Post-Doc position in
“Scientific Machine Learning and Mechanics for scale-bridging in granular materials”

Position overview

The appointment is part of the Chair “Artificial Intelligence and Mechanics for scale bridging in complex materials” (AIM), funded by **MIAI Cluster AI** and the ANR through the France 2030 program. The research will be conducted at **Université Grenoble Alpes** | **Inria** (Grenoble, France). The position provides the opportunity to work on a challenging, high-impact research topic at the crossroad of AI, physics, and mechanics, with excellent prospects for careers in both academia and industry.

Research context and project summary

Granular materials exhibit complex and distinctive behaviours arising from the disordered spatial arrangement of microscopic solid particles (grains). These materials are central to a wide spectrum of industrial and environmental processes. Yet, the mechanics of granular systems remain opaque due to their multiscale, nonlinear, and history-dependent behaviour. At the microscale, grain interactions—governed by nonsmooth phenomena, e.g. contacts, friction—drive the bulk dynamics at the macroscale, which challenge current modelling frameworks.

Modern experimental methods provide unprecedented quantitative observations, but they still cannot fully access the internal material state (e.g. contact forces, grain deformation). High-fidelity particle simulations represent reliable probes of the mechanics at the microscale but remain too computationally intensive at larger scales. Macroscopic, continuum-based models are hence often preferred for their computational efficiency. However, these models use heuristic constitutive equations that require phenomenological parameterisations based on conventional laboratory tests, not accounting for the rich measurement data that can be extracted today with in-operando experiments.

AIM’s interdisciplinary methodology bridges applied mathematics, mechanics, and artificial intelligence to better understand, model, and predict the mechanics and dynamics of granular media. Based on high-fidelity particle-scale simulations and cutting-edge in-operando experiments, data-driven methods will be developed to discover physics-based material descriptors and build a novel multiscale approach to robustly and accurately predict the fine- and large-scale behaviour of granular systems.

For more details: https://project.inria.fr/aimechanics | filippo.masi@inria.fr; vincent.acary@inria.fr

Description of the position

The research topic focuses on fundamental developments of a novel learning framework for the discovery of robust and accurate behaviour equations of granular media. While unknown, these laws must obey general principles from statistical mechanics and thermodynamics, which reduces the search space and opens the way for uncovering them using data-driven techniques and bridge the gap between constitutive modelling, numerical simulations, and experiments.

As a Postdoctoral Researcher, you will explore and develop AI methods to hardwire physical principles and discover interpretable, physics-based statistical descriptors of the microstructure from high-fidelity simulations (e.g. nonsmooth contact dynamics). You will build a robust framework to predict the multiscale behaviour of granular media with rigorous scale-bridging techniques based on stochastic homogenisation and benchmarked against available laboratory tests. The research position hinges on the interdisciplinary

integration of AI with theoretical/computational mechanics and physics to deepen the scientific understanding and modelling of complex materials. The outcomes will contribute to advancements with impact in the scientific community and the industry.

Requirements

Successful candidates are expected to have strong scientific skills and high motivation. Fluency in spoken and written English is mandatory. The candidate will carry out research, develop tools, and write scientific articles in close collaboration with the project's PIs, Dr Vincent Acary and Dr Filippo Masi, and the members of the AIM group.

The candidate is expected to have:

- Proven track record in applied mathematics, scientific computing, and computational mechanics;
- Proficiency in programming (Python/C++);
- Solid knowledge of numerical methods.

Highly appreciated qualifications include:

- Background in mechanics/physics (e.g., continuum mechanics, statistical mechanics, granular media, geomechanics);
- Experience with physics-informed ML, reduced-order modelling, and discrete element modelling;
- Strong skills in software development in computational mechanics;
- Teamwork, communication, and collaboration skills.

This role spans AI and mechanics. We are looking for candidates who are strong in both areas. Exceptional applicants with deep expertise in one and solid foundations in the other are also encouraged to apply.

Conditions of employment

The appointment is for a duration of two years. The successful candidate will be appointed by Université Grenoble Alpes and will join the AIM research group, with members from TRIPOP, THOTH project teams (Inria), the Geomechanics group at 3SR, and the ECRINS team (INRAE-IGE). The candidate will be based at the Inria Center of Grenoble Alpes University and UGA, including an engaging and collaborative research environment with access to state-of-the-art computing resources, field and laboratory facilities, and numerous opportunities for professional development and collaboration.

The position also includes opportunities to engage in academic activities, such as supervising Master's and undergraduate students. The project includes funding for travel to international conferences and research visits, fostering the dissemination of the findings and collaborations within the academic community.

Applications

Applications will be reviewed on a rolling basis. The position will stay open until it is filled.

Suitable, highly motivated candidates should submit their application **online**, containing a CV, a cover letter detailing interests, qualifications related to the position, an academic track record, and contact details of two reference Professors. Candidate selection will be performed on the basis of the excellence of the CV and motivation.