PhD position in
"Artificial Intelligence and non-smooth mechanics for bridging scales in natural gravitational hazards"

Position overview

The successful candidate will conduct interdisciplinary research bridging applied mathematics, mechanics, and granular physics at INRIA-TRIPOP and INRAE-ECRINS. The project addresses challenging problems in Granular Physics and Artificial Intelligence to better understand, model, and predict the dynamics of natural gravitational hazards, providing extensive opportunities for academic and industrial career development. The appointment is part of a pending research grant.

Keywords

Artificial Intelligence, Computational mechanics, Granular flow, Non-smooth dynamics.

Research environment

TRIPOP (Inria Grenoble Rhône-Alpes, Laboratoire Jean Kuntzmann) team specialises in modelling, simulation, control of non-smooth dynamical systems, and data-driven modelling of complex materials.

ECRINS (INRAE, IGE) team specialises in gravity-driven natural hazards, aiming to improve understanding, prediction, and management of landslides, rockfalls, snow avalanches, and debris flows through integrated research approaches.

Supervisory team:

- Vincent Acary (INRIA-TRIPOP) vincent.acary@inria.fr
- Thierry Faug (INRAE-ECRINS) thierry.faug@inrae.fr
- Filippo Masi (INRIA-TRIPOP) filippo.masi@inria.fr
- Franck Bourrier (INRAE-ECRINS, INRIA-TRIPOP) franck.bourrier@inrae.fr

Research context and project summary

Climate change intensifies gravitational hazards with increasing threats to safety and infrastructures. Traditional modelling approaches, relying on phenomenological parameterisations of the state space determined through human trial-and-error adjustments, fail to fully capture the complex, non-smooth, and multiscale rheology of granular systems. The project seeks to develop advanced physics- and data-driven models that accurately represent granular flows and their non-smooth dynamics, aided by high-fidelity simulations and available experimental datasets.

For more details, contact: filippo.masi@inria.fr

Description of the position

As a PhD researcher, you will explore and develop Artificial Intelligence methods aimed at robust and high-fidelity modelling of granular systems and flows. You will focus on developing first-principled, data-driven models and advanced numerical simulations to enhance predictive accuracy.

The interdisciplinary research will integrate AI with physics and mechanics to advance scientific understanding of gravitational natural hazards and rheology. Outcomes will contribute to advancements with impact in the scientific community and the industry.

Requirements

Successful candidates should demonstrate strong scientific capabilities and high motivation. Fluency in spoken and written English is mandatory. The candidates will carry out research, develop tools, and write scientific articles in close collaboration with the supervisory team and the members of TRIPOP and ECRINS.

The candidate is expected to have:

- Background in Applied Mathematics or completed related coursework.
- Proficiency in programming (e.g., Python, C++).
- Knowledge of Machine Learning.

Highly appreciated qualifications include:

- Background in dynamics, mechanics, geomechanics, or geophysics.
- Passion for software development in computational mechanics.
- Teamwork and collaboration skills.

Conditions of employment

The appointment is for a duration of three years. The successful candidate will join the TRIPOP and ECRINS research groups within Inria and INRAE-IGE. Both groups provide an engaging, collaborative research environment with access to state-of-the-art computing resources, field and laboratory facilities, and numerous opportunities for professional development.

The position also includes opportunities to engage in academic activities, such as supervising Master's and undergraduate students.

Applications

Highly motivated and suitable candidates should submit their application **online**, containing a CV, a cover letter detailing interests and qualifications related to the position, an academic track record, and contact details of two reference professors.

Selection will be based on the quality of the CV and motivation letter.