Parallel Markov Chain Monte Carlo Methods in Predictive Simulations for Porous Media Flows

V. Ginting[1], F. Pereira[2], and A. Rahunanthan[3]

[1]*Department of Mathematics, University of Wyoming, Laramie, Wyoming, USA*
[2]*Department of Mathematics and School of Energy Resources, University of Wyoming, Laramie, Wyoming, USA*
[3]*Center for Fundamentals of Subsurface Flow, Laramie, Wyoming, USA*

ABSTRACT: We consider the problem of forecasting flows in porous media. Our strategy consists of establishing a complete statistical description of subsurface properties, such as permeability and porosity that are conditioned to existing measurement data. A Bayesian approach using Markov Chain Monte Carlo (MCMC) methods is well suited for reconstructing permeability and porosity fields. A crucial step in this statistical approach is the calculation of the likelihood information, which involves solving coupled partial differential equations with permeability and porosity as input parameters. The flow simulator computation time and the sequential nature of MCMC simulation limit the posterior exploration in a practical period of time. It is imperative to address this issue appropriately in ways that make the posterior exploration tractable. The parallel computation of MCMC can substantially reduce computation time and can make the framework more attractable to the prediction of flows in porous media. To parallelize MCMC chains one could consider: (1) parallelizing a single MCMC chain using pre-fetching algorithm, or (2) running multiple MCMC chains in parallel. In this talk, we discuss such parallel MCMC approaches for forecasting production in an oil reservoir.