Offre n°2024-07395

PhD Position F/M Artificial intelligence tools for clinical data warehouses in neuroimaging (H/F)

Type de contrat : Fixed-term contract

Niveau de diplôme exigé : Graduate degree or equivalent

Fonction : PhD Position

Contexte et atouts du poste

You will work within the ARAMIS Lab (www.aramislab.fr) at the Paris Brain Institute (https://institutducerveau-icm.org/en), one of the world top research institutes for neurosciences. The institute is ideally located at the heart of the Pitié-Salpêtrière hospital, downtown Paris. The ARAMIS Lab, which is also part of Inria (the French National Institute for Research in Digital Science and Technology), is dedicated to the development of new computational approaches for the analysis of large neuroimaging and clinical data sets. With about 40 people, the lab has a multidisciplinary composition, bringing together researchers in machine learning and statistics and medical doctors (neurologists, neuroradiologists). You will interact locally with the PhD students and engineers of the lab, as well as our medical collaborators at the Pitié-Salpêtrière hospital.

The PhD thesis will be co-directed by Ninon Burgos (Research Scientist, HDR) and Olivier Colliot (Research Director). The position is funded through the GALAN project, a large-scale national grant in collaboration between the ARAMIS Lab, the Lille Neurosciences and Cognition Research Team, the departments of neuroradiology of the Pitié-Salpêtrière hospital and of the CHU of Lille, and the teams in charge of the CDWs of AP-HP and CHU of Lille. You will be involved in these collaborations and interact with the different partners.

Mission confiée

In recent years, very large clinical data warehouses (CDW) have been created containing the medical data of millions of patients. The AP-HP (Assistance Publique-Hôpitaux de Paris) CDW brings together data from multiple hospitals in the Paris region, including clinical data, diagnoses, medical reports and medical imaging data. CDWs provide fantastic opportunities to revolutionize digital healthcare. However, harnessing CDWs for research raises major challenges, among which controlling for data quality, biases and dealing with the full range of possible disorders and medical conditions.

Our team is a pioneer on the topic of neuroimaging in CDWs. We have built the first automatic quality control system for T1-weighted brain MRI of CDWs [1,2], that we subsequently extended to FLAIR MRI [3]. We have demonstrated that AI models trained on research data failed to generalize to clinical routine data and that, when data quality is not adequately taken into account, this leads to the catastrophic phenomenon of "short-cut" learning where the AI model learns to recognize image quality in place of the radiological features of the disorders [4].

The general objective of this PhD thesis project is to develop AI-based tools to harness the full potential of neuroimaging data in CDWs and to demonstrate that they can be used to develop trustworthy and unbiased AI-assisted reading systems for neuroradiology. Specific objectives are:

- **Objective 1: build AI-based quality control (QC) tools for different types of MRI sequences,** including T2-weighted, T2*-weighted, susceptibility weighted imaging and diffusion weighted imaging. To that purpose, we will develop new approaches based on transfer learning and synthetic data generation.
- **Objective 2: build a proof-of-concept unbiased AI-assisted reading system for neuroradiology.** To that purpose, we will develop unsupervised anomaly detection to assist the detection of lesional areas, leveraging previous work from the team [5,6] while exploring new approaches such as diffusion models.

The work will also include data management and preparation tasks, installation of code and dependencies in specific environments, and performance benchmarking. The methodological developments will be integrated into ClinicaDL (https://clinicadl.readthedocs.io), an open-source software platform designed to enable reproducible neuroimaging processing with deep learning.

This project is expected to have a major impact on several aspects. It will allow researchers to fully exploit the very rich but complex neuroimaging data in CDWs, potentially leading to major new

discoveries in various fields such as a better understanding of the factors influencing healthy and pathological brain aging. The project will result in next generation AI-based diagnostic tools that are expected to generalize well and thus have a high potential for translation to the clinic.

- [1] Simona Bottani, Ninon Burgos, Aurélien Maire, Adam Wild, Sébastian Ströer, Didier Dormont, Olivier Colliot. Automatic quality control of brain T1-weighted magnetic resonance images for a clinical data warehouse. Medical Image Analysis, 2021. https://hal.inria.fr/hal-03154792v3

- [2] Sophie Loizillon, Simona Bottani, Aure□lien Maire, Sebastian Stro□er, Didier Dormont, Olivier Colliot, Ninon Burgos, APPRIMAGE Study Group. “Automatic motion artefact detection in brain T1-weighted magnetic resonance images from a clinical data warehouse using synthetic data”. Medical Image Analysis, 2024. https://hal.inria.fr/hal-03910451v2

- [3] Sophie Loizillon, Olivier Colliot, Lydia Chougar, Sebastian Stroer, Yannick Jacob, Aurélien Maire, Didier Dormont and Ninon Burgos. Semi-supervised Domain Adaptation for Automatic Quality Control of FLAIR MRIs in a Clinical Data Warehouse. In DART 2023 - 5th MICCAI Workshop on Domain Adaptation and Representation Transfer, 2023 https://inria.hal.science/hal-04273997

- [4] Simona Bottani, Ninon Burgos, Aurélien Maire, Dario Saracino, Sebastian Stroer, Didier Dormont, Olivier Colliot. Evaluation of MRI-based machine learning approaches for computer-aided diagnosis of dementia in a clinical data warehouse. Medical Image Analysis, 2023. https://inria.hal.science/hal-03656136v2

- [5] Sophie Loizillon, Yannick Jacob, Aure□lien Maire, Didier Dormont, Olivier Colliot, Burgos Ninon “Detecting Brain Anomalies in Clinical Routine with the beta-VAE: Feasibility Study on Age-Related White Matter Hyperintensities.” 2024. https://openreview.net/forum?id=YFf0vLf2T1

- [6] Ravi Hassanaly, Maëlys Solal, Olivier Colliot, and Ninon Burgos. Pseudo-healthy image reconstruction with variational autoencoders for anomaly detection: A benchmark on 3D brain FDG PET, 2024. https://inria.hal.science/hal-04445378

Principales activités

Main activities:

- research
- write scientific papers
- present work at scientific conferences
- programming
- data managagement and curation
- interact with partners (clinicians, scientists, engineers)

Compétences

- Master’s degree or engineering degree with computer science, signal/image analysis and/or applied mathematics profile
- Strong interest for medical applications
- Knowledge of deep learning
- Knowledge in digital image processing and medical imaging
- Good programming skills in Python
- Good writing skills
- Good relational and communication skills to interact with professionals from various backgrounds
- Proficient in French language

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 (after 12 months of employment)
- Professional equipment available (videoconferencing, loan of computer equipment, etc.)
- Social, cultural and sports events and activities
- Access to vocational training
- Social security coverage

Informations générales

- **Thème/Domaine :** Computational Neuroscience and Medicine
  Scientific computing (BAP E)
- **Ville :** Paris
- **Centre Inria :** Centre Inria de Paris
- **Date de prise de fonction souhaitée :** 2024-10-01
- **Durée de contrat :** 2 years
- **Date limite pour postuler :** 2024-07-31

Contacts

- **Équipe Inria :** ARAMIS
- **Directeur de thèse :**
  Colliot Olivier / Olivier.Colliot@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.

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.