

Offre n°2024-07629

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

*Le descriptif de l'offre ci-dessous est en Anglais*

Type de contrat : CDD

Niveau de diplôme exigé : Thèse ou équivalent

Fonction : Post-Doctorant

### A propos du centre ou de la direction fonctionnelle

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...

### Contexte et atouts du poste

Every year Inria International Relations Department has a few postdoctoral positions in order to support Inria international collaborations. A postdoctoral position is opened within the Inria-KAIST partnership. It is part of the [SHAARE associate team](#), initiated between the [Auctus](#) team at Inria and the [IRiS](#) lab at KAIST that 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.

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.

### Mission confiée

The postdoctoral contract will have a duration of 24 months. The start date will be between November 1<sup>st</sup>, 2024, and not later than January 1<sup>st</sup>, 2025, depending on the candidate availability. The postdoctoral fellow will be recruited by the Inria center of the University of Bordeaux (Auctus team) in France, where he/she will start the research contract. The project duration will be half-time divided between France and South Korea, with exchange periods at KAIST (IRiS lab) to share the works and progresses (please note that the visits have to respect Inria rules for missions).

Candidates for postdoctoral positions are recruited after the end of their PhD or after a first post-doctoral period: for the candidates who obtained their PhD in the Northern hemisphere, the date of the PhD 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 PhD (and, if applicable, from the position held since the PhD); particular attention is thus paid to French or international candidates who obtained their doctorate abroad.

Lab contacts:

Margot Vulliez (Inria) [margot.vulliez@inria.fr](mailto:margot.vulliez@inria.fr) and Jee-Hwan Ryu (KAIST) [jhryu@kaist.ac.kr](mailto:jhryu@kaist.ac.kr)

## Principales activités

Humans and robots can jointly perform a task in haptic teleoperation. The human operator remotely controls the robot while receiving feedback on the task environment. Such remote interaction is particularly beneficial in confined, unsafe, or sensitive environments such as hazardous sites, underwater or space. It 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 concepts have been proposed in the literature to transfer part of the task from the human to the robot. These approaches range from complementary and predefined subtask allocations to adaptive shared-control methods. Focusing on this second and more flexible paradigm, the postdoctoral project aims at improving shared control in haptic teleoperation.

To act as an effective collaborator, the robot should adapt its assistive behavior with respect to the human intent. The human inputs are first analyzed to infer the operator goal (such as the target object in pick-and-place) and consequently planned the robot assistive behavior. The authority level, that gives the impact of each agent on the action, is then fixed depending on some task-oriented criteria. The shared-autonomy approach combines the human motions and the robot assistive motions into a joint action, based on the authority distribution. A Model Predictive shared controller is developed at Auctus team [1] to compute the robot motion on a time horizon, given both the human and robot assistive trajectories. It generates a unified action, formulated as an optimization problem under robot and human limits and environmental constraints.

Two key aspects must be studied in our shared-autonomy approach to improve human-robot coordination and better share the task. According to their background and preferences, the postdoctoral scholar will work on these challenges:

1. Developing a method that dynamically adapts the authority level to better distribute the task between the human-robot agents. In conventional approaches the authority level is computed at each task state, as a function of task-oriented criteria (proximity to target [2]) or human-based indices (expertise [3], human activity [4]). The IriS lab has proposed a dynamic authority distribution method [4] that allocates the control authority in real-time from the energy produced in the human-robot interaction. This approach should be extended to a global optimization problem that capture task, human, environment factors to online shift the authority level.

2. Improving human intent detection in our shared controller to better adapt the robot assistance to the human need. Up to now, we use simple task descriptions to detect the human task goal and plan the robot assistive motions. We want to go through the extensive literature about human intent prediction [5] to implement more advanced methods that decode the user commands and infer his/her intention. Such intent prediction will be based on Hidden Markov Models or Gaussian Mixture Regressions. It will predict the most likely elementary action, encoded as a force-motion manipulation pattern, that the Human wants to do.

[1] E. Jabbour, M. Vulliez, J-P. Gazeau, V. Padois, C. Pr  ault, "Haptic shared control in human-robot collaboration", Poster at JJCR 2023 (Journ  e des Jeunes Chercheurs en Robotique), Oct 2023, Moli  ts et Ma  , France

[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, Daejeon, South Korea, October 9-14, 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, July 12-16, 2021 (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). IEEE, 2015. p. 5222-5227.

[5] LOSEY, Dylan P., MCDONALD, Craig G., BATTAGLIA, Edoardo, et al. A review of intent detection, arbitration, and communication aspects of shared control for physical human-robot interaction. *Applied Mechanics Reviews*, 2018, vol. 70, no 1, p. 010804.

## Comp  tences

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.

## Avantages

- 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
- Access to vocational training
- Social security coverage

## Rémunération

gross monthly remuneration (before salary charges and taxes): 2788 euros

## Informations générales

- **Thème/Domaine** : Robotique et environnements intelligents
- **Ville** : Talence
- **Centre Inria** : [Centre Inria de l'université de Bordeaux](#)
- **Date de prise de fonction souhaitée** : 2025-01-01
- **Durée de contrat** : 2 ans
- **Date limite pour postuler** : 2024-06-02

## Contacts

- **Équipe Inria** : [AUCTUS](#)
- **Recruteur** :  
Vulliez Margot / [margot.vulliez@inria.fr](mailto:margot.vulliez@inria.fr)

## A propos d'Inria

Inria est l'institut national de recherche dédié aux sciences et technologies du numérique. Il emploie 2600 personnes. Ses 215 équipes-projets agiles, en général communes avec des partenaires académiques, impliquent plus de 3900 scientifiques pour relever les défis du numérique, souvent à l'interface d'autres disciplines. L'institut fait appel à de nombreux talents dans plus d'une quarantaine de métiers différents. 900 personnels d'appui à la recherche et à l'innovation contribuent à faire émerger et grandir des projets scientifiques ou entrepreneuriaux qui impactent le monde. Inria travaille avec de nombreuses entreprises et a accompagné la création de plus de 200 start-up. L'institut s'efforce ainsi de répondre aux enjeux de la transformation numérique de la science, de la société et de l'économie.

**Attention:** Les candidatures doivent être déposées en ligne sur le site Inria. Le traitement des candidatures adressées par d'autres canaux n'est pas garanti.

## Consignes pour postuler

Applications for this Inria postdoc are submitted on line 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.

**The deadline of application is June 2, 2024.**

### Sécurité défense :

Ce poste est susceptible d'être affecté dans une zone à régime restrictif (ZRR), telle que définie dans le décret n°2011-1425 relatif à la protection du potentiel scientifique et technique de la nation (PPST). L'autorisation d'accès à une zone est délivrée par le chef d'établissement, après avis ministériel favorable, tel que défini dans l'arrêté du 03 juillet 2012, relatif à la PPST. Un avis ministériel défavorable pour un poste affecté dans une ZRR aurait pour conséquence l'annulation du recrutement.

### Politique de recrutement :

Dans le cadre de sa politique diversité, tous les postes Inria sont accessibles aux personnes en situation de handicap.