

2021-04112 - Post-Doctoral Research Visit F/M Integration and validation of a Single-Cell-based Gene Regulatory Network in a Multiscale Model of the CD8 T Cell Immune Response

Contract type : Fixed-term contract
Level of qualifications required : PhD or equivalent
Fonction : Post-Doctoral Research Visit

About the research centre or Inria department

Grenoble Rhône-Alpes Research Center groups together a few less than 650 people in 37 research teams and 8 research support departments.

Staff is localized on 5 campuses in Grenoble and Lyon, in close collaboration with labs, research and higher education institutions in Grenoble and Lyon, but also with the economic players in these areas.

Present in the fields of software, high-performance computing, Internet of things, image and data, but also simulation in oceanography and biology, it participates at the best level of international scientific achievements and collaborations in both Europe and the rest of the world.

Context

A postdoctoral position is open in the Inria Dracula team. The position is to be funded by an ANR grant (MEMOIRE project). Partners of the project are Inria Dracula, Inserm Immunology team (Head Dr. J. Marvel), AltraBio (private company). While other partners will focus on single cell data analysis, our work will focus on the modeling part: inference of a gene regulatory network, integration into a multiscale model, and validation of the model by comparison with experimental data.

The position is an opportunity to be involved in a strongly interdisciplinary consortium, and to strengthen experience in computational immunology or computational biology by working on single cell data modeling.

The Inria Dracula team focuses on the development of methods and tools for the multiscale modeling of physiological processes, with applications, among others, in immunology (description of the immune response, vaccine design). Dr. Olivier Gandrillon and Dr. Fabien Crauste will co-supervise the postdoc, they have a jointly experience of interdisciplinary works and have already co-supervised several postdocs on computational immunology-related projects.

Assignment

The specific CD8+ T cell immune response is based on complex interactions between CD8+ T cells and other immune cells as well as target cells. These interactions are either direct cell-to-cell interactions, relying on cell membrane contact, or cytokine mediated. In each case, surface proteins integrate signals that influence CD8+ T cell gene regulatory networks (GRN) that code for cell survival, differentiation, proliferation, and death. Our group previously introduced a multi-scale model of the CD8+ T cell immune response based on the description and dynamical interaction of a CD8+ T cell dynamics model and a GRN model [1,2,3]. The later, however, was focused on the interactions of only 6 genes, whose roles were identified in the literature.

The aim of this post-doctoral position is

1st/ to implement in C++/Python a GRN inferred from single cell data and described by a piecewise deterministic Markov model [4], and

2nd/ to couple the GRN with an existing cell dynamics model [2,3], in order to

3rd/ use the multiscale model to describe experimental data and to investigate the dynamics of CD8+ T cells.

The postdoctoral research will be part of an ANR-funded project, MEMOIRE, and the work will be performed in close collaboration with immunologists, located in Lyon. It will require skills in interdisciplinary communication and computational biology.

[1] S. Prokopiou, L. Barbarroux, S. Bernard, J. Mafille, Y. Leverrier, C. Arpin, J. Marvel, O. Gandrillon, F. Crauste (2014) Multiscale modeling of the early CD8 T cell immune response in lymph nodes: an integrative study. *Computation*, 2(4), 159-181.

[2] X. Gao, C. Arpin, J. Marvel, S. Prokopiou, O. Gandrillon, F. Crauste (2016) IL-2 sensitivity and exogenous IL-2 concentration gradient tune the productive contact duration of CD8+ T cell-APC: a multiscale modeling study. *BMC Systems Biology* 10, 77.

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 :** Lyon
- **Inria Center :** CRI Grenoble - Rhône-Alpes
- **Starting date :** 2021-11-01
- **Duration of contract :** 12 months
- **Deadline to apply :** 2021-12-31

Contacts

- **Inria Team :** DRACULA
- **Recruiter :**
Gandrillon Olivier / olivier.gandrillon@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

There you can provide a "broad outline" of the collaborator you are looking for what you consider to be necessary and sufficient, and which may combine :

- tastes and appetencies,
- area of excellence,
- personality or character traits,
- cross-disciplinary knowledge and expertise...

This section enables the more formal list of skills to be completed and 'lightened' (reduced) :

- "Essential qualities in order to fulfil this assignment are feeling at ease in an environment of scientific dynamics and wanting to learn and listen."
- " Passionate about innovation, with expertise in Ruby on Rails development and strong influencing skills. A thesis in the field of **** is a real asset."

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.

Warning : you must enter your e-mail address in order to save your

[3] S. Girel, C. Arpin, J. Marvel, O. Gandrillon, F. Crauste (2019) Model-based assessment of the role of uneven partitioning of molecular content on heterogeneity and regulation of differentiation in CD8 T-cell immune responses. *Front. Immunol.* 10, 230.

[4] A. Bonnaïffoux, U. Herbach, A. Richard, A. Guillemin, S. Gonin-Giraud, PA. Gros, O. Gandrillon (2019) WASABI: a dynamic iterative framework for gene regulatory network inference. *BMC Bioinformatics* 20, 220.

Main activities

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Skills

- Research: The applicant will have an experience in computational biology, ideally in computational immunology, and will be able to implement C++ and Python codes [j'ai ajouté l'expérience en C++/Python, parce qu'à present il me semble que c'est ça qu'il faut faire : coder le modèle à partir de Simuscale]. In addition, the usage of various (deterministic, stochastic) mathematical formalisms and an experience in parameter estimation with experimental data will be considered as a plus.
- Language: English (basic French notions may ease daily life)
- Relational skills: interdisciplinary meetings and research are at the core of the project, so it is expected that the Postdoc Fellow is comfortable with researchers from other fields. Good ability for team playing will be appreciated.

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

Salary: 2 653€ gross/month (income tax excluded).

application to Inria. Applications must be submitted online on the Inria website. Processing of applications sent from other channels is not guaranteed.