Offer #2025-08823

Post-Doctoral Research Visit F/M Post-doc: learning contact-rich locomotion for humanoid robots

Contract type : Fixed-term contract

Level of qualifications required : PhD or equivalent

Fonction : Post-Doctoral Research Visit

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 one of the Inria Centres in France but it is recommended that the time is shared between France and the partner's country (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 Inria team Hucebot, based in Nancy, France, and University College London (UCL) are collaborating to develop the next generation of control algorithms for humanoid robots thanks to modern artificial intelligence. This partnership is supported by the LEG-AI Inria Associated team, which provides funding for travel and scientific exchanges between the two countries.

The overall goal of this collaboration is to combine forces to mix machine learning algorithms, especially imitation learning and reinforcement learning, with whole-body control, that is, synchronizing all the joints of a humanoid robot to achieve a task while keeping its balance. Both teams have extensive experience with 4-legged (especially UCL) and 2-legged (especially Hucebot) robots, and have invested in several robotic platforms (for quadrupeds: AnyMal, Unitree Go2; for humanoids:

Unitree G1, PAL Robotics Talos, IIT iCub). This post-doctoral position will focus on the G1 humanoid robot, which both teams recently acquired, although the other robots (e.g., Talos) can be used for some specific experiments.

This position will require regular stays in London (at least 2 weeks / year) as well as regular remote meetings with the UCL team.

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 frequently employ additional contact points to enhance their stability, such as using a handrail or a wall while walking, or to extend their reach, as in grasping a distant object. Similarly, humanoid robots would benefit from a similar strategy. However, current robots prioritize minimizing the number of contacts and utilizing them exclusively for feet and necessary interactions with the environment, like pushing a button [Atkeson 2018]. The few controllers for multi-contact whole-body control assume that the motion is quasi-static, which means that the robot moves much slower than a human [Henze 2016, Rouxel 2025].

One of the main reason for the limited use of contacts is that most of the work in robot control is model-based, that is, using a model of the robot and optimization algorithm to search for the optimal behavior [Henze 2016, Rouxel 2025]. While one can assume that a model of the robot is known, the model of the environment is usually not fully accessible; in particular, some critical quantities like the surface properties have to be guessed. Model-based algorithms also tend to be brittle because they assume a perfect model of the robot, which is never fully accurate.

In the last 5 years, reinforcement learning in simulation revolutionized quadruped locomotion and replaced model-based approaches as the dominating approach [Lee 2020, Hoeller 2024]. By learning robust policies offline, quadrupeds are now capable of highly dynamic motion and take vision/depth sensors as inputs. This learning approach has now replaced model-based approaches as the main paradigm

for legged locomotion.

The objective of this post-doc is to achieve the same transition for humanoid robots: leveraging artificial intelligence to learn policies for biped robots that are highly-dynamic, contact-rich and perception-driven.

Besides the inherent instability of biped locomotion compared to quadrupeds, one of the specific challenges is that humanoid robot are expected to perform in human-made environments, whereas quadrupeds are more designed for outdoor operation. This means that contacts for humanoids have to be chosen carefully to avoid any potential damage to the environment; for instance, a humanoid robot should not lean on a window or put its hands between fragile objects.

In this post-doc, we will address this challenge with human demonstrations that show examples of additional contacts and combine it with reinforcement learning for learning robust locomotion policies. Both teams, UCL and Hucebot have extensive experience in learning algorithms for robots. The post-doc will rely on the recent work of the team about legged robot control [Turisi 2024, Penco 2019], multi-contact whole-body control [Rouxel 2024a, Totsila 2024] and learning from demonstration with flow matching algorithms [Rouxel 2024b], as well as the expertise of UCL for robot vision [Liu 2024]. The main platform will be the Unitree G1, as both UCL and Inria acquired this robot in 2025.

The post-doc will design new algorithms and demonstrate them on the humanoid robots of the teams, which should lead to publications in the top venues in robotics (IJRR, RA-L, ICRA/IROS, Humanoids) or machine learning (NeurIPS, ICML,CORL,...). He/she will have the support of the research engineers of the team and work closely with the PhD students working on machine learning for robotics.

He/she will have the opportunity to supervise a few master students and participate to the ongoing projects of the team.

Recent videos of the team:

- Multi-contact : https://www.youtube.com/watch?v=RGkZS57_6Nk
- Flow matching : https://www.youtube.com/watch?v=LGyeOBybr8o
- Talos locomotion: https://www.youtube.com/watch?v=PGgf6ZnCsw0

References

- C. G. Atkeson *et al.*, “What happened at the DARPA robotics challenge finals,” *The DARPA robotics challenge finals*, 2018.
- B. Henze, M. A. Roa, and C. Ott, “Passivity-based whole-body balancing for torque-controlled humanoid robots in multi-contact scenarios,” *Int. Journal of Robotics Research*, vol. 35, no. 12, 2016.

- Hoeller D, Rudin N, Sako D, Hutter M. Anymal parkour: Learning agile navigation for quadrupedal robots. Science Robotics. 2024 Mar 13;9(88):eadi7566.
- Lee J, Hwangbo J, Wellhausen L, Koltun V, Hutter M. Learning quadrupedal locomotion over challenging terrain. Science robotics. 2020 Oct 21;5(47):eabc5986.
- Liu J, Lyu S, Hadjivelichkov D, Modugno V, Kanoulas D. ViT-A*: Legged Robot Path Planning using Vision Transformer A. In2023 IEEE-RAS 22nd International Conference on Humanoid Robots (Humanoids) 2023 Dec 12 (pp. 1-6). IEEE.
- Penco L, Scianca N, Modugno V, Lanari L, Oriolo G, Ivaldi S. A multimode teleoperation framework for humanoid loco-manipulation: An application for the icub robot. IEEE Robotics & Automation Magazine. 2019 Oct 30;26(4):73-82.
- Rouxel Q, Ferrari A, Ivaldi S, Mouret JB. Flow matching imitation learning for multi-support manipulation. In2024 IEEE-RAS 23rd International Conference on Humanoid Robots (Humanoids) 2024 Nov 22 (pp. 528-535). IEEE.
- Rouxel Q, Ivaldi S, Mouret JB. Multi-contact whole-body force control for position-controlled robots. IEEE Robotics and Automation Letters. 2024.
- Totsila D, Rouxel Q, Mouret JB, Ivaldi S. Words2contact: Identifying support contacts from verbal instructions using foundation models. In2024 IEEE-RAS 23rd International Conference on Humanoid Robots (Humanoids) 2024 Nov 22 (pp. 9-16). IEEE.
- Turrisi G, Modugno V, Amatucci L, Kanoulas D, Semini C. On the benefits of GPU sample-based stochastic predictive controllers for legged locomotion. In2024 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) 2024 Oct 14 (pp. 13757-13764). IEEE.

Skills

The typical applicant has a good publication record in robotics venues (IJRR, TRO, RA-L, IROS, ICRA, IROS, Humanoids) and/or machine learning (NeurIPS, ICML, ICLR, CVPR).

Programming skills: most of the work will be carried out in Python (with Pytorch).

Algorithmic skills:

- common robotics alogorithms (kinematics, etc.)
- machine learning algorithms, especially for imitation learning and reinforcement learning

Language: English is the official language of the team. French is not required (many members of the team do not speak French).

Remuneration

2788 € gross/month

General Information

- **Theme/Domain :** Robotics and Smart environments
  Software engineering (BAP E)
- **Town/city :** Villers lès Nancy
- **Inria Center :** Centre Inria de l'Université de Lorraine
- **Starting date :** 2025-11-01
- **Duration of contract :** 2 years
- **Deadline to apply :** 2025-05-23

Contacts

- **Inria Team :** LARSEN
- **Recruiter :**
  Ivaldi Serena / serena.ivaldi@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

The ideal applicant loves humanoid robots and is not afraid of real experiments. He/she wants to be part of the currently ongoing revolutions of humanoid robotics. He/she should have a good knowledge of either robotics or machine learning, ideally both.

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

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.