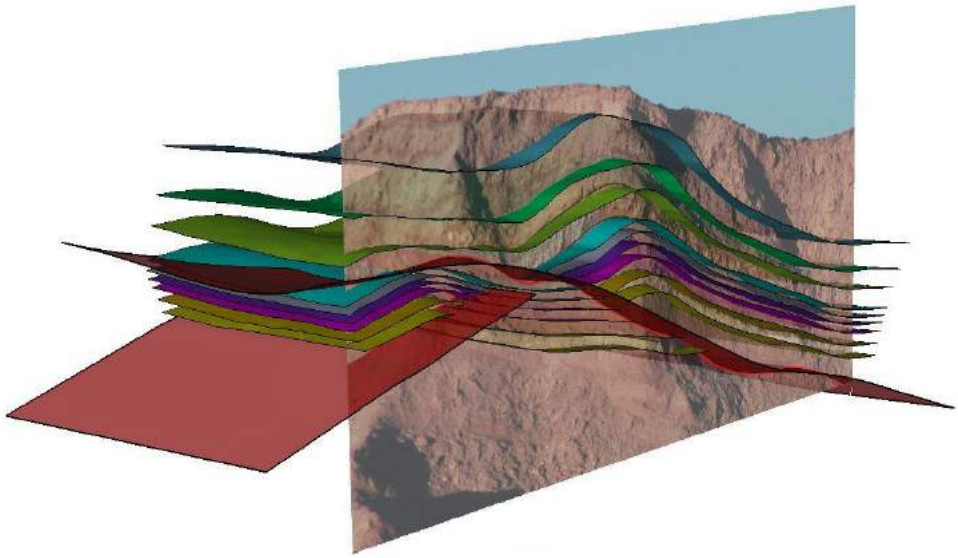
RING Team
NEWSLETTER



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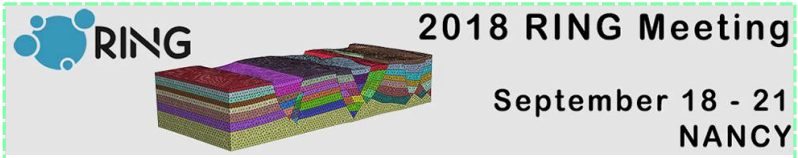


Do not forget to submit your paper !

News

New team members

Welcome to Mustapha ZAKARI, Research Engineer

After completing his PhD in Plasma Physics Modeling, Mustapha Zakari worked as a High Performance Computing postdoc for Devinci Labs and Bull in Paris. He worked on the parallelization on Bullion of a numerical model allowing the simulation of the magneto-elastic behavior of ferromagnetic materials (C ++, Finite Elements, 3D Adaptive Mesh Refinment). Mustapha was then recruited at the Institut de Physique du Globe de Paris as a Research Engineer in Scientific Computing. He worked on the improvement of different numerical models (mantle convection, landscape evolution, hydrothermal circulation, solar magnetism). He joined the Institut Jean Le Rond D'Alembert (Paris 6) where he worked for the CEA and Ecole Centrale de Lyon on various simulation methods for the propagation of infrasonic acoustic waves in the Earth's atmosphere.

Welcome to Yves FRANTZ, PhD

Yves holds a master's degree in numerical geology from ENSG (Nancy) and joined the RING team in November 2017. He did a 3 month engineering mission to develop a graph library. He has started a PhD in february on karstic system simulation under the supervision of Pauline Collon.
The main idea is to develop new methodologies to simulate karstic systems that honor available data (in particular connectivity data) and geological knowledge (e.g., inception features).
Even if he loves seeking mineral in the wild, Yves is more the indoor type and tends to spend most of his free time at home reading or spending his time on different electronic devices.

Welcome to Melchior SCHUH SENLIS, PhD

Melchior holds a master's degree in numerical geology from ENSG (Nancy) and joined the RING team as a PhD student in November 2017.
He works on the application of ALE (Arbitrary Lagrangian-Eulerian) methods to the management of complex heterogeneities for mechanical simulations on geological models. Indeed, those methods could allow to handle large deformations and faults more easily, for example in the case of geomechanical restoration. He intends to capitalize on the numerical framework already implemented in RINGMecha and RINGMesh and on the expertise on geomechanical homogenisation of the RING team to achieve this goal. He is advised by Paul Cupillard and Guillaume Caumon. Outside the lab, Melchior likes to do all kinds of artistic and handcrafting.

Welcome to Corentin GOUACHE, PhD

Corentin holds a master's degree in geological engineering from ENSG (Nancy) and in tectonic research from UL via the Terre et Planètes master (GPRE). He joined the RING team as a PhD student in January 2018.
The PhD is going to investigate seismic organisation in space, time and magnitude to improve the prediction of earthquakes and anticipate their impact. A first axis of this research work consists in adding a new component in stochastic earthquake generator. At the end, the method would be able to generate aftershocks sequences caused by major earthquakes, and to affect the surounding occurence probability of earthquakes. In this way, spatio-temporal correlations between earthquakes could be studied with machine learning methodology. The second axis consists in simulating complete seismic wave fields in realistic geological structures to finely evaluate the peak ground acceleration (PGA) for different seismic scenarios in French West Indies and around Nice. A non-periodic 3D homogenization of the target geological structures is necessary to correctly take in account the geological structures geometry. He is supervised by François Bonneau, Jean-Marc Montel (CRPG, Nancy) and Pierre Tinard (Caisse Centrale de Réassurance, Paris). After official hours, Corentin likes reading, doing sport and hiking.

News

Past conferences:

o Ring was at the **4th European Meeting on 3D Geological Modelling** in Orleans presenting RingMesh and the team's science. Thanks to BRGM and organising committee that allowed us to share with academia and surveys on interoperability and modelling challenges.

o RING had a booth at the **GEO 2018 Conference and Exhibition** in Bahrein. This was a great opportunity to advertise RING to the attendees and to discuss about the potential of RING technologies to address some geomodeling challenges of the Middle East.

Upcoming conferences:

80th EAGE Conference & Exhibition 2018
Copenhagen, Denmark
11 – 14 June
o Finite difference implicit modeling of geological structures, (Irakarama et al.)
o A graph-based method to detect and correct invalid features in subsurface structural models (P. Anquez, J. Pellerin and G. Caumon)
o RINGMesh: An open-source platform for shared Earth Modeling, (Bonneau et al.)
o Implicit structural modeling with local meshless functions, (J. Renaudeau, E. Malvesin, F. Maerten, G. Caumon)
o A workflow for 3D stochastic modeling of salt from seismic images (N. Clausolles, P. Collon, G. Caumon)
o On the need for spatial adaptivity and geological constraints in integrative subsurface models (G. Caumon, G. Godefroy, J. Edwards)

IAMG2018
Olomouc, Czech Republic
2 – 8 September
o A graph-based approach to simplify subsurface structural models and assess the impact on physical modeling (P. Anquez, J. Pellerin, G. Caumon)
o The weighted curvature minimization: a correction to thickness variations in implicit structural modeling. (J. Renaudeau, E. Malvesin, F. Maerten, G. Caumon).

Journal papers since March 2017:

Jouves J, Viseur S, Arfib B, et al (2017) Speleogenesis, geometry, and topology of caves: A quantitative study of 3D karst conduits. Geomorphology 298:86–106. doi: 10.1016/j.geomorph.2017.09.019

Parquer MN, Collon P, Caumon G (2017) Reconstruction of Channelized Systems Through a Conditioned Reverse Migration Method. Mathematical Geosciences 49:965–994. doi: 10.1007/s11004-017-9700-3

Dewaide L, Collon P, Poulain A, et al (2018) Double-peaked breakthrough curves as a consequence of solute transport through underground lakes: a case study of the Furfooz karst system, Belgium. Hydrogeology Journal 26:641–650. doi: 10.1007/s10040-017-1671-4

Edwards J, Lallier F, Caumon G, Carpentier C (2018) Uncertainty management in stratigraphic well correlation and stratigraphic architectures: A training-based method. Computers & Geosciences 111:1–17. doi: 10.1016/j.cageo.2017.10.008

Mazuyer A, Cupillard P, Giot R, et al (2018) Stress estimation in reservoirs using an integrated inverse method. Computers & Geosciences 114:30–40. doi: 10.1016/j.cageo.2018.01.004

Godefroy G, Caumon G, Ford M, et al (2018) A parametric fault displacement model to introduce kinematic control into modeling faults from sparse data. Interpretation 6:B1–B13. doi: 10.1190/INT-2017-0059.1

RINGMesh: An open source data model for integrative numerical geology

Francois Bonneau1, Arnaud Botella2, Pierre Anquez1, Benjamin Chauvin3, Antoine Mazuyer1, Guillaume Caumon1

1 RING-GeoRessources, UL/CNRS/CREGU/ASGA, 2 Total S.A./ASGA 3 Earth and Planetary Sciences, Faculty of Arts and Sciences, Harvard University

A geological model is an interpretation of the subsurface organization combining data measured on the field and geological concepts. RINGMesh is an open-source initiative that proposes a data model to hold the geometry and the topology of such a geological model (Pellerin et al., 2017). It is neither a geomodeler nor a mesher but, it implements a "GeoModel" object that aims at defining and sharing tools and algorithms to perform validity checks and classical fixes related to both geometrical and topological issues. RINGMesh gathers a set of features to load, export and visualize “GeoModels”. The primary use of the library is to convert geological models through various file formats and to link software (e.g. geomodeler, mesher, and simulator). It is a smart converter because of validity tests and repairing options.

Since its first implementation, described by Pellerin et al. (2017), the GeoModel has been evolving and has gained flexibility. RINGMesh now supports both 2D and 3D models. The GeoModel data structure is composed by a set of entities and a bi-directional scheme gives access to entity adjacencies. Mesh entities define the topology and the geometry of each Corner, Line, Surface and Region. Geological entities are composed of a set of Mesh entities that have the same geological feature (e.g. horizon, fault and layer). An abstraction degree has been added in order to be able to manipulate a purely topological GeoModel. The implementation is now based on an abstract mesh that can be specified according to any data structure (e.g. discretized mesh made of vertex, segment, polygons and cells; mathematical parametric (spline, NURBS)). This enlarges its representation ability and may provide a direct wrapper to physical simulators, mesher and geomodeler. The default mesh data structure of the mesh entities is implemented in the geometric algorithm library "Geogram" (Levy, 2017).

RINGMesh proposes an extensive and mutable design. We encourage the community to develop their own applications and workflows (e.g. Chauvin et al., 2016, Botella, 2016) and to feed the project with generic tools and features. It is developed in C++11 and regularly tested by continuous integration tools. Non regression and unit tests are run before and after any merge to the main repository. The library can be downloaded from its github repository (https://github.com/ringmesh/RINGMesh). An up-to-date list of features and tutorials are available on the website of the project (http://ringmesh.org).

References

Botella, A. (2016) Génération de maillages non structurés volumiques de modèles géologiques pour la simulation de phénomènes physiques, PhD thesis, Université de Lorraine.

Chauvin, B., Lovely, P.J., Stockmeyer, B., Plesch, A., Caumon, G., Shaw, J.H., (2017) Validating novel boundary conditions for 3D mechanics-based restoration: an extensional sandbox model example AAPG Bulletin, doi: 10.1306/0504171620817154.

Levy, B. (2017) Geogram. Last date of access 2017-12-04. URL http://alice.loria.fr/software/geogram

Pellerin, J., Botella, A., Mazuyer, A., Chauvin, B., Bonneau, F., Caumon, G., Levy, B. (2017) RINGMesh: A programming library for developing mesh based geomodeling applications. Computers & Geosciences, 104, 93-100, doi: 10.1016/j.cageo.2017.03.005.

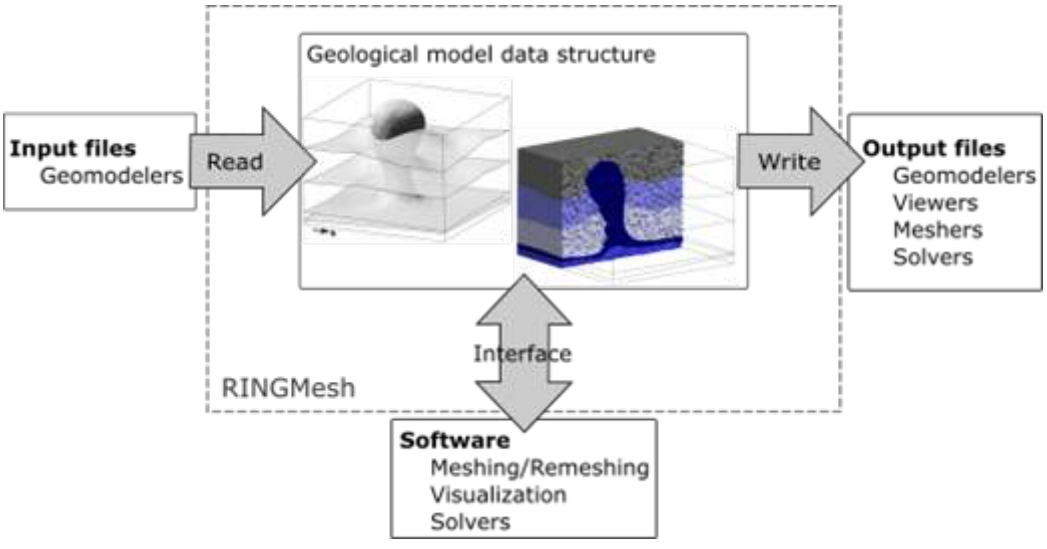
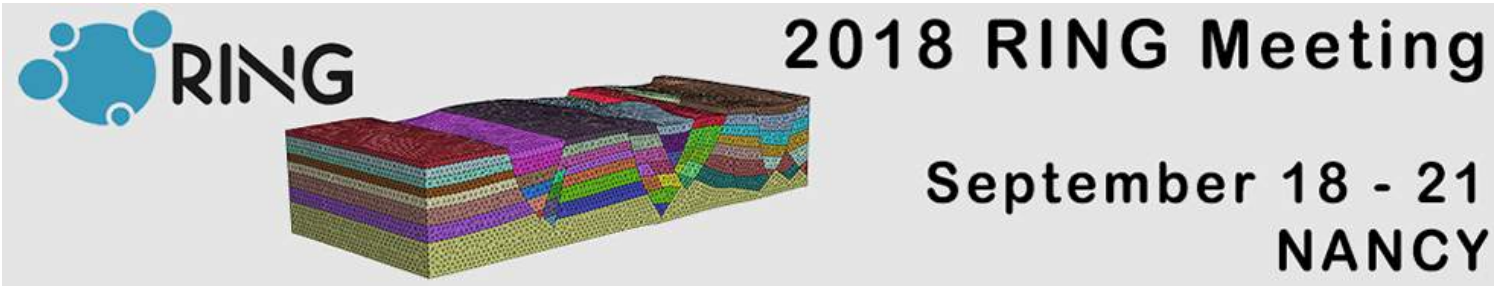


Fig. 1 RINGMesh provides an open source data model to handle geological models. The current implementation shares a set of classical tests and algorithms based on the "GeoModel" geometry and topology.

Event



The RING team is pleased to invite all its academic and industrial sponsors to the **2018 RING Meeting** in Nancy. As usual, the meeting consists in a mix of technical presentations and training sessions.

As each year, we welcome external contributions to the technical meeting.

CALL FOR PAPERS:

Papers of interest cover
- Important methodological advances in Integrative Numerical Geology and Geomodeling (theory and applications) ;
- Improvements and derivative works of technologies initiated by the team (SKUA-GOCAD Research Plugins and RING stand-alone libraries) ;
- Case studies and applications of RING technologies ;
- Review on challenging geomodeling problems that you are facing.

Important dates for 2018:

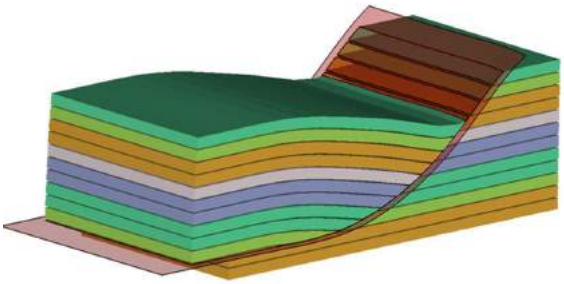
Abstract due: before 15th of April
Notification for acceptation: 30th of April
Registration open: 1st of May
Full paper due to: 20th of July
Registration close: 10th of September
2018 RINGMeeting: 18-21 September

Event

Upcoming and past thesis defenses:

Gabiel GODEFROY - March 29th, 2018 - Kinematic and stochastic fault modeling from sparse data for structural uncertainty analysis

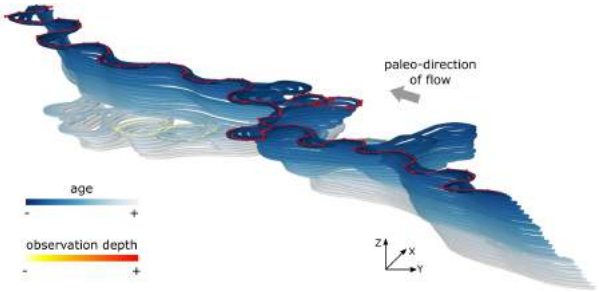
Jury:
Florian WELLMANN - Referee - AICES - Deutschland
Juliette LAMARCHE - Referee - Centre Européen de Recherche et d'Enseignement des Geosciences de l'Environnement - France
Clare BOND - Inspector - School of Geosciences Department of Geology and Petroleum Geology - UK
Bertrand MAILLOT - Inspector - University of Cergy-Pontoise - France
Guillaume CAUMON - Thesis supervisor - University of Lorraine - France
Mary FORD - Thesis supervisor - CRPG / CNRS
Florent LALLIER - Invited member - TOTAL



Summary:
The subsurface is largely inaccessible to direct observations. Geologists interpret the available data (that are often ambiguous or sparse) using their geological prior knowledge. In my Ph.D., I focus on uncertainties related to the modeling of faulted structures from sparse data. These structural uncertainties impact resources exploration and production, waste storage or ground engineering hazards. I propose a method relying on graph theory and on numerical rules (representing the geological knowledge) to generate several interpretation scenarios from the available evidence. I also present a numerical fault operator that deforms preexisting geological structures in accordance with a theoretical displacement model. This kinematic modeling strategy improves the quality of 3D structural models when only few observations are available.

Marion PARQUER - April 5th, 2018 - Reverse-time modeling of channelized meandering systems from geological observations

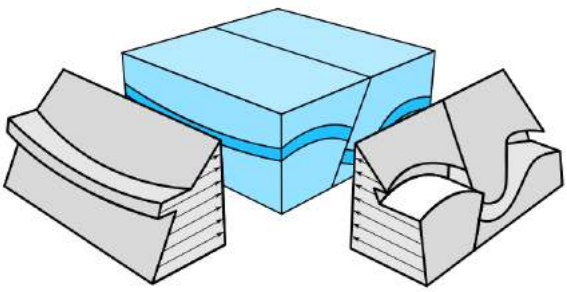
Jury:
Sylvie BOURQUIN - Referee - University of Rennes
Clayton DEUTSCH - Referee - University of Alberta
Isabelle COJAN - Inspector - MINES ParisTech
François MÉTIVIER - Inspector - IPGP - Université Paris Diderot
Zoltán SYLVESTER - Inspector - BEG - University of Texas
Guillaume CAUMON - Thesis supervisor - University of Lorraine
Pauline COLLON - Thesis co-supervisor - University of Lorraine
Jean-Loup RUBINO - Invited member - TOTAL



Summary:
Meandering systems shape landscapes through time and space. Their migration forms sandy bars. Meanders are set aside by stream simplification. Channels are abandoned by avulsion.
Once buried, the resulting deposits are good targets for natural resource storage thanks to the porosity and permeability of some associated facies.
The last channel path, abandoned meanders and sometimes point bar traces can be observed with subsurface imaging techniques. However, the geometrical and chronological analysis of deposits is difficult due to the reworking of the channel belt with erosion and deposition.
This thesis proposes a reconstruction method of channelized systems respecting the observations. Starting from the last observed channel stage, anterior stages are reconstructed time step by time step. Eroded abandoned meanders are simulated and integrated at the appropriate time step, along with the ones observed, according to a stochastic chronology simulation based on spatial and statistical criteria.

Antoine MAZUYER - April 19th, 2018 - Reservoir stress estimation by inverse approach

Jury:
Jean CHERY - Referee - University of Montpellier
Kerry GALLAGHER - Referee - University of Rennes
Judith SAUSSE - Inspector - University of Lorraine
Sylvie SCHUELLER - Inspector - IFP Energies Nouvelles
Pauline SOULOUMIAC - Inspector - University of Cergy-Pontoise
Richard GIOT - Thesis supervisor - University of Poitiers
Paul CUPILLARD - Thesis co-supervisor - University of Lorraine
Pierre THORE - Thesis co-supervisor - TOTAL
Marianne CONIN - Invited member - University of Lorraine
Yves Leroy - Invited member - TOTAL



Summary:
Initial stress state is the stress state before any human activity. We present a method to estimate the initial stress state in a 3D domain from sparse data. This method relies on an inverse approach which uses the finite elements method to solve the elastic mechanical problem. The method is successfully tested on a synthetic case where the reference solution is known. The method is then applied to a real case : the Neuquèn basin in Argentina where borehole stress data is available. This application reveals some of the limits of the presented method. Then, the effect of faults on the stress state is investigated. Different modeling strategies are presented : the objective is to reduce the computing cost, which can be very high when dealing with such complex structures.