



Offer #2024-08277

Post-Doctoral Research Visit F/M Post-Doctoral Fellowship on "Dedicated computational approaches for multiscale hyperbolic conservation laws"

Contract type : Fixed-term contract

Renewable contract : Yes

Level of qualifications required : PhD or equivalent

Fonction : Post-Doctoral Research Visit

Context

The source of many phenomena in physical and life sciences, and in most engineering disciplines, is to be found in microscopic features of the system under consideration. Linking the properties of matter at these different scales is a major challenge, both from the theoretical perspective (understanding how to link a model or an equation at a certain scale to another one at a different scale) and the numerical one (how to couple two consistent descriptions of matter, e.g. atomistic and continuum, using the same code).

MATERIALS originally focused on computational chemistry issues (electronic structure calculations for materials, laser control of chemical reactions) before gradually widening its scope beyond such considerations and their applications, and applying its expertise to related topics at very different scales. This has led to studies in molecular dynamics (in situ molecular system evolution), in computational statistical mechanics (computation of ensemble averages), and studies of relationships with more traditional mechanical models at the continuum scale (multiscale simulation of solid materials in general, including periodic and random homogenization of elliptic PDEs and the design of associated numerical approaches).

MATERIALS currently offers a range of expertise, rarely found on the international scene, in a number of promising topics for numerical simulation and applied mathematics in general: molecular chemistry, solid-state physics, numerical modeling in materials science, etc.

Assignment

Applications are invited for a postdoctoral fellowship to work on the development of efficient computational approaches in the context of multiscale materials.

Computing the properties of heterogeneous materials and media is a challenging issue. Our research team has a long-term experience in contributing to the theoretical foundations of such problems and the improvement of the corresponding computational approaches (see e.g. [C. Le Bris and F. Legoll, Examples of computational approaches for elliptic, possibly multiscale PDEs with random inputs, J. Comput. Phys. 2017]). The latter are often based on finite elements that are adapted to the precise microstructure of the media, in order to appropriately encode the fine-scale features.

The post-doc position will address some of the many relevant aspects, at the intersection between theoretical developments on homogenization problems and multiscale computational approaches. The focus of the work will be the prototypical multiscale hyperbolic conservation law

$$\partial_t u_\epsilon + \operatorname{div} F(x/\epsilon, u_\epsilon) = 0,$$

where u_ϵ is a scalar-valued function and the so-called flux F is a vector-valued function, supposedly depending upon the small scale ϵ and thus highly oscillatory. The equation is supplied with an initial condition, and possibly boundary conditions. Approaches in the spirit of Multiscale Finite Element (MsFEM) approaches, but specifically of finite volume type, will be explored and developed.

The candidate is expected to have a PhD in applied mathematics or computational mechanics, with a focus either on homogenization theory or on computational techniques for engineering problems, a good publication record and/or a solid expertise in programming.

Keywords: Homogenization, Multi-scale problems, Model reduction, Finite element methods, Finite volume methods.

Main activities

The candidate will be hired by ENPC - Institut Polytechnique de Paris, within the framework of a joint research team between ENPC and Inria. He/she will be supervised by Claude Le Bris and Frederic Legoll, who both are members of the Inria MATERIALS project-team and researchers at ENPC.

See <https://team.inria.fr/materials/> for more details on the activities of our research team.

Funding for the position is provided by a Grant of the European Office of Aerospace Research and Development. The anticipated start date for the postdoctoral position is January 2025. The successful candidate will be based at Ecole Nationale des Ponts et Chaussées, 77455 Marne La Vallée (RER A, station Noisy-Champs) and/or Inria Paris, 48 rue Barrault, 75013 Paris (Metro 6, station Corvisart).

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

General Information

- **Theme/Domain** : Numerical schemes and simulations
Scientific computing (BAP E)
- **Town/city** : Paris
- **Inria Center** : [Centre Inria de Paris](#)
- **Starting date** : 2025-01-01
- **Duration of contract** : 1 year, 6 months
- **Deadline to apply** : 2024-11-23

Contacts

- **Inria Team** : [MATERIALS](#)
- **Recruiter** :
Legoll Frederic / Frederic.Legoll@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

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.