



Offer #2023-06274

PhD Position F/M Frugal control of robots

Contract type : Fixed-term contract

Level of qualifications required : Graduate degree or equivalent

Fonction : PhD Position

About the research centre or Inria department

The Inria Grenoble - Rhône-Alpes research center groups together almost 600 people in 23 research teams and 7 research support departments.

Staff is present on three campuses in Grenoble, in close collaboration with other research and higher education institutions (University Grenoble Alpes, CNRS, CEA, INRAE, ...), but also with key economic players in the area.

Inria Grenoble - Rhône-Alpes is active in the fields of high-performance computing, verification and embedded systems, modeling of the environment at multiple levels, and data science and artificial intelligence. The center is a top-level scientific institute with an extensive network of international collaborations in Europe and the rest of the world.

Assignment

In the current time of major, global ecological crisis, robots could help us satisfy more efficiently our most basic needs (food, health, clothing, housing, transport), but to do so, they should reduce their own ecological footprint, considering the energy and overall resources necessary to manufacture and operate them. One overlooked aspect in this regard is the design and implementation of control laws, which can lead to intensive computations and impact the whole hardware design of robots.

The control of complex robots is commonly computed by numerically solving optimization problems [1,2]. These problems are often small enough (from tens to a few thousand variables) that they can be solved exactly, or with the highest numerical precision available. It would be beneficial, however, to study what precision is really needed at the different steps of the computations: formulation of the problem, accuracy of the solution or inner computations of the optimization. This could help perform cheaper computations, allowing faster resolution and better energy efficiency.

The goal of this PhD is to identify how existing control laws can be amended to yield less computations while still fulfilling adequate control, investigating what is the necessary amount of precision required for different type of constraints, what is the sufficient precision for the different computations arising in a given control law and what cheap algorithms can be used as a consequence. This will take root in numerical benchmarks for several state-of-the-art control schemes applied to different robots and scenarios (humanoid, quadruped and industrial manipulator robots as well as self-driving vehicles).

A better understanding of how numerical approximations impact the actual behavior of the robot could also provide valuable insights for machine learning in robotics and this is definitely a direction that we will try to develop since machine learning approaches have been providing very interesting solutions to various robotics problems recently, but these solutions are approximate by construction.

References

- [1] J. Carpentier, P.-B. Wieber, "Recent progress in legged robots locomotion control", Current Robotics Reports, vol. 2(3), 2021
- [2] P. Wensing, M. Posa, Y. Hu, A. Escande, N. Mansard, A. Del Prete "Optimization-Based Control for Dynamic Legged Robots", submitted to IEEE Transactions on Robotics, 2022

Skills

Technical skills and level required :

- A good knowledge of Python. Experience in C++ is also appreciated
- A solid background in linear algebra
- Knowledge in robotics and numerical optimization are welcome.

Languages :

- Fluent communication in French or English

- Ability to read and write technical documents in English

Relational skills :

- Ability to work in a team

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 (90 days / year) 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 under conditions

Remuneration

1st and 2nd year: 2 051 euros gross salary /month

3rd year: 2 158 euros gross salary / month

General Information

- **Town/city** : Montbonnot
- **Inria Center** : [Centre Inria de l'Université Grenoble Alpes](#)
- **Starting date** : 2023-10-01
- **Duration of contract** : 3 years
- **Deadline to apply** : 2023-06-30

Contacts

- **Inria Team** : AT-EQUIPE-GRA
- **PhD Supervisor** :
Escande Adrien / adrien.escande@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 must be submitted online on the Inria website.

Processing of applications sent by other channels is not guaranteed.

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.