Offer #2024-07659

Post-Doctoral Research Visit F/M Multi-type growth fragmentation equations with singular coefficients

**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, 2024 and not later than January, 1st 2025. 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).

**Assignment**

Candidates for postdoctoral positions are recruited after the end of their Ph.D. or after a first postdoctoral 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**

In a recent paper [7], Denis Villemonais and Alexander Watson gave a probabilistic solution to prove the existence, uniqueness and existence of a spectral gap for the growth fragmentation equation, using in particular quasi-stationary distribution theory [2]. The goal of this work was, on the one hand, to determine general conditions for the existence and uniqueness of a semigroup satisfying this equation, and on the other hand, to describe its long-time behavior.

The aim of the post-doc project is three fold: it concerns the extension of this result to physically or mathematically relevant situations, the extension of abstract quasi-stationary results to non-exponential convergence situations, and of the study of control problem for branching processes.

First, we aim at extending these methods and results to the situation where \( k(\cdot,(0, +\infty)) \) is not locally bounded, to cases with accumulation of jumps toward 0, to models with several types of particles, and to prove a sufficient criterion ensuring that the spectrum is discrete. This last property is of great importance in order to derive fluctuation results for the branching process associated to the growth fragmentation phenomenon.

Second, we aim to prove that the limiting behaviour of this equation is
exponential with a well defined limiting profile, under assumptions which only ensure non-exponential convergence. To do this, we will consider the problem of proving the existence and convergence toward a quasi-stationary distribution in the situation where the recent results [2] do not hold, and which represent an open challenge in the theory of quasi-stationary distribution, but in some very specific cases such as some birth and death processes (see e.g. [4, 3]) and diffusion processes [6].

Third, we will consider the problem of controlling branching processes for the maximization of the eigenvalue (or asymptotic growth rate) under appropriate constraint involving e.g. the dispersion of the number of individuals at fragmentation time. We will start the investigation by considering models where explicit computations are possible, such as in [1] where explicit formulas from refracted Lévy processes are used.

These researches will be conducted in the perimeter of the associate Inria team MAGO, with collaborators from UCL and Inria Nancy.

References

Skills
Required qualifications: PhD thesis in probability theory / stochastic processes. The selected candidate will be based in Nancy and will make visits to UCL, UK, when needed. It is also expected that the selected candidate will play a role in the organization of the meetings of the associate Inria team MAGO and will be interested by the other subjects of the team, including models with coagulation and discussion with physicists.

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 (after 6 months of employment) 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
2788€ gross/month

General Information
- Theme/Domain: Modeling and Control for Life Sciences
- Town/city: Villers lès Nancy
- Inria Center: Centre Inria de l'Université de Lorraine
- Starting date: 2024-11-01
- Duration of contract: 2 years
- Deadline to apply: 2024-05-31

Contacts
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

Application deadline
2 June 2024

How to apply

Your detailed CV should be uploaded on jobs.inria.fr and also sent by email to denis.villemonais@univ-lorraine.fr. Your detailed CV should include a description of the PhD and a complete list of publications with the two most significant ones highlighted, and a motivation letter.

In addition, two letters of recommendation should be sent directly by their authors to denis.villemonais@univ-lorraine.fr

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.