



Offre n°2025-08922

PhD Position F/M Geometric statistics on stratified quotient spaces: topologically constrained multi-atlases for brain diffeomorphometry

Type de contrat : Fixed-term contract

Niveau de diplôme exigé : Graduate degree or equivalent

Autre diplôme apprécié : Master 2

Fonction : PhD Position

Niveau d'expérience souhaité : Recently graduated

A propos du centre ou de la direction fonctionnelle

The Inria centre at Université Côte d'Azur includes 42 research teams and 9 support services. The centre'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

The PhD project will take place at Inria Center of Université Côte d'Azur in the Epione team under the supervision of Xavier Pennec, in close collaboration with Mathieu Carrière in the Datashape team. This PhD is funded for 3 years as part of the project Meditwin where many teams from Inria, 3DS (Dassault Systemes), 7 IHUs (University Research Hospitals) and other partners contribute to build personalized virtual twins of organs, metabolism and cancer, for better diagnosis and treatment

Mission confiée

The number of acquisition of biomedical images and associated clinical data is currently rapidly increasing. We can now study patients at the scale of a population of subjects to model the normal and pathological structural variations, and then simulate the disease evolution to forecast the medical outcome. Pivotal applications include the evolution of the brain in Alzheimer's and other neurodegenerative diseases, and analysis of the shape and contraction of the heart to simulate different pathologies. This is the core topic of the [Meditwin project](#) joining forces between Inria and 3DS.

Building generative models simulating the organs function and pathologies however requires prior models of the organs anatomy so that the simulation becomes patient-specific. Establishing representative spatial models of the anatomy at the scale of a population of subjects is the goal of computational anatomy. A classical method is to compute the mean shape (called template or atlas) and encode its variability through tangent PCA or deformation modes. Despite important successes, anatomical data tend to exhibit an extensive variability than cannot be modelled with such a unimodal Gaussian model, hampering the prediction power. Thus, the field has moved in practice towards multiple atlases.

The goal of PhD is to develop new methodological techniques for modelling the very wide variability of inter-subject image registration. The PhD student will in particular investigate:

- New stratified representations of template images / shapes;
- New representations of diffeomorphism and of their action on images or shapes;
- Innovative dimension reduction on transformation spaces;
- Innovative reduced-order image registration algorithms;
- Experimentations on real-world image databases to demonstrate the power of the developed methods.

The detailed PhD objectives are described at https://www-sop.inria.fr/asclepios/recrutement/2025_PhD_Meditwin.pdf.

Principales activités

- Study the state of the art in diffeomorphic image registration, particularly based on stationary velocity fields;
- Study geometric statistics methods in stratified quotient spaces;
- Study Topological data analysis (TDA) methods applied to 3D surfaces, functions and densities;
- Develop new sparse representations of images and densities;
- Develop new methods for atlas and multi-atlas construction from 3D medical images based on these new representations;

- Realise experiments on significant databases of medical images, notably brain images;
- Write and publish the scientific results in top level scientific journals and conferences.

Compétences

- Master 2 degree with strong competences in mathematics, notably geometry and topology. Some knowledge in signal and image processing is necessary, some knowledge of medical imaging would be an important asset.
- Solid programming and IT skills are necessary (Python or C++, bash scripting, version control systems).
- Strong communication abilities with fluent English (written and spoken)

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

Duration: 36 months

Location: Sophia Antipolis, France

Gross Salary per month: 2200€ (2025)

Informations générales

- **Thème/Domaine** : Optimization, machine learning and statistical methods
Statistics (Big data) (BAP E)
- **Ville** : Sophia Antipolis
- **Centre Inria** : [Centre Inria d'Université Côte d'Azur](#)
- **Date de prise de fonction souhaitée** : 2025-10-01
- **Durée de contrat** : 3 years
- **Date limite pour postuler** : 2025-08-31

Contacts

- **Équipe Inria :** [EPIONE](#)
- **Directeur de thèse :**
Pennec Xavier / Xavier.Pennec@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

- Passion for research and willingness to advance the state of the art up to real world prototypes.
- Competences for abstraction, theory and implementation.
- Interest in geometry, topology and programming.

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.