

1 Postdoctoral Position in  
“New Methods in Quantitative Homogenization and Generalized Continuum Models”

## AVAILABLE POSITION

The position provides the opportunity to work on fundamental mathematical and computational questions at the interface of homogenization theory, continuum mechanics, applied mathematics, and scientific computing.

The research will be conducted at ENSTA, Institut Polytechnique de Paris (QS 24th worldwide in Mathematics, 4<sup>th</sup> in France, and QS 29th in Engineering & Technology, 1<sup>st</sup> in France, [see here](#)), in close scientific collaboration with BOKU University.

## RESEARCH CONTEXT AND PROJECT SUMMARY

The research project aims at advancing quantitative homogenization theory for microstructured heterogeneous materials and generalized continua. Enriched asymptotic descriptions of the continuum displacement field can lead to coupled macro- and microscale problems and, at the macroscopic scale, to micromorphic or other generalized continuum models. The central objective is to establish rigorous convergence rates and error estimates for such enriched homogenized descriptions relative to the underlying heterogeneous continuum problem.

The research will build on mathematical approaches including asymptotic homogenization, two-scale convergence, periodic unfolding, and quantitative homogenization. Particular attention will be devoted to quantitative estimates capable of assessing the accuracy, validity, and range of applicability of the homogenized description.

A further objective is to extend these developments beyond idealized settings and investigate the influence of strong material heterogeneity, nonlinear and history-dependent constitutive behavior, high material contrast, and localization phenomena on the convergence properties of the homogenized models.

The theoretical developments will be complemented by numerical studies aimed at measuring convergence rates, validating analytical predictions, and assessing the practical accuracy of the resulting homogenized models. Applications will include heterogeneous solids, complex and architected materials with and without multiphysics couplings.

## DESCRIPTION OF THE POSITION

As a postdoctoral researcher, you will focus on the development and extension of quantitative homogenization methods for generalized continuum descriptions. The work will include rigorous analysis of convergence and error estimates for enriched macro-micro homogenization frameworks, development of appropriate corrector and quantitative homogenization techniques, and extension of these methods toward more complex heterogeneous material problems and multiphysics.

The analytical developments will be supported by numerical implementation and computational studies for the verification of theoretically predicted convergence rates and the assessment of homogenization errors. The researcher will work closely with members of the ERC-INJECT group and collaborators in applied mathematics, continuum mechanics, computational mechanics, and geomechanics.

## REQUIREMENTS

Successful candidates are expected to have strong scientific skills, intellectual curiosity, and high motivation. Fluency in spoken and written English is mandatory.

The candidate is expected to have:

- A PhD in Applied Mathematics, Mathematics, Mechanics, or a closely related field.
- Demonstrated experience with rigorous homogenization methods, in particular two-scale convergence and/or periodic unfolding.
- Demonstrated experience with quantitative homogenization, including corrector estimates, error estimates, or convergence-rate analysis.

The following experience will be highly appreciated:

- Generalized continuum theories, including micromorphic media.
- Nonlinear or history-dependent material behavior.

- Scientific programming and numerical implementation, including computational homogenization and/or finite-element methods.

The candidate should be able to work independently and collaboratively in an interdisciplinary and international research environment.

### **CONDITIONS OF EMPLOYMENT**

The successful candidate will be appointed by ENSTA and will join the ERC-INJECT research group of Prof. Ioannis Stefanou. They will be based at the Mechanical Hub building, a collaborative environment housing leading research laboratories in mechanics from ENSTA and École Polytechnique, both members of Institut Polytechnique de Paris. The project will also involve regular scientific interaction and close collaboration with Dr Alexandros Stathas from BOKU University.

The research environment provides access to state-of-the-art computational resources (HPC), opportunities for collaboration and professional development, and regular interaction with researchers in mechanics, applied mathematics, and materials science in the vibrant environment of Institut Polytechnique de Paris.

The position includes opportunities to participate in seminars, international conferences, and research visits. The starting date will be agreed upon with the selected candidate.

### **APPLICATIONS**

The position is open and will start upon agreement.

Suitable, highly-motivated candidates should submit an application (including a CV, a research statement describing interests and qualifications related to the offered position and contact details or references of at least two reference Professors) to:

Prof. Ioannis Stefanou: [ioannis.stefanou@ensta.fr](mailto:ioannis.stefanou@ensta.fr)

Dr Alexandros Stathas: [alexandros.stathas@boku.ac.at](mailto:alexandros.stathas@boku.ac.at)

Candidate selection will be based on scientific excellence, expertise in mathematical homogenization and quantitative analysis, motivation, fit with the research topic.