

Contribution ID: 578

Type: Oral Presentation

Multiscale Sampling for Subsurface Characterization

Wednesday, 2 June 2021 14:30 (15 minutes)

The characterization of natural subsurface formations is a challenging task because of the large dimension of the stochastic space. Typically a dimensional reduction method, such as a Karhunen-Loeve expansion (KLE) needs applied to the prior distribution to make these problems computationally tractable. Due to the large variability of properties of subsurface formations (such as permeability and porosity) it may be of value to localize the sampling strategy, so that it can better capture local variability of rock properties.

In this work we introduce the concept of multiscale sampling to localize the search in the stochastic space. We work within a Bayesian framework. We combine the simplicity of a preconditioned Markov chain Monte Carlo (MCMC) method

with a new algorithm to decompose the stochastic space in orthogonal complement subspaces, through a oneto-one mapping to a non-overlapping domain decomposition of the region of interest. The localization of the search is performed by Gibbs sampling: we apply a KLE expansion locally, at the subdomain level.

The effectiveness of the proposed framework is tested in the solution of inverse problems related to elliptic partial differential equations. We use multi-chain studies in a multi-GPU cluster to show that the new algorithm clearly improves the convergence rate of the preconditioned MCMC method.

Time Block Preference

Time Block B (14:00-17:00 CET)

References

[1] J. Christen , C. Fox , Markov chain Monte Carlo using an approximation, J. Comput. Graph. Statistics 14(4) (2005) 795–810.

[2] Y. Efendiev, A. Datta-Gupta , V. Ginting , X. Ma , B. Mallick , An efficient two-stage Markov chain Monte Carlo method for dynamic data integration, Water Resour. Res. 41(12) (2005).

[3] X. T. Tong, M. Morzfeld, Y. M. Marzouk, MALA-within-Gibbs Samplers for High Dimensional Distributions with Sparse Conditional Structure, SIAM J. Sci. Comput., 42(3), A1765–A1788.

Acceptance of Terms and Conditions

Click here to agree

Newsletter

Student Poster Award

Primary author: Dr RAHUNANTHAN, Arunasalam (Central State University)

Co-authors: Mr ALI, Alsadig (The University of Texas at Dallas); Dr AL-MAMUN, Abdullah (United International University); Dr PEREIRA, Felipe (The University of Texas at Dallas)

Presenter: Dr RAHUNANTHAN, Arunasalam (Central State University)

Session Classification: MS14

Track Classification: (MS14) Uncertainty Quantification in Porous Media