2D and 3D Modeling of Rock Fracturing Processes in Geomechanics

This hands-on short course covers:

- Numerical modeling of complex, non-linear, coupled rock engineering problems
- Simulation of rock fracture and fragmentation in 2D and 3D
- Fluid flow and fluid-induced rock fracturing
- Fundamental principles of the state-of-the-art Irazu finite-discrete element software
- Hands-on Irazu tutorials

Case study: 3D simulation of excavation-induced fracturing
Workshop Description

The finite-discrete element method (FDEM) is a numerical approach that combines continuum mechanics principles with discrete element algorithms 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, 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 and extended to three-dimensional (3D) modelling.

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 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 rock fracturing problems.

Case study: Fluid injection in a permeable, jointed rock mass

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 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 and rock mechanics testing 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 is a geomechanics specialist and manager of Geomechanica’s simulation software, Irazu. His area of expertise lies in the development and use of finite-discrete numerical methods to investigate failure processes in rocks. He is the recipient of the 2015 Rocha Medal of the ISRM. He holds a PhD degree in Civil Engineering (rock mechanics) from the University of Toronto, Canada.

Bryan Tatone is a geomechanics specialist and manager of Geomechanica’s rock mechanics laboratory. His area of expertise is rock discontinuity roughness and shear behaviour, which he has studied both experimentally and numerically. He will be awarded the 2017 Rocha Medal of the ISRM. He holds a PhD degree in Civil Engineering (rock mechanics) from the University of Toronto, Canada.
For more information and to inquire about our special offers for course participants contact us at:

**Telephone**    +1-647-478-9767
**Email**        info@geomechanica.com
**Website**      www.geomechanica.com
**Address**      #900 - 390 Bay St W
                    Toronto, Ontario
                    M5H 2Y2 Canada

**Event information:**

**Venue**        51st US Rock Mechanics/
                    Geomechanics Symposium
**Where**        Westin St. Francis, San Francisco, California
**When**         Sunday, June 25, 2017
**Website**      www.armasympoisum.org