



Offer #2024-07997

Post-Doctoral Research Visit F/M Adaptivity (regularization, solvers, meshes) and a posteriori error estimators for the geological sequestration of CO₂ in the framework of the SPE 11 benchmark

Contract type : Fixed-term contract

Level of qualifications required : PhD or equivalent

Fonction : Post-Doctoral Research Visit

Context

- Inria team SERENA, <https://team.inria.fr/serena>
- IFP Energies nouvelles, <https://www.ifpenergiesnouvelles.com/>
- international collaborations/travel to conferences/workshops

Assignment

Subject

The recruited person is supposed to work on numerical simulation of the **geological sequestration of CO₂**, more precisely in the context of the **SPE 11 benchmark** <https://www.spe.org/en/csp/>. The work more precisely concerns integrated discretization–regularization–linearization–algebraic resolution .

Main goals

The main goals are to:

1. Put in place a **posteriori error estimators** which allow to quantify the error between the numerical approximation (known) and the exact solution (unknown).
2. Develop **adaptive balancing** strategy for the **regularization parameter**, the iterative **linearization** algorithm (Newton), and the iterative **linear algebraic solver**. This should lead to robust solvers and enable to significantly reduce the usual number of linear and nonlinear iterations.
3. Develop adaptive steering of the choice of **time step** and of the **local mesh refinement**. This will lead to adaptive front tracking and automatic recognition of viscous and gravitational phenomena.

All these points are requested in the SPE 11 specification and their successful addressing should lead to more robust simulations and significant gain in the total simulation time without compromising the quality of the results. Moreover, control of the precision of approximate solution will be ensured.

References and links

Description of the problem, a state of the art, and bibliography are available in the scientific papers <https://doi.org/10.1137/120896918>, <https://doi.org/10.1016/j.jcp.2014.06.061>, <https://doi.org/10.1016/j.cma.2023.116558>, <https://doi.org/10.1016/j.cma.2017.11.027> and at the following URL: <https://project.inria.fr/gatipor/publications/>.

Responsibilities

The person recruited will be responsible for theoretical developments and their computer implementation.

Main activities

- Design of **integrated discretization–regularization–linearization–algebraic resolution numerical approaches** for approximate solution of partial differential equations (PDEs).
- Development of a **posteriori estimates** on the error between the unknown PDE solution u and an available numerical approximation $u_H^{j,k,i}$ obtained on a computational mesh T_h , regularization step j , linearization step k , and linear algebraic solver step i .
- Distinguish the **different error components**, namely the discretization, regularization, linearization, and algebraic resolution ones.
- **Steer** all these ingredients **adaptively** (adaptive regularization, adaptive inexact linearization).
- Application to the **SPE 11 benchmark** <https://www.spe.org/en/csp/>.

Skills

Ph.D. in numerical analysis and scientific computing (finite element methods, linearization methods (Picard, Newton, L-scheme), multigrid/domain decomposition algebraic solvers). Programming skills in C++.

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

General Information

- **Theme/Domain** : Earth, Environmental and Energy Sciences
Biologie et santé, Sciences de la vie et de la terre (BAP A)
- **Town/city** : Paris
- **Inria Center** : [Centre Inria de Paris](#)
- **Starting date** : 2025-01-01
- **Duration of contract** : 12 months
- **Deadline to apply** : 2024-10-24

Contacts

- **Inria Team** : [SERENA](#)
- **Recruiter** :
Vohralík Martin / Martin.Vohralik@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.

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.