2018-00643 - Post-doctorant : Coupling of population dynamics and domain evolution

Level of qualifications required : PhD or equivalent
Fonction : Post-Doctoral Research Visit

About the research centre or Inria department

Located at the heart of the main national research and higher education cluster, member of the Université Paris Saclay, a major actor in the French Investments for the Future Programme (Idex, LabEx, IRT, Equipex) and partner of the main establishments present on the plateau, the centre is particularly active in three major areas: data and knowledge; safety, security and reliability; modelling, simulation and optimisation (with priority given to energy).

The 450 researchers and engineers from Inria and its partners who work in the research centre’s 31 teams, the 100 research support staff members, the high-level equipment at their disposal (image walls, high-performance computing clusters, sensor networks), and the privileged relationships with prestigious industrial partners, all make Inria Saclay Île-de-France a key research centre in the local landscape and one that is oriented towards Europe and the world.

Context

Models of structured population dynamics are increasingly used to study the time-evolution of the distribution of a population along space, age, or other morphological, physiological or behavioral traits. One of the main interests of such models lies in gaining insight on the long-term behavior of the population. Hence environmental changes, even when happening at a slower time scale than the birth-rate processes, should not be neglected. This has been highlighted in the literature and mathematical models have already been developed to take into account the environmental fluctuations’ impact on the population dynamics. However the reverse phenomenon is also true: changes in the population can affect the environment. We are then faced with a two-way coupling between environmental and population changes.

Assignment

The post-doctoral project will be dedicated to designing a mathematical framework enabling this double coupling and applying it to the specific issue of coupled germ cell growth and somatic cell kinetics in ovarian follicular development.

In ovarian follicles, a growing oocyte (the germ cell) is surrounded by increasingly many layers of somatic cells. The oocyte synthesizes and releases specific growth factors which influence the proliferation and differentiation functions of the overlaying somatic cells. In turn, the somatic cells release stimulate the growth of the oocyte. Hence the oocyte growth influences both the spatial structure of the cell population and its proliferation rate, while the changing number of somatic cells controls the oocyte growth.

Main activities

The work will consist in developing a mathematical framework for the coupling of structured population dynamics and domain evolution using the PDE formulation. The model formulation will be inspired from an available stochastic individual-based model. Individual-based models allow one to keep track of the trajectory of each individual cell. However, when the population size increases, simulations become very costly, and continuous models are preferred. Then the population is described by a density and its evolution is given by a deterministic partial differential equation (PDE).

The new model will be applied to the case of ovarian development, and numerical simulations will be confronted to experimental data to validate the model. It will then be used to predict and explain the behavior of cell populations. The new formulation will render the model developed in more universal and applicable to other problems as well, such as the interplay between myocardium reshaping and cell dynamics during cardiac remodeling.

Skills

A general background in applied mathematics is required, including solid notions in the analysis and simulation of partial differential equations. Interest in mathematical biology and biomedical sciences would be appreciated.

General Information

- Town/city : PALAISEAU
- Inria Center : CRI Saclay - Île-de-France
- Starting date : 2018-11-01
- Duration of contract : 1 year, 4 months
- Deadline to apply : 2018-04-30

Contacts

- Inria Team : SRH-SAC
- Recruiter : Moireau Philippe / philippe.moireau@inria.fr

Conditions for application

Applicants have to provide the following documents to be considered at the selection procedure:
- CV
- publication list and 2 representative publications (that you judge representative of your work)
- motivation letter (explaining why the selected topic, how do you think you can fit the topic, what are your motivations for the topic compared to your previous work, etc)
- 2 recommendation letters

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). Authorization 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. 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 application to Inria. Applications must be submitted online on the Inria website. Processing of applications sent from other channels is not guaranteed.
Benefits package
- Subsidised catering service
- Partially-reimbursed public transport
- Social security
- Paid leave
- Flexible working hours
- Sports facilities

Remuneration
Monthly gross salary: 2,653 euros