



Offer #2025-08922

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

Contract type : Fixed-term contract

Level of qualifications required : Graduate degree or equivalent

Other valued qualifications : Master 2

Fonction : PhD Position

Level of experience : Recently graduated

About the research centre or Inria department

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.

Context

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

Assignment

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.

Main activities

- 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.

Skills

- 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)

Benefits package

- 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)

Remuneration

Duration: 36 months

Location: Sophia Antipolis, France

Gross Salary per month: 2200€ (2025)

General Information

- **Theme/Domain** : Optimization, machine learning and statistical methods
Statistics (Big data) (BAP E)
- **Town/city** : Sophia Antipolis
- **Inria Center** : [Centre Inria d'Université Côte d'Azur](#)
- **Starting date** : 2025-10-01
- **Duration of contract** : 3 years
- **Deadline to apply** : 2025-08-31

Contacts

- **Inria Team :** [EPIONE](#)
- **PhD Supervisor :**
Pennec Xavier / Xavier.Pennec@inria.fr

About Inria

Inria is the French national research institute dedicated to digital science and technology. It employs 2,600 people. Its 200 agile project teams, generally run jointly with academic partners, include more than 3,500 scientists and engineers working to meet the challenges of digital technology, often at the interface with other disciplines. The Institute also employs numerous talents in over forty different professions. 900 research support staff contribute to the preparation and development of scientific and entrepreneurial projects that have a worldwide impact.

The keys to success

- 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.

Warning : you must enter your e-mail address in order to save your application to Inria. Applications must be submitted online on the Inria website. Processing of applications sent from other channels is not guaranteed.

Instruction to apply

Applications must be submitted online on the Inria website. Collecting applications by other channels is not guaranteed.

Defence Security :

This position is likely to be situated in a restricted area (ZRR), as defined in Decree No. 2011-1425 relating to the protection of national scientific and technical potential (PPST). Authorisation to enter an area is granted by the director of the unit, following a favourable Ministerial decision, as defined in the decree of 3 July 2012 relating to the PPST. An unfavourable Ministerial decision in respect of a position situated in a ZRR would result in the cancellation of the appointment.

Recruitment Policy :

As part of its diversity policy, all Inria positions are accessible to people with disabilities.