**Call for applications -**

**Junior Professorship Contract**

# Innovative numerical simulations for sustainable construction materials

*Junior professorships are a hiring pathway based on research and teaching projects which, at the end of their term, and after evaluation of the scientific merit and professional aptitude of the agent by a tenure commission, allow access to a full position as a university professor.*

*Publication of this call for applications: Euraxess website of the European Commission, Galaxie, Gustave Eiffel University website*

**Lead institution/organisation**: Université Gustave Eiffel
Name of the head of institution/organisation: Gilles Roussel, President of the Université Gustave Eiffel
Location: *Descartes Campus, Marne La Vallée*
Academic region: Île-de-France

**Keywords**: *discrete numerical simulation, discrete media, colloidal pastes, physical modeling, rheology*

**Expected duration**: 3 years

Tenure, on completion (and after evaluation of both scientific merit and professional aptitude): corps des professeurs des universités 2è classe

**Scientific theme**: civil engineering and construction materials

**Corresponding CNU/CoNRS/CSS section(s)**: CNU 28-60/CoCNRS 09-10

**Institution strategy** :

Gustave Eiffel University focuses its activity towards themes related to cities and territories, ranging from the basic understanding of materials to the development of architectural techniques. In the current context, it is mobilising its strengths to meet the scientific challenges posed by the energy transition, thanks to which it has received the I-Site label on a project entitled “the cities of tomorrow”. Making human activity compatible with the preservation of natural resources implies major changes in our construction methods, via formulating less polluting materials (earth-based construction, biosourced cements), and by developing more resource efficient techniques (additive construction). These downstream issues mobilise a large part of the University's experimental research and raise fundamental scientific questions relating to the physical origin of the mechanical behaviour of civil engineering materials. The project aims to create a chair integrating teaching and research on the discrete numerical simulation of construction materials. It will reinforce the work on the rheophysics of these materials by providing an essential link between experimentation and modelling.

**Strategy of the host laboratory** :

The Navier laboratory (UMR UGE-ENPC-CNRS) brings together researchers and teacher-researchers from various backgrounds who study materials of relevance to the fields of civil engineering, construction, energy and the environment. A large part of its activity is experimental and uses advanced equipmental techniques (X-ray micro-tomograph, MRI, additive construction platform). A founding member of Labex MMCD, the Navier laboratory is involved in numerous collaborations on the university site on topics related to materials and sustainable construction. The strength and originality of the laboratory is to accompany experimentation with multidisciplinary and multi-scale theoretical and numerical approaches. This activity focuses in particular on the numerical simulation of divided materials (granular media, glassy materials) aimed at identifying the physical origin of their mechanical behaviour (rheology). The person recruited will reinforce and extend this activity by developing numerical tools that allow relevant discrete simulations of colloidal pastes to be carried out, with the aim of providing essential elements of understanding for the interpretation of experiments.

**Summary of the scientific project** :

Many civil engineering and environmental materials are dense colloidal pastes, involving particles of various shapes and sizes ranging from a few tens of nanometres to a few microns. These materials exhibit complex rheological behaviours (threshold, thixotropy, ageing) whose physical origins are still poorly understood. As a consequence, enormous research efforts must be made to master their formulation and implementation. Discrete numerical simulation is an indispensable tool for identifying the relevant physical mechanisms and guiding the interpretation of experiments. But current tools are far from taking into account the complexity and richness of the interactions of these particles. The project aims to address this need. The person recruited will have to demonstrate established expertise in discrete numerical simulation, propose relevant and original avenues for modelling at the particle scale, and set up a simulation implementation programme that makes it possible to establish clear links between microscopic-scale and macroscopic behaviour.

**Summary of the teaching project** :

The “junior professor” to be recruited will reinforce the teaching team of ESIPE, which is a public engineering school within the Gustave Eiffel University with, in particular, a course program dedicated to Civil Engineering. The courses offered in this context will increasingly take into account issues related to the ecological and energy transition, which calls for a perfect mastery of the use of new construction materials and a reinvention of construction methods. The person recruited will be able to diversify and possibly renew part of the existing educational offer, related, e.g. to fresh material processing and control. In addition, he/she will be able to teach within the university's doctoral training programme, on topics such as, for example, physical modelling and numerical simulation methods, which are skills that are increasingly expected from doctoral students in physics or mechanics of materials.

**Financial summary**: an accompanying funding of €180,000 is planned for the funding of a PhD student and for one year of a post-doctorate researcher. A substantial allowance (20000€) is planned for travel fees (for the CPJ, the PhD student and the postdoc) and computer equipment.

**Scientific dissemination**: The project will result in publications on both technical developments and the construction of theoretical frameworks for the interpretation of the experimental problems studied and the behaviours explored.

**Open science**: digital tools can be developed, for example, in the framework of the open software "LAMMPS", and made available to the community. Publications will be made freely available.

**Science and society**: The visualization of numerical simulation results for granular materials and suspensions allows for effective pedagogical demonstrations in popularization initiatives (open houses, science fairs, welcoming young students to the laboratories, laboratory and university websites).

**Indicators**: Number of papers and publications, development of collaborations with researchers specialised in relevant materials (cements, clays, earth)

## Campaign calendar

-Collection of applications: until 16 May 2022 at 4 pm
-Selection of applications: end of May 2022
-Hearings: June 2022
-Starting date: 1 September 2022

## Terms and conditions of application:

The application must include the following documents:

- Identity document with photograph
- Proof of possession of a doctorate, as provided for in article L.612-7 of the Education Code, or of a diploma whose equivalence is to be assessed by the institution's career committee for teacher-researchers
- File attached to this call, duly completed

The administrative documents as well as the defence report written in whole or in part in a foreign language must be accompanied by a translation into French, the conformity of which the candidate will certify on his or her honour. Otherwise, the application will be deemed inadmissible. The translation of the analytical presentation as well as the works, books, articles and achievements is optional.

It is strongly recommended to contact the laboratory and the host team (jean-noel.roux@univ-eiffel.fr, olivier.pitois@univ-eiffel.fr).

**All documents must be submitted in digital form on Galaxie before :**

**Monday 16 May 2022 4pm**

Any application that is incomplete by the above-mentioned deadline will be deemed inadmissible

**Arrangements for the organisation of hearings**

Only those candidates who have been selected by the selection committee responsible for the auditions will be invited to the audition.

**The auditions will take place at the Cité Descartes, 77 420 Champs-sur-Marne**