Department of Mathematics and Statistics
Colloquium Lecture Series

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BAYESIAN UNCERTAINTY QUANTIFICATION IN LARGE SCALE SPATIAL INVERSE PROBLEMS

We consider a Bayesian approach to nonlinear inverse problems in which the unknown quantity is a random spatial field. The Bayesian approach contains a natural mechanism for regularization in the form of prior information, can incorporate information from heterogeneous sources and provide a quantitative assessment of uncertainty in the inverse solution. The Bayesian setting casts the inverse solution as a posterior probability distribution over the model parameters. Karhunen- Loeve expansion is used for dimension reduction of the random spatial field. Furthermore, we use a hierarchical Bayes model to inject multiscale data in the modeling framework. In this Bayesian framework, we show that this inverse problem is wellposed by proving that the posterior measure is Lipschitz continuous with respect to the data in total variation norm. Computational challenges in this construction arise from the need for repeated evaluations of the forward model (e.g. in the context of MCMC) and are compounded by high dimensionality of the posterior. We develop two-stage reversible jump MCMC which has the ability to screen the bad proposals in the first inexpensive stage. Numerical results are presented by analyzing simulated as well as real data from hydrocarbon reservoir..Ie .Ie .Iecandidate.Iefor