Offre n°2025-08885

PhD Position F/M PhD - Uncertainty Quantification for PET reconstructed images with AI

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

Type de contrat : CDD

Niveau de diplôme exigé : Bac + 5 ou équivalent

Fonction : Doctorant

Niveau d'expérience souhaité : Jeune diplômé

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 (15 teams) and the Institut Polytechnique de Paris (12 teams). Its activities occupy over 600 people, scientists and research and innovation support staff, including 44 different nationalities.

The centre also hosts the **Institut DATAIA**, dedicated to data sciences and their disciplinary and application interfaces.

Contexte et atouts du poste

In the context of the ANR AAIMME project centered on the use of AI for Positron Emission Tomography (PET), a medical imaging modality, the aim of this PhD

thesis is to investigate uncertainty quantification in PET reconstructed images with AI.

Subject: PET is a functional and quantitative nuclear medicine imaging modality, with applications in oncology, neurology and pharmacology. Estimating images of the injected radiotracer distribution to the patient from the acquired tomographic data is a large-scale ill-posed inverse problem (typically millions of estimates for hundreds of millions of projections) that requires numerically efficient reconstruction methods.
AI-based techniques developped in this context have led to superior signal to noise ratio and contrast recovery compared to generic (non-AI) reconstruction techniques. This opens up the possibility to a reduce the dose injected to the patient without sacrificing image quality and quantification [1]. However a major challenge remains to obtain reliable quantitative estimates.
In the Opis and BioMaps teams, several reconstruction techniques (deep unrolling and Plug and Play) have been proposed for robust image reconstruction using AI [2,3]. In parallel, the teams have investigated uncertainty quantification using Bayesian Neural Networks (BNN) [4] and the posterior bootstrap framework for classical reconstruction [5]. This PhD thesis proposes to investigate the use of these techniques to obtain reliable and robust estimates in PET reconstructed images.

[1] A. J. Reader et al, "Deep Learning for PET Image Reconstruction," in IEEE Transactions on Radiation and Plasma Medical Sciences, vol. 5, no. 1, pp. 1-25, Jan. 2021
[2] F. Sureau et al, « Convergent ADMM Plug and Play PET Image Reconstruction ». Proceedings of the 17th International Meeting on Fully3D In Radiology and Nuclear Medicine; Stony Brook, 2023.
[3] M. Savanier et al. "Deep unfolding of the DBFB algorithm with application to ROI CT imaging with limited angular density." IEEE Transactions on Computational Imaging 9 (2023): 502-516.
[4] Y. Huang et al, « Efficient bayes inference in neural networks through adaptive importance sampling », Journal of the Franklin Institute, Volume 360, Issue 16, pp 12125-12149, 2023,
[5] Filipovi?, Marina, et al. "Reconstruction, analysis and interpretation of posterior probability distributions of PET images, using the posterior bootstrap." Physics in Medicine & Biology 66.12 (2021): 125018.

Mission confiée

Missions: The recruited student will first implement a BNN, train it on a denoising task and test uncertainty quantification on simple simulated reconstructed PET images. In a second step, deep unrolling of a reconstruction algorithm involving BNNs will be carried out to provide uncertainties.

Environment: The phd student will be supervised by Emilie Chouzenoux (Head of OPIS team, Inria Saclay) and Florent Sureau (CEA researcher, BioMaps Laboratory). The student will join the Inria Saclay team OPIS (https://opis-inria.eu/). He/she will be located in the Centre de la Vision Numérique, in

CentraleSupélec campus, Saclay, France. He/she will enjoy an international and creative environment where research seminars and reading groups take place very often. Informatic material expenses will be covered within the limits of the scale in force.

Principales activités

Main activities :

Programming in Python environment

Bibliographical study

Deep learning architecture design

Scientific meetings

Deep learning training/testing

Writing of scientific reports

Compétences

Languages : The candidate must be fluent in english and/or french languages.

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

2200€ gross/month

Informations générales

- **Thème/Domaine :** Optimisation, apprentissage et méthodes statistiques Statistiques (Big data) (BAP E)
- **Ville :** Gif sur Yvette
- **Centre Inria :** Centre Inria de Saclay
- **Date de prise de fonction souhaitée :** 2025-09-01
- **Durée de contrat :** 3 ans
- **Date limite pour postuler :** 2025-08-31

Contacts

- **Équipe Inria :** OPIS
- **Directeur de thèse :**
  Chouzenoux Emilie / emilie.chouzenoux@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.

L'essentiel pour réussir

We seek for a talented candidate in Master 2 studies, with a solid background in optimization, statistics, and a strong motivation for the medical imaging field. Experience in Python programming is necessary. An experience in PyTorch or TensorFlow is highly recommended.

The candidates are requested to send a CV and a motivation letter to apply for this position.

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.