Offer #2025-08849

Post-Doctoral Research Visit F/M Multiscale numerical methods for nonlinear problems in geosciences

Level of qualifications required : PhD or equivalent

Fonction : Post-Doctoral Research Visit

About the research centre or Inria department

The Inria centre at Université Côte d'Azur includes 42 research teams and 9 support services. The centre's staff (about 500 people) is made up of scientists of di?erent nationalities, engineers, technicians and administrative staff. The teams are mainly located on the university campuses of Sophia Antipolis and Nice as well as Montpellier, in close collaboration with research and higher education laboratories and establishments (Université Côte d'Azur, CNRS, INRAE, INSERM ...), but also with the regiona economic players.

With a presence in the fields of computational neuroscience and biology, data science and modeling, software engineering and certification, as well as collaborative robotics, the Inria Centre at Université Côte d'Azur is a major player in terms of scientific excellence through its results and collaborations at both European and international levels.

Context

Every year Inria International Relations Department has a few postdoctoral positions in order to support Inria international collaborations.

This offer is part of the newly formed associate team GEM3 between the IPES research team (http://ipes.lncc.br/) at LNCC/Brazil and the Galets Project Team at the Inria Center at Université Côte d'Azur. The associate team is focussed on

development and analysis of multiscale numerical methods for elliptic and parabolic partial differential equations (PDEs) arising in surface and subsurface geophysics. Ranging from modeling floods in realistic urban environments to subsurface CO2 storage, the applications addressed by the associate team are characterized by their geometrical complexity and strong nonlinear couplings. This motivates our focus on multiscale discretization methods with a particular emphasis on the treatment of nonlinear problems.

The postdoctoral contract will have a duration of 12 to 24 months. The default start date is November 1st, 2025 and not later than January, 1st 2026. The postdoctoral fellow will be recruted by the Inria center at Université Côte d'Azur France but will be jointly supervised by French and Brazilian members of GEM3 team and will be expected to carry out multiple research visits to Brazil.

Assignment

Unlike the traditional finite element method, which relies on an explicitly given approximation space (typically piecewise polynomial), in multiscale numerical methods the approximation space is driven numerically by the PDE model, incorporating fine-scale details of the domain geometry and coefficient distribution. The multiscale methods developed by the associate team can be interpreted as approximate substructuring techniques, where the interiors of macro-cells are eliminated through a low-dimensional parametrization of either Neumann data (as in MHM [1,3]) or Dirichlet data (as in Trefftz methods [2]). Since the computation of the approximation basis is local to the coarse cells, multiscale numerical methods are highly parallelizable, which allows them to benefit from increasing computational facilities while keeping communications very low. Alternatively, multiscale basis functions can be “learned” using machine learning techniques, which makes multiscale methods even more accessible.

The research program of this postdoctoral program will focus on error analysis of multiscale numerical discretization methods for nonlinear problems, and their integration with domain decomposition and scientific machine learning approaches.

[1] Araya, R., Harder, C., Paredes, D., & Valentin, F. (2013). Multiscale hybrid-mixed method. SIAM Journal on Numerical Analysis, 51(6), 3505-3531.

[2] Boutilier, M., Brenner, K., & Dolean, V. (2024). Robust methods for multiscale coarse approximations of diffusion models in perforated domains. Applied Numerical Mathematics, 201, 561-578.

[3] Gomes, A. T. A., Pereira, W. S., & Valentin, F. (2023). The MHM method for linear elasticity on polytopal meshes. IMA Journal of Numerical Analysis, 43(4), 2265-2298.

Main activities

- Conduct bibliographical reviews.
- Perform theoretical analysis of multiscale and domain decomposition methods.
- Implement multiscale and domain decomposition methods within an existing parallel framework.
- Design novel techniques combining scientific machine learning and multiscale numerical methods.
- Write and publish research articles.

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

Contract duration : 12 to 24 months

Rémunerating : 2 927€ gross/month

General Information

- **Town/city :** Sophia Antipolis
- **Inria Center :** Centre Inria d'Université Côte d'Azur
- **Starting date :** 2026-01-01
- **Duration of contract :** 12 months
- **Deadline to apply :** 2025-05-28

Contacts

- **Inria Team :** AT-SOP
- **Recruiter :**
  Brenner Konstantin / konstantin.brenner@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

We are looking for candidates with a strong background in Numerical Analysis and Scientific Computing, including the design and analysis of discretization schemes, multiscale numerical methods, domain decomposition, multigrid solvers and preconditioners. Expertise in Scientific Machine Learning and a keen interest in complex real-world simulations are also very welcome.

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.