

Modeling of Coupled Hydro-Mechanical Deformation and Fracturing Processes in Geomechanics

This hands-on short course covers:

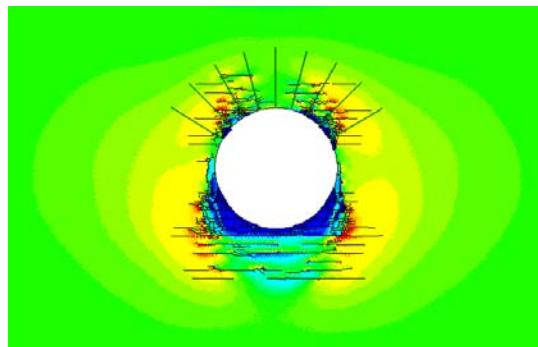
- Numerical modeling of complex, non-linear, coupled rock engineering/geomechanics problems
- Rock fracture and fragmentation
- Fluid flow and fluid-induced fracturing in unconventional plays
- Fundamental principles of the state-of-the-art **Irazu** finite-discrete element software
- Hands-on **Irazu** tutorials

Case study: Simulation of hydraulic fracturing in a jointed rock mass

Workshop Description

The hybrid finite-discrete element method (FDEM) is an explicit numerical approach that combines continuum mechanics principles (FEM) with discrete element algorithms (DEM) to simulate multiple interacting deformable and fracturing bodies. With its ability to qualitatively and quantitatively reproduce failure processes in brittle materials, FDEM is gaining increasing acceptance in civil, mining, geological, and petroleum engineering applications, where fracture and fragmentation processes are key to fully understanding the rock mass behaviour. Recently, Geomechanica's FDEM software, **Irazu**, has been enhanced with full hydro-mechanical (H-M) coupling to model fluid flow and fluid-induced fracturing in unconventional plays.

This one-day course will combine theoretical lectures on the fundamental principles of FDEM with practical modeling sessions where participants will be guided through several simulation cases. The course will start with a general introduction to the FDEM modelling philosophy and its application to engineering geology, rock mechanics, and geophysics problems. After a quick review of the basic algorithms, such as finite element deformation, contact detection, and contact interaction, the fracture model will be discussed in more depth. More advanced features of Irazu, including: in-situ stress initialization, rock excavation, and the incorporation of rock-reinforcement and Discrete Fracture Networks (DFNs), and hydro-mechanical coupling will also be introduced. In the second part of the course, participants will gain valuable hands-on experience through a series of practical modelling exercises using Geomechanica's Irazu software to model practical H-M-coupled problems in oil & gas, geothermal, and civil engineering applications.



Case study: Excavation-damaged zone around an underground opening in a bedded rock mass and effect of rock-reinforcement elements

Workshop Objectives

By attending this short course, participants will learn the basic concepts and algorithms embedded into FDEM and how to work with it. Attendees will leave the course with a basic understanding of the FDEM simulation approach, its strengths, limitations, and how it can be applied to model

complex engineering problems, such as underground excavations in discontinuous rock masses and hydraulic fracturing in unconventional plays. Participants will learn how to build FDEM models in Geomechanica's Irazu software, including the assignment of correct input parameters, and post-processing of the results.

Target Audience

This one-day course is specifically designed for geotechnical, geological, mining and petroleum engineers, as well as undergraduate and post-graduate students and researchers. In particular, anyone who wishes to use or is considering using FDEM to tackle challenging rock mechanics problems would benefit from this course.

Provided Materials

The short course organizer will provide each participant with: (i) electronic copies of the course slides, (ii) electronic and hard copies of the Irazu software manual and tutorials, and (iii) a demo version of the Irazu Graphical User Interface software.

Company Profile and Instructors

Geomechanica Inc. develops advanced simulation software and provides consulting services for nuclear waste management organizations, oil and gas companies, consulting firms, research institutions and universities. Geomechanica's software development has resulted in commercial release of Irazu standalone software as well as Irazu Cloud, which provides the use of Irazu software as a service. Our past consulting work involves site-selection process and preliminary design of a geological repository in Northern Switzerland, assessing the damage around mine shafts, stability analysis of open pit mines, simulating block caving operations, and analysis of hydraulic fracturing treatments in unconventional reservoirs.



Andrea Lisjak holds a PhD in civil engineering (rock mechanics) from the University of Toronto, Canada and is a recipient of the prestigious Manuel Rocha Medal 2015 of the International Society for Rock Mechanics for his doctoral thesis. Andrea's areas of expertise lie in the development and use of hybrid continuum-discontinuum numerical methods to investigate failure processes in rocks.



Omid Mahabadi holds a PhD in civil engineering (rock mechanics) from the University of Toronto, Canada. Omid is president and CEO of Geomechanica. Omid's areas of expertise range from numerical and experimental rock mechanics to the development and use of hybrid continuum-discontinuum numerical methods to investigate failure processes in rocks.



For more information and to inquire about our special offers for course participants contact us at:

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Event information:

Venue	50th US Rock Mechanics/ Geomechanics Symposium
Where	Houston, Texas
When	Sunday, June 26, 2016
Website	www.armasymposium.org