2019-01308 - Post-Doctoral Research Visit F/M Advanced thermal well modelling for high performance simulation of geothermal systems

Type de contrat : CDD de la fonction publique
Niveau de diplôme exigé : Thèse ou équivalent
Fonction : Post-Doctorant

A propos du centre ou de la direction fonctionnelle

The Inria Sophia Antipolis - Méditerranée center counts 37 research teams and 9 support departments. The center's staff (about 600 people including 400 Inria employees) is composed of scientists of different nationalities (250 foreigners of 50 nationalities), engineers, technicians and administrators. 1/3 of the staff are civil servants, the others are contractual. The majority of the research teams at the center are located in Sophia Antipolis and Nice in the Alpes-Maritimes. Six teams are based in Montpellier and a team is hosted by the computer science department of the University of Bologna in Italy. The Center is a member of the University and Institution Community (ComUE) “Université Côte d'Azur (UCA)”.

Contexte et atouts du poste

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, Simon Lopez and Farid Smai from BRGM, and Laurent Jeannin and Marc Perreaux from Storengy. The postdoc will be member of both LJAD and of the INRIA team Coffee (Complex Flows For Environment and Energy).

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 percents 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 percents of their electricity consumption from renewable resources by 2020 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 by LJAD-Inria and BRGM (Bureau de Recherches Géologiques et Minières - French Geological Survey) in 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 BGRM, 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 flow simulation tool for geothermal systems focusing on fluids and accounting for complex fault networks and wells.

Mission confiée

The objective of this postdoctoral project is to focus on advanced well modelling which plays a key role in geothermal studies both to monitor the hot fluid production and cold water injection, and to assimilate available well data measurements. At the reservoir kilometer scale, the mesh cannot resolve the well boundary with a radius of say 10 cm. It results that the well will be modelled as a 1D trajectory. Considering our nodal spatial discretization, it will be convenient and efficient to represent the 1D well trajectory as a subset of edges of the mesh, allowing to account easily for slanted or multibranch wells.

Principales activités

The thermal well model is typically based either on a Drift Flux Model (DFM) or on a No Pressure Wave (NPW) model both accounting for the mass, momentum and energy conservations along the well. This type of models must take into account the liquid and gas phases, the thermodynamical equilibrium between phases, phase compressibility, buoyancy forces, wall friction, and slip between phases. Compared with the DFM model, the NPW model considers a simplified version of the momentum equation by ignoring the pressure waves and will be preferred in this project. Its discretization in space will be based on a staggered finite volume scheme discretizing typically the pressure, temperature, volume fractions and molar fractions unknowns at the nodes of the
well while the liquid and gas velocities are discretized at the edges of the well. The well model will be considered stationary at the reservoir time scale. It will be coupled to the reservoir model using a fully implicit time integration combined with two point Fourier and Darcy fluxes taking into account the radial flow geometry. One of the major numerical difficulties to be addressed is the need for efficient and robust nonlinear and linear solvers in order to be able to use time steps that are consistent with the reservoir evolution time scale.


Compétences
Applicants should have a PhD in scientific computing/applied mathematics and be familiar with scientific programming (Fortran and/or C++, Python, MPI), numerical methods for PDEs and collaborative development tools.

Avantages
- 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

Rémunération
Gross salary per month : 2653 €

Informations générales
- Thème/Domaine : Schémas et simulations numériques
  Calcul Scientifique (BAP E)
- Ville : Nice
- Centre Inria : CRI Sophia Antipolis - Méditerranée
- Date de prise de fonction souhaitée : 2019-09-01
- Durée de contrat : 2 ans
- Date limite pour postuler : 2019-04-16

Contacts
- Equipe Inria : COFFEE
- Recruteur :
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A propos d'Inria
Inria, l'institut national de recherche dédié aux sciences du numérique, promeut l'excellence scientifique et le transfert pour avoir le plus grand impact. Il emploie 2400 personnes. Ses 200 équipes-projets agiles, en général communes avec des partenaires académiques, impliquent plus de 3000 scientifiques pour relever les défis des sciences informatiques et mathématiques, souvent à l'interface d'autres disciplines. Inria travaille avec de nombreuses entreprises et a accompagné la création de plus de 160 start-up. L'institut s'efforce ainsi de répondre aux enjeux de la transformation numérique de la science, de la société et de l'économie.

Consignes 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 d'autres canaux n'est pas garanti.