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Contribution ID: **584**

Type: **Oral Presentation**

Bayesian Inference of Poroelastic Properties from Induced Seismicity Data Using an Energy-based Poromechanics Model

Wednesday, 2 June 2021 14:45 (15 minutes)

Deep water injection related to shale gas extraction is increasingly relevant for the energy sector. Injected fluids in porous deformable elastic media increase pore pressure, reduce normal effective stress, and change the available friction along factures and faults. Consequently, slip can occur, causing seismic events. Understanding this mechanism and identifying the stress field around the injection wellbores play a central role in assessing the seismic hazard. One of the crucial steps is inferring the unknown model parameters (i.e. poroelastic properties) from the noisy data of injection sites. Due to the indirect relation between the uncertain parameters and the empirical observation (i.e. number of earthquakes and stress drop variations in injection sites) and the high dimension of parameters'domain, the inverse problem is computationally expensive. In this work, we develop a nonlinear forward model by formulating a variational continuum framework of multi-component poromechanics to characterize the evolution of stress, pore pressure, and other mechanical quantities. We adopt a Bayesian inference framework to integrate the partial differential equations (PDEs) of the forward mechanical model with models of uncertainty for observation and parameters. The Bayesian framework provides a probabilistic characterization of the unknown parameters of the physics-based model by updating the prior knowledge of these parameters based on the noisy measurements of injection sites. Maximizing the updated probability distribution or the posterior distribution provides the solution of high-dimension inverse problem. To quantify the uncertainty and predictability of the Bayesian method's solution, we investigate sampling algorithms and their challenges to explore the high-dimension parameter spaces. We use the accelerated Markov Chain Monte Carlo (MCMC) algorithms using the local gradient and Hessian (of the posterior) information to get samples from the posterior distribution.

Time Block Preference

Time Block C (18:00-21:00 CET)

References

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