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

Level of qualifications required: PhD or equivalent
Function: Post-Doctoral Research Visit

About the research centre or Inria department

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 contractural. 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).

Context

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 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 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 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 INRIA team Coffee (Complex Flows For Environment and Energy and join the ANR project CHARMS http://www.anr-charms.org

Assignment

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:


Main activities

- 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

Skills

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

Benefits package

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

Remuneration

Gross salary per month : 2653 €