Offer #2024-07929

Post-Doctoral Research Visit F/M Individual-based modeling of coupled single-cell and population processes

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 Saclay-Île-de-France Research Centre was established in 2008. It has developed as part of the Saclay site in partnership with Paris-Saclay University and with the Institut Polytechnique de Paris since 2021.

The centre has 39 project teams , 27 of which operate jointly with Paris-Saclay University and the Institut Polytechnique de Paris. Its activities occupy over 600 scientists and research and innovation support staff, including 54 different nationalities.

Context

Inria is the French national institute for research in computer science, control, and applied mathematics promoting scientific excellence and technology transfer. The research topics of pour group are at the intersection of mathematical biology, statistics, control engineering, and statistical physics applied to problems in biology.

Assignment

This research project aims to better understand the mechanisms related to gene expression and plasmid
copy number fluctuations in a cell population with application to synthetic biology.

Modelling gene expression has been the subject of much interest in the literature. The models proposed are generally single-cell, and based on the central dogma of molecular biology, which describes a simplified scheme whereby instructions on DNA are transcribed into messenger RNA, which in turn is translated into proteins. In this scale, the environment is often assumed to be highly invariant and the number of molecules for each protein is small and therefore subject to considerable stochasticity. These numbers of molecules are modelled using continuous-time Markov chains (CTMC). In the scale of the demography, this individual dynamics becomes rapid and can be approximated by continuous models like ODEs. In addition, it becomes essential to take into account the unequal sharing of all this molecular content at the time of cell division. This mechanism is well known to enhance the heterogeneity of gene expression at the population level. How to develop models that capture all these aspects while remaining analytically or numerically tractable is an open research question and will be the focus of this project.

Main activities

- Develop an individual-based modeling framework that can be used to understand coupled single-cell and population processes.
- Develop approaches to mathematically analyse individual-based models and to numerically simulate them.
- Make use of single-cell microscopy data of our collaborators to parameterize a model of a synthetic gene circuit in bacteria.
- Use the model to study how the burden for cells created by the synthetic gene circuit affects emerging population growth rates.

Skills

- Strong programming and mathematics skills.
- Prior experience with single-cell microscopy data.
- Prior experience with stochastic individual-based models.

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 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

Remuneration

According to profile

General Information

- **Theme/Domain :** Modeling and Control for Life Sciences
  Biologie et santé, Sciences de la vie et de la terre (BAP A)
- **Town/city :** Palaiseau
- **Inria Center :** Centre Inria de Saclay
- **Starting date :** 2024-11-01
- **Duration of contract :** 2 years
- **Deadline to apply :** 2024-10-31

Contacts

- **Inria Team :** LIFEWARE
- **Recruiter :**
  Ruess Jakob / jakob.ruess@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

A CV that demonstrate strong scientific skills.

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.