Offre n°2025-08705

PhD Position F/M Rare-event detection with local pattern modeling for large scale physical simulations

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

Type de contrat : CDD

Niveau de diplôme exigé : Bac + 5 ou équivalent

Fonction : Doctorant

A propos du centre ou de la direction fonctionnelle

The Inria Saclay-Île-de-France Research Centre was established in 2008. It has developed as part of the Saclay site in partnership with **Paris-Saclay University** and with the **Institut Polytechnique de Paris** .

The centre has **40 project teams**, 27 of which operate jointly with Paris-Saclay University and the Institut Polytechnique de Paris; Its activities occupy over 600 people, scientists and research and innovation support staff, including 44 different nationalities.

Contexte et atouts du poste

This PhD focuses on developing novel unsupervised machine learning techniques for rare-event detection in large-scale physics simulations on high-performance computing (HPC) clusters. By leveraging in situ processing, the goal is to efficiently characterize local data distributions, identifying rare but meaningful events and anomalies while minimizing computational and communication overhead. The project will explore convolutional dictionary learning and hybrid unrolled models to enhance interpretability and scalability, with a strong emphasis on benchmarking and integration into real-world scientific applications. The research aims to

contribute to machine learning for science by improving event detection methodologies and fostering interdisciplinary collaborations.
The results of this thesis will be published in ML conferences as well as integrated into dedicated benchmarking packages such as benchopt, to improve the impact of the work and the quality of ML benchmarks.

Mission confiée

This project aims to provide guidelines to develop tools needed for efficient discovery of rare events and
anomalies. For the first year, indicative planning can be split into trimesters:
• First trimester: Bibliography and synthesis of existing practices for rare-event discovery. Study of basic methods
based on CDL reconstruction error.
• Second trimester: Derivation of a first algorithm to detect surprising events based on CDL. Definition of an
experimental protocol to evaluate the different methods.
• Third trimester: Theoretical and experimental evaluation of the proposed method on multiple benchmarks.
Particular care will be taken with the statistical validity of the results and the ease of use.
• Fourth trimester: Synthesis of the obtained results and redaction of a first conference paper on evaluating
confidence interval during a random search with reduced repetitions.

The second year will be aimed toward building hybrid unrolled model to characterize normal patterns and detect
anomalous reconstruction in novel signals. During the first trimester, the candidate will explore classical unrolling
techniques in line with the CDL-based approach studied during the first year. This work will serve as a basis in
the next 6 months to allow deriving a transformer-based architecture which will expand on capacity of our model to
characterize unseen signals. This will be applied to various existing benchmarks and the validity of the conclusion will
be evaluated on HPC simulation results. By the end of the second year, we expect the candidate would have published
a conference and a journal paper.

Principales activités

Main activity: Conduct research on event detection models for physical signals.

Additional activity: Participate in the development of the team's open source software.

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 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
- Social security coverage

Rémunération

Gross salary : 2.200 euros/month

Informations générales

- **Thème/Domaine :** Optimisation, apprentissage et méthodes statistiques
  Calcul Scientifique (BAP E)
- **Ville :** Palaiseau
- **Centre Inria :** Centre Inria de Saclay
- **Date de prise de fonction souhaitée :** 2025-04-01
- **Durée de contrat :** 3 ans
- **Date limite pour postuler :** 2025-04-30

Contacts

- **Équipe Inria :** MIND
- **Directeur de thèse :**
  Moreau Thomas / thomas.moreau@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'e?orce ainsi de répondre aux enjeux de la transformation numérique de la science, de la société et de l'économie.

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

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.