, programming (C++, Python), and kinematic/dynamic modeling.

Any additional experience in haptics, telerobotics, planning, or machine learning would be appreciated. We would value past balanced researches that had combined fundamental works to experimental studies.

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 partial teleworking and flexible organization of working hours
- Professional equipment available (videoconferencing, loan of computer equipment, etc.)
- Social, cultural and sports events and activities

Remuneration

Gross monthly remuneration (before salary charges and taxes): 2927 euros

General Information

- **Theme/Domain :** Robotics and Smart environments
- **Town/city :** Talence
- **Inria Center :** Centre Inria de l'université de Bordeaux
- **Starting date :** 2025-11-01
- **Duration of contract :** 12 months
- **Deadline to apply :** 2025-06-01

Contacts

- **Inria Team :** AUCTUS
- **Recruiter :**
  Vulliez Margot / margot.vulliez@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.

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

Applications for this Inria-DRI postdoctoral position are submitted online and must include:
- A detailed CV with a description of the PhD and a complete list of publications with the two most significant ones highlighted.
- A motivation letter with a description of the candidate interests and planned methodology to tackle the research project.
- Two letters of recommendations.
- A passport copy.

Contacts:
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Deadline for application : June 1, 2025.

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.