Offer #2025-08821

PhD Position F/M Triangulating stratified spaces

Contract type : Fixed-term contract

Level of qualifications required : Graduate degree or equivalent

Fonction : PhD Position

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 di?erent 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 regiona 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

PhD-opening in the ANR StratMesh project

OVERVIEW AND CONTEXT:

We offer a 3-year paid PhD position without obligated teaching (it is optional) at the Inria centre Université Côte d'Azur within an ANR project on triangulating stratified

spaces and applying these triangulations for the medial axis and symmetry set. This project is a joint project between us (Jean-Daniel Boissonnat and Mathijs Wintraecken, Datashape), the Inria teams GAMBLE (Nancy) and OURAGAN (Paris) and our partners in Nantes. The day-to-day supervision will be by Mathijs Wintraecken the `directeur de these' will be Pierre Alliez of the Titane team (also at Inria centre Université Côte d'Azur).

CONTACT:

If you are interested in the position please contact me at mathijs.wintraecken ``at'' inria.fr

STARTING DATE:

The starting date is negotiable, and preferably before 1st of March 2026. However, I hope to conduct the first round of interviews before summer 2025.

Assignment

KEYWORDS:

Stratified spaces, Triangulating/Meshing, Manifold and stratification learning, Shape learning, Persistent homology/topological data analysis

SCIENTIFIC GOALS:

Manifolds are the generalizations of surfaces to arbitrary dimension, while stratified spaces consist of manifold pieces but can contain non-smooth ridges and singularities. These spaces occur naturally in many different fields ranging from mechanical engineering and numerical hydrodynamics to algebraic geometry. Moreover, triangulations or meshes (that is combinations of vertices, edges, triangles, etc. that correctly represent underlying space) of these spaces are needed for computations. In spite of the fact that stratified spaces are ubiquitous in physics, engineering and (applied) mathematics, little progress has been made on triangulations of these spaces beyond 3D and even in 3D many challenges remain.

The goal of the StratMesh project and this PhD-project is to triangulate a specific type of stratified spaces, namely those that are given by equations but in arbitrary dimension and codimension.

This is strongly connected with manifold learning or stratification learning, because triangulations allow us to represent a learned shape efficiently and in a way that is relatively straightforward to manipulate.

The medial axis and symmetry set are two examples of stratified space that are used in e.g. shape learning/recognition and shape segmentation. The medial axis lies in the centre of a shape and captures many aspects of its geometry and topology. Formally it consists of the points in ambient space that do not have a unique closest point on the set itself. We'll apply the general theory and algorithms which we'll

develop in the first part of the project to this context. If time allows, we'll use this in combination with topological data analysis (persistent homology techniques) to develop new shape descriptors. The part concerning shape descriptors will be in collaboration with Erin Chambers, University of Notre Dame, IN, USA.

REFERENCES:

Boissonnat, JD., Wintraecken, M. The Topological Correctness of PL Approximations of Isomanifolds. Found Comput Math 22, 967–1012 (2022). https://doi.org/10.1007/s10208-021-09520-0

Boissonnat, JD., Kachanovich, S., Wintraecken, M. Tracing Isomanifolds in R^d in Time Polynomial in d using Coxeter–Freudenthal–Kuhn Triangulations, SIAM Journal on Computing 52, 452-486 (2023). https://doi.org/10.1137/21M1412918 and https://hal.science/hal-04083489/file/SIAMAuthor.pdf

Main activities

Conduct research in the context of the PhD project, follow the literature and communicate the results of the research both in France and internationally.

Skills

There is some flexibility within the context of the project and the student could put his/her own accents on the research (in particular more or less implementation of algorithms can be negotiated). The ideal candidate would have some familiarity with at least two of the following (I would not expect a potential PhD student to be familiar with all, this is not a senior postdoc):

-Computational geometry, in particular meshing

-Differential geometry

-Computational topology

-Whitney stratified spaces

-Programming in C++

-(Differential) topology

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
- Social security coverage

Remuneration

Duration: 36 months
Location: Sophia Antipolis, France
Gross Salary per month: 2200€ (2025)

General Information

- **Theme/Domain :** Algorithmics, Computer Algebra and Cryptology Scientific computing (BAP E)
- **Town/city :** Sophia Antipolis
- **Inria Center :** Centre Inria d'Université Côte d'Azur
- **Starting date :** 2025-09-01
- **Duration of contract :** 3 years
- **Deadline to apply :** 2025-05-16

Contacts

- **Inria Team :** DATASHAPE
- **PhD Supervisor :**
  Wintraecken Mathijs / mathijs.wintraecken@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

REQUIREMENTS:

The candidate needs to have (or be close to completing) a Master's thesis in computer science, mathematics, or a closely related field. In exceptional circumstances students who followed a 4-year bachelor program will also be considered. The students need to be able to communicate clearly in English (both written and spoken). Basic knowledge of French may make some things easier in daily life, but is not required.

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

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.