PhD Positions at the University of Lorraine (FRANCE)

Context

The RING team is seeking two outstanding PhD candidates to address research questions in integrative numerical geology. These full-time positions are for a three-year term. The PhD topics outlined below can be tailored to the interests and experience of the successful candidates.

The PhD scholarships are sponsored by an international consortium of 12 companies and 123 research institutes. The successful candidates will work in the RING Team[1], a pluridisciplinary group of 12-15 researchers and graduate students working at the interface of geoscience, computer science and applied mathematics. The team is part of Ecole Nationale Supérieure de Géologie in the GeoRessources[2] laboratory, a research lab of Université de Lorraine and CNRS. The research team is driven by passion for developing computer-based methods and theories for geological modeling, serving the geoscience community to address scientific and natural resource managements challenges. It has a strong industry partnership culture.

Location: Nancy, France. Nancy is a UNESCO World Heritage city with a vibrant student life and a rich cultural agenda, only 90 minutes away from Paris, Luxembourg and Strasbourg.

Candidate profile

The ideal candidate is passionate about science, has a solid background in applied mathematics, statistics and physics, and has strong scientific writing skills. An experience in computer programming is required. A background or a proven interest in geoscience is appreciated.

Candidates should hold a MSc in (quantitative) Earth Sciences, Geophysics or Physics, Computer Science, Geostatistics, Porous Media, Applied Mathematics, or related fields.

A strong command of English language is required. French language is preferable, but not necessary.

How to apply

Application files must be sent to jobs@ring-team.org before June 20th and must include:

- A cover letter,
- A CV, including contact information for two or more referees
- A research outcome (Master's thesis or paper) written by the candidate
- A transcript of grades Location

Possible PhD topics

1. **Trans-dimensional inversion of flow data**

   The applications of inverse problem theory to geoscience mainly consider continuous model parameters. In geology, however, some model components are discrete at the scale of concern and the number of parameters itself becomes an unknown of the problem. To address this issue, trans-dimensional methods have been developed (e.g., Bodin et al., 2009). The objective of this PhD is to consider suitable geological parameterizations and to exploit the local aspect of model updating for setting up a trans-dimensional inversion of subsurface flow data.

[1] http://ring.georessources.univ-lorraine.fr
[2] http://georessources.univ-lorraine.fr/

2. **Stokes-based restoration of structural models**
   Structural restoration is commonly used to assess the deformation of geological structures and to reconstruct past basin geometries. To bring more physical behavior and better handle large deformations in this process, a reverse-time method based on the Stokes equations was recently proposed by Schuh-Senlis et al. (2020). The goal of the PhD is to investigate the viscous properties of sedimentary materials and fault behavior at the geological time-scale in order to improve this method.
3. **Stochastic inversion of FWI images for reducing structural uncertainties**
   Owing to the lack and incompleteness of subsurface data, significant uncertainties exist on the position of structural surfaces (faults and horizons). The present project proposes to develop an innovative way of inverting seismic data to reduce uncertainties on these structures. Instead of using seismic recordings and wave propagation simulations, the method will rely on full waveform inversion (FWI) images and the homogenization operator (e.g., Cupillard & Capdeville, 2018). To be achieved, the development of efficient computing technology for geomodeling will be necessary.
4. **Stochastic simulation of karstic networks with γ-graphs** (in collaboration with LIRIS (INRIA Lyon))
   Karstic networks are complex underground assemblies of cavities and tunnels generated by the dissolution of highly soluble rocks. In the frame of virtual scene synthesis, Paris et al. (2019) propose a promising procedural approach to generate karstic features. The goal of this research will be to investigate the possibilities of a recent graph-based approach to stochastically simulate networks that honor geological information and analog data, and thus better assess the associated uncertainties. Integrating this work in an inversion framework using hydrogeological data would be also considered.

References

BODIN T & SAMBRIDGE M. (2009). Seismic tomography with the reversible jump algorithm. *Geophysical Journal International 178*(3):1411-1436. https://doi.org/10.1111/j.1365-246X.2009.04226.x

CUPILLARD P & CAPDEVILLE Y. (2018). Non-periodic homogenization of 3-D elastic media for the seismic wave equation. *Geophysical Journal International 213*(2):983-1001. https://doi.org/10.1093/gji/ggy032

PARIS A, GALIN E, PEYTAVIE A, GUÉRIN E & GAIN J. (2019). Terrain Amplification with Implicit 3D Features. *ACM Transactions on Graphics 38*(5):1-15. https://doi.org/10.1145/3342765

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