

Fracture Initiation and Propagation in Porous Media: Variational Phase-Field Model

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Prof. Keita Yoshioka is a professor for geo-energy production engineering in the department of Petroleum Engineering at Montanuniversität Leoben. His presentation will be at 9:00 Central Time on Thursday, March 23, 2023. The topic is “Fracture Initiation and Propagation in Porous Media: Variational Phase-Field Model.”

Abstract

Fracturing is applied to stimulate wells in hydrocarbon and geothermal energy production. In well stimulation operations, fractures are deliberately created, but they are something to avoid or to be controlled in underground energy and CO₂ storage or nuclear waste disposal. This shift in the focus prompts us to study not only propagation but also nucleation of fractures. And subsequently we need simulation capabilities for both propagation and nucleation.

In this presentation, I will briefly go over how conventional fracture mechanics fails to address fracture nucleation and introduce a variational phase-field model which has witnessed the explosive popularity within the mechanics community since its inception in the early 2000's. Part of this success is because of its ability to capture complex fracture behaviors, including nucleation and propagation along complex unknown path in 2 and 3 dimensions without the need for ad-hoc criteria and geometric restrictions on crack path. I will then focus on its applications and necessary adaptations for hydraulic fracturing. Finally, I will close my talk with future prospectives and further research topics in this subject.

Biography

Dr. Yoshioka received his Bachelor of Science in Resources and Environmental Engineering from Waseda University, Japan in 2003 and Ph.D. in Petroleum Engineering from Texas A&M University in 2007. He then joined Chevron's geomechanics teams in Houston. He conducted internal consulting and corporate research on various geomechanical problems for more than 10 years including a short term assignment in Chevron's geothermal operation in Indonesia. In 2017, he moved to Germany and started working on an open source code development project at the Helmholtz Centre for Environmental Research focusing on computational fracture mechanics. Since 2022, he has been professor for geo-energy production engineering at the department of Petroleum Engineering at Montanuniversität Leoben.