Simulation of 3D fracture propagation under I, II and III mixed-mode loading conditions

Dr. Xin Cui, MIT

Thursday January 25, 2024, 9:00 a.m. Central Time

Xin Cui, postdoctoral associate at MIT, will speak on Thursday, January 25, 2024, at 9:00 a.m. Central Time.

The topic is “Simulation of 3D fracture propagation under I, II and III mixed-mode loading conditions.”

Abstract

Fracture propagation prevails in many natural phenomena and engineering activities, such as the development of natural faults, stability of rock slopes and hydraulic fracturing. Numerical simulation is an excellent way to understand this process. However, due to the complex geometry and loading conditions, the simulation of 3D fracture propagation is very challenging. In this talk, I will introduce a robust algorithm to simulate 3D fracture propagation under I, II and III mixed-mode loading conditions. The displacement discontinuity method using triangular elements combined with stress-based Schöllmann criterion allows us to comprehensively consider the near-field loading and precisely capture the twisted shapes of 3D fracture during propagation. In the simulation, the fracture front is smoothed out at each time step, which significantly increases the robustness of the algorithm. In addition, hydraulic fracturing is governed by two coupling equations: mass conservation and stress equilibrium. This study compared different ways to solve the two coupling equations and concluded that solving the two equations separately and performing iterations between the two until convergence shows great advantages.

Biography

Xin Cui is now a postdoctoral associate at MIT working with Professor Herbert Einstein at Department of Civil and Environmental Engineering and Dr Camilla Cattania at Department of Earth, Atmospheric, and Planetary Sciences. Before joining MIT, he got his PhD from University of Hong Kong in the field of rock mechanics. Xin’s research mainly focuses on using different numerical methods, including BEM, FEM and FVM, to simulate geomechanical processes, such as fracture propagation, thermo-hydro-mechanical coupling and injection-induced seismicity.