2018-00591 - Postdoctoral position on the high performance simulation of geothermal systems, ANR CHARMS: quantitative Reservoir ModelS for Complex Hydrothermal Systems

Niveau de diplôme exigé : Thèse ou équivalent
Fonction : Post-Doctorant

Contexte et atouts du poste

Geothermal energy is a carbon-free steady energy source with low environmental impact. In countries with a favorable geological context, high temperature geothermal energy can make a significant contribution to power production. On the French territory, it is already an attractive option in volcanic islands context compared to importing fossil fuel. Today, about 5 percent of yearly electricity consumption of Guadeloupe already comes from geothermal energy and it is essential for achieving energetic and environmental targets, according to which the overseas territories should produce 50 percent of their electricity consumption from renewable resources by 2050 and achieve their energy autonomy in 2030. As for other parts of the world, the geothermal development potential of the Caribbean islands is high and several industrial projects are in preparation or already underway, in French overseas territories (Guadeloupe, Martinique) as well as in nearby islands (Dominica, Montserrat).

Numerical modeling has become essential in all phases of geothermal operations. It is used in the exploration phases to assess the geothermal potential, validate conceptual hypothesis and help well siting. Field development and resource management need quantitative estimation to prevent resource exhaustion and achieve its sustainable exploitation (production/injection scenarios). Finally numerical modeling is also helpful in studying exploitation-related industrial risks such as the interaction with shallow water levels (drinking water resources, hydrothermal vents or eruption).

The code ComPASS http://www.anr-charms.org/page/compass-code is an open source parallel code initiated in 2012 and co-developed by LJAD-Inria and BRGM (Bureau de Recherches Géologiques et Minières - French Geological Survey) since 2015. It is devoted to the simulation of multiphase non-isothermal Darcy flows and includes complex network of fractures/faults represented as interfaces of co-dimension one coupled to the surrounding matrix. The discretization is based on vertex and cell unknowns and is adapted to polyhedral meshes and heterogeneous media. The ComPASS code is co-developed since 2017 by the partners of the ANR CHARMS project including BRGM, LJAD-Inria, Storengy, la Maison de la Simulation and the Jacques Louis Lions laboratory. The main objective of the CHARMS project is to develop a new generation simulator for geothermal systems focusing on fluids and accounting for complex fault networks and wells.

We offer a two years research position to join the ANR CHARMS project and the ComPASS code development team. The postdoctoral position will be held in the J.A. Dieudonné department of Mathematics (LJAD) at the University Nice Sophia Antipolis (UNS) in collaboration with Roland Masson, Konstantin Brenner from Inria/LJAD and Simon Lopez from BRGM. The postdoc will be member of both the LJAD and of the OrthoMol project at the Rolando Masson laboratory. The LJAD is a part of the Louis-Jean Antoine de Bougainville University (UNS), which is a public university in Nice, France. The LJAD is a member of the University Côte d'Azur (UCA) and of the so-called “Scientific Research and Technology Community (ComUE) "Université Côte d’Azur (UCA)".”

Informations générales

- **Thème/Domaine**: Sciences de la planète, de l'environnement et de l'énergie
  Calcul Scientifique (BAP E)
- **Ville**: Nice
- **Centre Inria**: CRI Sophia Antipolis - Méditerranée
- **Date de prise de fonction souhaitée**: 01-09-2018
- **Durée de contrat**: 2 ans
- **Date limite pour postuler**: 30-05-2018

Contacts

- **Equipe Inria**: COFFEE
- **Recruteur**: Masson Roland / roland.masson@inria.fr

L'essentiel pour réussir

Applicants should have a PhD in scientific computing/applied mathematics and be familiar with scientific programming, numerical methods for PDEs and software engineering tools. They should be keen on working in a collaborative environment both for research and code development.

Conditions pour postuler

**Sécurité défense** :
Ce poste est susceptible d'être affecté dans une zone à régime restrictif (ZRR), telle que définie dans le décret n°2011-1425 relatif à la protection du potentiel scientifique et technique de la nation (PPST). L'autorisation d'accès à une zone est délivrée par le chef d'établissement, après avis ministériel favorable, tel que défini dans l’arrêté du 03 juillet 2012, relatif à la PPST. Un avis ministériel défavorable pour un poste affecté dans une ZRR aurait pour conséquence l’annulation du recrutement.

**Politique de recrutement** :
Dans le cadre de sa politique diversité, tous les postes Inria sont accessibles aux personnes en situation de handicap.

**Attention** : Les candidatures doivent être déposées en ligne sur le site Inria. Le traitement des candidatures adressées par
INRIA team Coffee (Complex Flows For Environment and Energy and join the ANR project CHARMS [http://www.anr-charms.org](http://www.anr-charms.org)

**Mission confiée**

Different research topics in connection with the CHARMS project are proposed during this two years depending on the candidate profile. They can involve typically the following topics.

- The simulation of the interaction of the subsurface with the atmosphere as an advanced boundary condition accounting for convective mass and energy transfer, liquid evaporation, rainfall and liquid outflow.
- The simulation of advanced well models represented as a set of edges of the mesh defining an oriented tree. The well model will take into account energy, mass and momentum conservation equations in the well coupled with the reservoir porous media flow and transport model.
- Positivity preserving scheme for the transient energy conservation equation.
- Application to the Bouillante geothermal field in Guadeloupe in collaboration with BRGM and other geothermal fields yet to be defined in collaboration with Storengy.

References:

F. Xing, R. Masson, S. Lopez, Parallel numerical modeling of hybrid-dimensional compositional non-isothermal Darcy flows in fractured porous media, Journal of Computational Physics, 345, pp. 637-664, 2017, [https://hal.archives-ouvertes.fr/hal-01420361](https://hal.archives-ouvertes.fr/hal-01420361)

F. Xing, R. Masson, S. Lopez, Parallel Vertex Approximate Gradient discretization of hybrid dimensional Darcy flow and transport in discrete fracture networks. Computational Geosciences, 13 december 2016. [https://hal.archives-ouvertes.fr/hal-01272498](https://hal.archives-ouvertes.fr/hal-01272498).

L. Beaude, T. Beltzung, K. Brenner, S. Lopez, R. Masson, F. Smal, J.F. Thebault, F. Xing, Parallel geothermal numerical model with faults and multibranch wells, accepted in ESAIM Proceedings, 2017. [https://hal-brgm.archives-ouvertes.fr/hal-01472944](https://hal-brgm.archives-ouvertes.fr/hal-01472944).


**Principales activités**

- Develop new physical models and numerical algorithms in the ComPASS code in collaboration with the ANR project teams
- Support the BRGM and Storengy teams for geothermal studies using ComPASS
- Write reports and articles
- Presentation in conferences

**Compétences**

Technical skills and level required : numerical methods for PDEs, scientific programming, software engineering tools

Languages : fortran, python, MPI, gitlab, petsc

Relational skills : keen on working in a collaborative environment

**Avantages sociaux**

- Subsidised catering service
- Partially-reimbursed public transport
- Social security
- Paid leave
- Flexible working hours
- Sports facilities

**Rémunération**

Gross salary per month : 2653 €