Paris, March 15, 2024

Post-doc position, Inria Paris / IFP Energies nouvelles

Title: Adaptivity (regularization, solvers, meshes) and a posteriori error estimators for the geological sequestration of CO2 in the framework of the SPE 11 benchmark

Subject

The proposed post-doc concerns integrated discretization–regularization–linearization–algebraic resolution 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 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. The work will be carried out in collaboration between the project-team SERENA https://team.inria.fr/serena/ of Inria Paris https://www.inria.fr/centre/paris (joint team with the CERMICS https://cermics-lab.enpc.fr/ laboratory at the Ecole des Ponts ParisTech) and IFP Energies nouvelles https://www.ifpenergiesnouvelles.fr/.

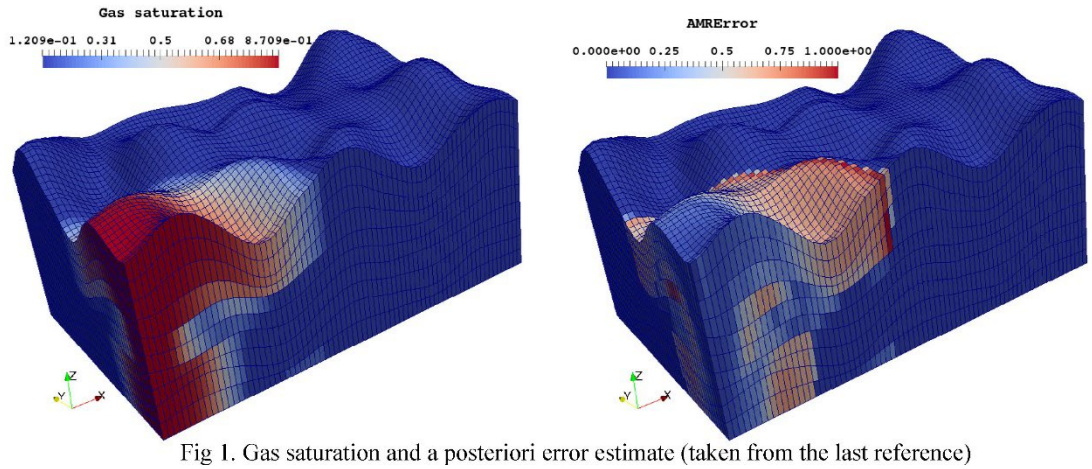

Fig 1. Gas saturation and a posteriori error estimate (taken from the last reference)

References

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

Profile of a candidate

Ph.D. in numerical analysis and scientific computing (finite element or volume methods, linearization methods (Picard, Newton), applications to flows in porous media, programming skills (C, C++, Matlab).

Practicalities

Timing: 1 year with possible prolongation, starting spring/summer 2024.
Location: Inria Paris and IFP Energies nouvelles, Rueil-Malmaison.
The knowledge of French language is welcome but by no means compulsory.

Application

Send CV highlighting your background in numerical analysis, scientific computing, flows in porous media, and programming, a very brief motivation letter, and recommendation letter(s) to Martin Vohralík martin.vohralik@inria.fr, Soleiman Yousef soleiman.yousef@ifpen.fr, and Eric Flauraud eric.flauraud@ifpen.fr.

RESEARCH CENTRE OF PARIS
2 rue Simone Iff
CS 42112
75589 Paris Cedex 12
Tél. : +33 (0)1 80 49 40 00

www.inria.fr