Offre n°2025-08815

Post-Doctoral Research Visit F/M Longitudinal AI-based modelling for an improved characterization of post-radiotherapy brain lesions and their evolution

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

Type de contrat : CDD

Niveau de diplôme exigé : Thèse ou équivalent

Fonction : Post-Doctorant

Niveau d'expérience souhaité : De 3 à 5 ans

A propos du centre ou de la direction fonctionnelle

The Centre Inria de l'Université de Grenoble Alpes groups together almost 600 people in 22 research teams and 7 research support departments.

Staff is present on three campuses in Grenoble, in close collaboration with other research and higher education institutions (Université Grenoble Alpes, CNRS, CEA, INRAE, …), but also with key economic players in the area.

The Centre Inria de l'Université Grenoble Alpe is active in the fields of high-performance computing, verification and embedded systems, modeling of the environment at multiple levels, and data science and artificial intelligence. The center is a top-level scientific institute with an extensive network of international collaborations in Europe and the rest of the world.

Contexte et atouts du poste

Radiotherapy plays an important role in the treatment of aggressive brain tumors such as glioblastoma. Although it undeniably helps extend patients' survival, it can also be accompanied by neurological complications in the short or long term, the most frequent being leukoencephalopathy - a progressive and diffuse abnormality of the white matter characterized by demyelination, axonal loss, and vascular lesions. The underlying pathophysiological mechanisms and the processes of cognitive decline associated with leukoencephalopathy remain poorly understood.

This post-doc position is part of an ANR project entitled RADIO-AIDE for "RADIation-induced neurOtoxicity assessed by spatio-temporal modelling combined with Artificial Intelligence after brain raDiothErapy". The project is guided by the rich and multimodal data from the EpiBrainRad cohort including patients treated by RT for a high-grade glioma. More details about the project can be found at https://www.irsn.fr/recherche/projet-radio-aide

Mission confiée

In this context, the goal of the post-doc is thus to help characterizing different possible side-effects of radiotherapy and in particular white matter lesions, identified as white matter hyperintensities (WMH) in the patient brain. We will aim at investigating and developing advanced spatio-temporal (ST) models and AI tools [Young et al 2024, Couronne et al 2019] to extract, if it exists, a set of ST features which characterize WMH of different nature that may be associated either to post-RT side-effects (eg radio-induced leukoencephalopathies, radio-necrosis, post-RT oedema) or to treatment responses (eg brain tumor progression, peritumoral oedema). So doing we will help in improving knowledge about the radiosensitivity of healthy brain tissues**.**

Principales activités

More specifically, we will focus on two main sources of such WMH, leukoencephalopathies and oedema, which are not easily distinguished by radiologists when they delineate them on eg. FLAIR images. The hope is that radiomics [van Griethuysen et al 2017] and accounting for the temporal dynamics of the observed lesions will help in better separating them.

The task thus aims at adapting a radiomics approach based on multivariate statistical tools to extract specific signatures of WMH. Several attempts have been made to analyse in this way multimodal MR images but mainly in a quantitative radiomics context eg. [Arnaud et al. 2018]. In this project, we will aim at leveraging the information extracted from various MR modalities by turning it into meaningful features in order to adapt radiomics techniques. The hope is to perform a first

meaningful analysis by combining some global features**.** We will target an automated lesion identification procedure where identification includes both location and characterization via so-called signatures representative of various physiological parameters in accordance with the expected tissue types.

To extract discriminative multivariate features and turned them into individual lesion signatures, we will first investigate multivariate statistical tools based on mixtures of generalized multivariate Student distributions that allow a variety of distributional forms [Arnaud et al., 2018]. The signatures can then be subsequently pooled together to build a statistical fingerprint model of the different lesion types that captures lesion characteristics while accounting for inter-subject variability. We also propose to investigate more recent machine learning tools such as diffusions and flows in the longitudinal context [Yang et al 2024, Puglisi et al 2024] to assess their ability to directly provide spatio-temporal signature, possibly by combining them with more standard mixed effect models as for example done in [Sauty et al 2022].

References:

Arnaud A., Forbes F., et al. (2018). IEEE Transactions on Medical Imaging, doi: 10.1109/TMI.2018.2794918.

Yiyuan Yang, Ming Jin, Haomin Wen et al. A Survey on Diffusion Models for Time Series and Spatio-Temporal Data, 2024.

L. Young, N. P. Oxtoby, S. Garbarino, N. C. Fox, F. Barkhof, J. M. Schott, and D. C. Alexander,“Data-driven modelling of neurodegenerative disease progression: Thinking outside the blackbox”, Nature Reviews Neuroscience, vol. 25, no. 2, pp. 111–130, Feb. 2024.

Raphael Couronne, Marie Vidailhet, Jean-Christophe Corvol, Stephane Lehericy, and Stanley Durleman. Learning disease progression models with longitudinal data and missing values. In ISBI 2019 - International Symposium on Biomedical Imaging, Venice, Italy, April 2019.

Benoît Sauty, Stanley Durrleman. Progression models for imaging data with Longitudinal Variational Auto Encoders. MICCAI 2022, International Conference on Medical Image Computing and Computer Assisted Intervention, Sep 2022, Singapore, Singapore.

Puglisi, D. C. Alexander, and D. Ravì, Enhancing spatiotemporal disease progression models via latent diffusion and prior knowledge, 2024.

van Griethuysen, J. J. M., Fedorov, A., Parmar, C., Hosny, A., Aucoin, N., Narayan, V., Beets-Tan, R. G. H., Fillon-Robin, J. C., Pieper, S., Aerts, H. J. W. L. (2017). Computational Radiomics System to Decode the Radiographic Phenotype. Cancer Research, 77(21), e104–e107. https://doi.org/10.1158/0008-5472.CAN-17-0339.

Compétences

Machine learning, statistics, deep learning

Image processing

Neurosciences and medical applications

Software development skills: Python, TensorFlow et Pytorch

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
- Complementary health insurance under conditions

Rémunération

- 2788 gross salary per month

Informations générales

- **Thème/Domaine :** Optimisation, apprentissage et méthodes statistiques Statistiques (Big data) (BAP E)
- **Ville :** Montbonnot
- **Centre Inria :** Centre Inria de l'Université Grenoble Alpes
- **Date de prise de fonction souhaitée :** 2025-06-02
- **Durée de contrat :** 1 an, 7 mois
- **Date limite pour postuler :** 2025-05-31

Contacts

- **Équipe Inria :** STATIFY
- **Recruteur :**
  Forbes Florence / florence.forbes@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

Rich and multidisciplinary, the subject takes place in a larger project that brings together various experts in image processing and neuroimaging, statistics and machine learning, radiotherapy and neuro-oncology, as well as a start-up, Pixyl, which develops AI-based tools for clinical applications. Collaboration with Grenoble Institute of Neursciences is expected

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.