Offre n°2025-08582

Internship on correlated dynamics of many particles by the environment

Le descriptif de l'offre ci-dessous est en Anglais

Type de contrat : Stage

Niveau de diplôme exigé : Bac + 5 ou équivalent

Fonction : Stagiaire de la recherche

A propos du centre ou de la direction fonctionnelle

The Inria center at Université Côte d'Azur includes 42 research teams and 9 support services. The center's staff (about 500 people) is made up of scientists of different 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 regional 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.

Contexte et atouts du poste

Solid particles are omnipresent in our daily life and in the environment. To name a few examples, particles are present in atmospheric sciences (dispersion of pollutants, aerosols and/or pollen) or in marine sciences (plastic contamination in oceans, sediments in rivers).

The dynamics of particles immersed in a fluid is governed by a number of interactions including: hydrodynamics forces (due to the action of the fluid on particles) and inter-particle forces. When complex deposits occur by the accumulation of many particles on a surface (forming a so-called bed), the dynamics of each individual objects becomes correlated to the one of nearby objects.

The aim of this internship is twofold: (1) to study spatial and temporal correlations in the near-wall motion of particles within a bed using fine-scale simulations and (2) to develop a model reproducing such features using stochastic approaches.

Mission confiée

The dynamics of objects immersed in a fluid flow is described using Newton's second law of motion. It describes the evolution of the object's position, its translational velocity and its rotational velocity using information on the particle's mass, its moment of inertia and the forces / torques acting on it. Yet, behind this apparent simplicity lies complex modeling issues.

Particle dynamics involves mainly three types of forces:

- hydrodynamic forces, which arise from the action of the fluid flow on the particle (like drag and lift forces),
- inter-particle forces (like contact and adhesion forces or lubrication forces),
- external forces (like gravity).

When the flow is turbulent, large particles can affect the fluid flow around them. Such motion can be solved explicitly by resorting to fine-scale simulations where all the fluid scales are resolved with the Navier-Stokes equations, using a spatial discretization smaller than the particle sizes. When coupled to the dynamics of each individual particle, one can perform simulations of complex bed deposits exposed to a turbulent flow. This is the so-called Particle-Resolved Direct Numerical Simulation (abbreviated as PR-DNS).

Modeling issues appear when trying to capture some of the features observed with such small-scale simulations in large-scale simulations using CFD tools (Computational Fluid Dynamics). In fact, in such macroscopic models, all the scales of the turbulent flow are not explicitly solved. Instead, one relies on turbulence models to capture some effects related to the unresolved small-scale turbulent features. As a result, specific models have been developed to reproduce the effects of such small-scale features on

particle dynamics. This has led to the development of Lagrangian stochastic models. However, these models need to be extended now to include information on the correlated motion of particles. This internship is at the frontier between physics, mathematics and engineering.

Principales activités

During this internship, more advanced models for the simulation of dispersed two-phase flows will be developed, especially to capture correlated motion between particles deposited in a bed.

This includes the following tasks:

i. running simulations of complex beds exposed to a turbulent flow in simple configurations (e.g. with one or two layers of particles deposited on the surface);
ii. analyzing the results obtained using statistical tools to extract information on correlated motion;
iii. proposing, implementing and validating new stochastic models to capture the complex dynamics of particles in the near-wall region;

The candidate will be encouraged to write a publication in an international journal at the end of the internship. Motivated students will be encouraged to pursue their work on this topic with a PhD thesis.

More details on the internship can be found on theteam website.

Compétences

Candidates should be fluent in English, have a good experience in programming (C, C++) and in data analysis.

We will appreciate candidates with the following skills (optional):

- Knowledge in fluid dynamics
- Knowledge in statistical physics
- Knowledge in stochastic differential equations
- Rigorous, autonomous and creative thinking
- Interest in environmental applications

Avantages

- 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
- Contribution to mutual insurance (subject to conditions)

Rémunération

Traineeship grant depending on attendance hours.

Informations générales

- **Thème/Domaine :** Approches stochastiques
  Calcul Scientifique (BAP E)
- **Ville :** Sophia Antipolis
- **Centre Inria :** Centre Inria d'Université Côte d'Azur
- **Date de prise de fonction souhaitée :** 2025-03-01
- **Durée de contrat :** 6 mois
- **Date limite pour postuler :** 2025-02-28

Contacts

- **Équipe Inria :** CALISTO
- **Recruteur :**
  Henry Christophe / christophe.henry@inria.fr

A propos d'Inria

Inria est l'institut national de recherche dédié aux sciences et technologies du numérique. Il emploie 2600 personnes. Ses 215 équipes-projets agiles, en général communes avec des partenaires académiques, impliquent plus de 3900 scientifiques pour relever les défis du numérique, souvent à

l'interface d'autres disciplines. L'institut fait appel à de nombreux talents dans plus d'une quarantaine de métiers différents. 900 personnels d'appui à la recherche et à l'innovation contribuent à faire émerger et grandir des projets scientifiques ou entrepreneuriaux qui impactent le monde. Inria travaille avec de nombreuses entreprises et a accompagné la création de plus de 200 start-up. L'institut s'efforce ainsi de répondre aux enjeux de la transformation numérique de la science, de la société et de l'économie.

L'essentiel pour réussir

We are looking for M2 candidates with a major in:

- Applied Mathematics (Numerical methods, Statistics),
- Physics (Statistical Physics, Fluid Dynamics),
- Scientific Modeling
- and/or Computer Sciences (numerical simulations).

Attention: Les candidatures doivent être déposées en ligne sur le site Inria. Le traitement des candidatures adressées par d'autres canaux n'est pas garanti.

Consignes pour postuler

Applications must be submitted online on the Inria website. Collecting applications by other channels is not guaranteed.

Sécurité défense :
Ce poste est susceptible d'être affecté dans une zone à régime restrictif (ZRR), telle que définie dans le décret n°2011-1425 relatif à la protection du potentiel scientifique et technique de la nation (PPST). L'autorisation d'accès à une zone est délivrée par le chef d'établissement, après avis ministériel favorable, tel que défini dans l'arrêté du 03 juillet 2012, relatif à la PPST. Un avis ministériel défavorable pour un poste affecté dans une ZRR aurait pour conséquence l'annulation du recrutement.

Politique de recrutement :
Dans le cadre de sa politique diversité, tous les postes Inria sont accessibles aux personnes en situation de handicap.