



Research Highlight

Poroelasticity in PyLith

Poroelasticity refers to the coupling between mechanical deformation and fluid flow and is a process that is ubiquitous to the geosciences. Within crustal properties alone, poromechanics provide a governing framework to describe the processes behind subsurface hydrology, petroleum reservoirs and production, seismic activity, carbon capture and storage, and geothermal energy.

Prior efforts to incorporate poroelasticity within the PyLith framework have relied on a coupled approach employing a separate reservoir simulator in conjunction with the mechanical modeling capability built into PyLith. While permitting a specialized and refined means of modeling flow, this effectively required the consideration of two separate problems, with two separate modeling domains, and two separate means of simulation input. In addition, the iterative transfer of information between two separate models for fluid flow and mechanics reduced the ability for solver optimization.

With the upcoming version of PyLith, we have leveraged the new design to allow for the representation of multiphysics within what was formerly solely a mechanics code. This permits the solver flexibility and domain decomposition capabilities of the PETSc package, serving as the mathematical engine of PyLith, to be applied to the entire modeled domain. ([continued](#))

Figure. Representation of Cryer's problem - a fluid saturated porous sphere subjected to an instantaneous radial compressive stress

contributed by

Robert Walker and Matt Knepley, SUNY Buffalo and Brad Aagaard, USGS

Connecting at HQ

Dear Community,

Closing out a second summer of COVID, I reflect on the challenges of the past 3 years and the resiliency of our community. I am grateful for your support and commitment to seeing the continuance of building robust, open source community software for the geodynamics community. As I write this, our writing committee for CIG IV is just completing the hard task of distilling our vision of CIG IV into 20 pages. Many thanks to Bruce Buffet for his leadership and Wolfgang Bangerth, Sylvain Barbot, Ebru Bozdag, Laurent Montesi, Max Rudolph, Marc Speigelman, and Jolante van Wijk for tackling this herculean endeavor. And many thanks for those who participated in workshops and surveys in the lead-up. CIG IV has many opportunities for the community to engage and I look forward to working with the next generation of leaders in the geodynamics community.

Even though we could not meet in person for a second summer, three of our code communities met virtually. ASPECT's 8th hackathon promoted two contributors to that of Principal Developers, growing their ranks to 10. The breadth of research represented by contributors to the project continues to extend far beyond its original vision. Rayleigh's user-developer community made substantial progress on several code development projects as its community increases its proficiency through sustained interactions and hackathons - this year was its 3rd! PyLith's 2nd hackathon engaged a large group of new as well as familiar faces in tackling longstanding development needs. This includes poroelasticity (see *Research Highlight*) - a highly anticipated feature request that will give researchers the ability to investigate new classes of problems. Look for the release announcement for PyLith v3.0.0!

I look forward to reconnecting with many of you in 2022 as we plan for the resumption of in person meetings.

Lorraine Hwang, Director

News

The geodynamics community faces a number of long-standing issues in the recruitment of graduate students including a lack of diversity and proficiency in fundamental computational skills. The pilot 2021 CIG Summer Modeling Research Experiences (SMOREs) program aims to create a long-term foundation for addressing these issues by providing underrepresented groups funded training and research opportunities. In total, CIG received over 35 applications for the program from a wide range of STEM fields and backgrounds.

The four students selected began the program with two weeks of virtual tutorials which included both training in fundamental geodynamic concepts and practical computational training before launching into their individual research projects. Projects include modeling geoid anomalies over subduction zones, LLSVPs, and subduction on Venus. Join us for the **October 14 webinar** showcasing these projects.

This Fall, CIG will evaluate long-term plans for both the SMOREs research program and training. We hope to open the training courses to the broader geodynamics community in the coming years and will consider strategies to broaden the program to include additional topics. If you are interested in participating in these programs or providing feedback, please do not hesitate to contact us!

Many thanks to our program mentors Magali Billen (UC Davis), Katie Cooper (Washington State), Eric Mittelstaedt (University of Idaho), John Naliboff (New Mexico Tech), Max Rudolph (UC Davis), Suzanne Smrekar (JPL), Dave Stegman (UC San Diego), and Laura Waters (New Mexico Tech). Computational resources for the training and program were provided by XSEDE education allocation (TG-EES210021).

contributed by John Naliboff, New Mexico Tech

In Memorium

We are deeply saddened to learn about the passing of Min Chen. Min was a professor at Michigan State University and a member of our Science Steering Committee. Her expertise and passion for computational seismology, the mysteries of deep subduction zone earthquakes, and diversity and education will be missed.

She is survived by her daughters, Mia and Vivian, and their father Gabriel Ceriotti.

See also: [memorium1](#), [memorium2](#)

Governance

Nominations Open

Nominations are now open for this year's elections - 2 seats are open on the Executive Committee and 4 on the Science Steering Committee. We are thank Katie Cooper and Louis Moresi for their guidance and leadership on the EC and SSC members Ebru Bozdog, Min Chen, Krista Soderlund, and Cian Wilson for their contributions to the community. Email the Nominations Committee your nominations for these key governance positions as we look towards CIG IV. A candidate can be placed on the slate by the Nominating Committee or by nomination by three Member Representatives. [\[email\]](#)

Call for Focused Working Groups

CIG seeks to encourage new ideas from the community by forming Focused Working Groups (FWG). FWG's should address a specific topic and have a clearly defined scope e.g. workshop, white paper, benchmark, etc. A FWG should define concrete outcome(s) achievable within a short time frame, < 2 years. Anyone can propose one! We look forward to your ideas in continuing the CIG community's dynamic leadership in the earth sciences. [\[email\]](#)

Events

Webinars

Webinars are held the second Thursday of the month at 2P PT. Please see our [website](#) for connection information.

October 14 SMOREs Showcase

November 11 Veterans Day

December none - AGU

January 12 Raj Moulik, *Princeton University*

February 9 Ryan Orvedahl, *UC Davis*

March 9 Kali Allison, *UC Davis*

April 13 Robert Walker, *SUNY Buffalo*

May 12 *tbd*

Past Workshops

Information and reports on past workshops can be found on our website [\[past workshops\]](#):

- 2021 PyLith Hackathon [\[website\]](#)
- 2020 Rayleigh Hackathon [\[website\]](#)
- 2021 ASPECT Hackathon [\[website\]](#)

Remember to join our forum to receive announcements for these and other 2021-2022 events.