



**Offer #2023-06961**

## **Post-Doctoral Research Visit F/M Structure preserving and multidimensional well balanced discretizations for conservation laws**

**Contract type** : Fixed-term contract

**Renewable contract** : Yes

**Level of qualifications required** : PhD or equivalent

**Fonction** : Post-Doctoral Research Visit

### **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**

This project takes place within ongoing collaborations between the Inria CARDAMOM team, the math department at University of Bordeaux (W. Basukow), SISSA In Italy (D. Torlo), TU Clausthal in Germany (P. Oeffner), Vellore Institute of Technology in India (Y Mantri), and University of Malaga in Spain (C. Parés).

The recruited person will be working in the CARDAMOM inria team in Bordeaux with strong interactions and exchanges with the mentioned collaborators.

### **Assignment**

#### Context

This project follows the line of long term reserach on the development of improved discretizations for complex PDEs. Here the main focus are hyperbolic balance laws arising in many applications in physics and engineering. More particularly this project looks at so called structure preserving methods which embed genuinely discrete analogs of continuous constraints. Examples are solenoidal constraints and curl involutions, which also include he enhanced preservation of steady states, often referred to as well balanced. Other constraints as non-negativity or bounded variation within physically admissible values are also of great importance.

This work follows initial activities on the so called global flux quadrature (GFQ) approach, which has been shown to provide great enhancements in the approximation of stationary states, including multiD solenoidal constraints (see e.g. [\[GFQ-preprint\]](#) to appear on J.Comput.Phys., or [\[GFQ-talk\]](#) presented at the [Workshop on numerical approximation of hyperbolic PDEs in honor of Prof. Carlos Parés' 60th birthday](#) )

The postdoc will contribute to the investigation of several possible extensions of the approach, going from its application to more complex PDE systems, to the methodological enhancements discussed below.

### **Main activities**

Specifically, we aim in the coming years to develop the following aspects

- applications of the GFQ approach to nonlinear complex multidimensional systems (Shallow Water equations, Euler equations with gravity, Maxwell equations, MHD, etc)
- development of subcell limiting strategies compatible with GFQ
- use of the GFQ strategy to enhance the solution of unsteady problems : space time formulations and ADER
- combination of GFQ with different numerical techniques: continuous and discontinuous finite elements, finite differences, finite volumes
- Entropy conservative/stable formulations

The relations with other techniques as e.g. dimension by dimension extensions of the correction method using local solutions of 1D Cauchy problem proposed in [\[CP20\]](#) will also be investigated, as well as their coupling with high order embedded boundary techniques, somewhat in the spirit of [\[C23,S18\]](#).

## Skills

Technical skills and level required :

The candidate must have a strong background in the development and implementation of high order methods for hyperbolic PDES (finite volume and/or difference and/or finite element and/or discontinuous Galerkin). High proficiency in programming (C, C++, Fortran or Python) is also a must.

Languages :

English at good working level.

Relational skills :

The candidate must be able to work in an international environment involving multiple collaborators, and be willing to travel.

## 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 partial 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

gross monthly salary : 2788€ (before social security charges and income tax deduction)

## 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** : 2024-07-01
- **Duration of contract** : 12 months
- **Deadline to apply** : 2024-06-27

## Contacts

- **Inria Team** : [CARDAMOM](#)
- **Recruiter** :  
Ricchiuto Mario / [Mario.Ricchiuto@inria.fr](mailto:Mario.Ricchiuto@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 person recruited must be a motivated young researcher, passionate for the development of advanced numerical techniques for hyperbolic PDES, and applications.

The candidate must be willing to look at both theoretical aspects related to the formulation and properties of the methods, as well as their implementation in high performance codes.

**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

Please send the following documents :

- CV
- Cover letter
- Support letters (mandatory)
- List of publication

**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.