



Offer #2025-08816

**Post-Doctoral Research Visit F/M CWI-
Inria postdoctoral fellowship on
structure-preserving model reduction of
nonlinear conservation laws**

Contract type : Fixed-term contract

Level of qualifications required : PhD or equivalent

Fonction : Post-Doctoral Research Visit

Level of experience : From 3 to 5 years

About the research centre or Inria department

The Inria center at the University of Bordeaux is one of the nine Inria centers in France and has about twenty research teams.. The Inria centre is a major and recognized player in the field of digital sciences. It is at the heart of a rich R&D and innovation ecosystem: highly innovative SMEs, large industrial groups, competitiveness clusters, research and higher education players, laboratories of excellence, technological research institute...

Context

Every year Inria International Relations Department offers a few postdoctoral positions in order to support Inria's international collaborations. This postdoctoral offer will be in collaboration with the **Inria-CWI** (Centrum Wiskunde & Informatica) center in the **Netherlands**. The CWI and Inria have a long history of cooperation and scientific dialogue, and the two institutes have strengthened their collaboration and formalized their partnership by signing a new strategic agreement

in 2023.

The postdoctoral contract will have a duration of between 12 to 24 months. The expected start date is **November 1st, 2025** and not later than **January, 1st 2026**. The postdoctoral fellow will be recruited in the Inria Center of Bordeaux, France, but it is recommended to split time between France and the Netherlands (please note that the postdoctoral fellow has to start their contract being in France and visits have to follow Inria rules for missions).

Assignment

Candidates for postdoctoral positions are recruited after the end of their Ph.D. or after a first post-doctoral period: for the candidates who obtained their PhD in the Northern hemisphere, the date of the Ph.D. defense shall be later than **September 1, 2022**; in the Southern hemisphere, later than **April 1, 2022**. In order to encourage mobility, the postdoctoral position must take place in a scientific environment that is truly different from the one of the Ph.D. (and, if applicable, from the position held since the Ph.D.); particular attention is thus paid to French or international candidates who obtained their doctorate abroad.

Main activities

The postdoctoral project fits in the ongoing Inria-CWI Associate Team SPADES <https://team.inria.fr/memphis/spades-associate-team/>. The project SPADES (Structure-Preserving Approximations of Dynamical systems in Engineering and Science) focuses on the development and the analysis of structure-preserving model reduction techniques for conservation laws. Long research stays at CWI Amsterdam will be encouraged.

The postdoctoral project will focus on the development of space-time structure-preserving model reduction of parametric compressible flows, with emphasis on the compressible Euler and the Navier-Stokes equations.

Reduced order models introduce a further layer of approximation compared to the corresponding high-fidelity models, being designed to enable fast and efficient simulations while maintaining an acceptable level of accuracy. This is particularly important in parametric problems, when simulations need to be repeated many times under different input parameters. To allow for further reduction, we consider **space-time techniques** [1,2] as they enable model reduction of temporal degrees of freedom as well, as opposed to more traditional time-marching high-fidelity methods. Thus, space-time techniques have the potential to achieve much more significant speedups for parametric problems.

However, the development of reduced models with a low computational cost, which at the same time retain the physical properties and structures of high-fidelity models,

remains a major challenge. In this project, we shall focus on the development of **energy- and entropy-stable** numerical methods, to ensure nonlinear stability and accuracy of the numerical scheme, as well as consistency with the physics of the problem [3]. Such a property is also compelling in the case of discontinuities as it allows the method to capture the correct weak solution.

We also plan to address the development of effective deterministic and/or stochastic **closure terms** to model the effect of the truncated modes on the dominant dynamics (*truncation error*). Since we use standard (time-marching) high-fidelity models for snapshot generation, while using fully-implicit space-time methods for the construction of the reduced-order model, the closure model should also account for the discrepancy between the high-fidelity model and the reduced-order model (*model error*).

A tentative program of the project is as follows.

- Review of entropy- and energy-stable high-order methods and projection-based model reduction techniques for conservation laws.
- Design and implementation of space-time model reduction techniques for subsonic inviscid and viscous flows. We shall focus on the development of provably semi- and fully-discrete entropy- and energy-stable reduced models. We shall develop a space-time method for both high-fidelity and reduced-order computations, to facilitate the assessment of the model reduction procedure.
- Extension to shock-dominated (transonic, supersonic, all-Mach) flows. Such an extension requires to introduce limiting strategies to prevent oscillatory behaviors; it also probably requires the use of nonlinear data compression techniques.

Skills

The candidate should have a strong background in numerical methods for PDEs and good programming skills. Background in (i) projection-based MOR techniques, (ii) computational fluid dynamics, (iii) neural ODEs for closure modeling will be highly valued.

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 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

The monthly will be 2927€ (before social security contributions and monthly withholding tax).

General Information

- **Theme/Domain** : Numerical schemes and simulations
Scientific computing (BAP E)
- **Town/city** : Talence
- **Inria Center** : [Centre Inria de l'université de Bordeaux](#)
- **Starting date** : 2025-11-01
- **Duration of contract** : 2 years
- **Deadline to apply** : 2025-06-01

Contacts

- **Inria Team** : [MEMPHIS](#)
- **Recruiter** :
Taddei Tommaso / tommaso.taddei@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

The applicant should hold a PhD degree in scientific computing, or a related field and have an excellent track record of publications in scientific computing.

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

If you are interested by this job, please could you apply on website [jobs.inria](http://jobs.inria.fr) with the following documents :

- cv
- cover letter

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.