Mathematical Sciences
The University of Texas at El Paso

Spring 2017
Colloquium Series

Tuesday, February 14, 2017 at 3:30pm in Bell Hall 143

(Note the unusual day and time)

Candidate for the position of Assistant Professor in Computational Science

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Bayesian approaches in inverse problems and uncertainty quantification

Predictions related to physical systems governed by complex mathematical models depend on underlying model parameters. For example, prediction of oil production is strongly influenced by subsurface properties, such as permeability, porosity and other spatial fields. These spatial fields may be highly heterogeneous and vary over a rich hierarchy of scales. Given the observations from the system (possibly contaminated with errors), inference on the underlying parameter and its uncertainty constitutes the uncertainty quantification of the inverse problem. The inverse problem may be ill-posed. Bayesian methodology provides a natural framework for such problems by imposing regularization through prior distribution. Solution procedures use Markov Chain Monte Carlo (MCMC) or related methodology, where, for each of the proposed parameter values, we solve the underlying forward problem. The solution requires finite element or finite volume techniques. Because of the high computational cost in evaluating the forward models it is important to develop fast, scalable efficient methodology, without sacrificing accuracy.

We focus on various inverse problems and uncertainty quantification techniques. An inverse problem characterization and uncertainty quantification approach under asymmetric skewed error for heat equation is developed. Later, we consider the flow equation and pressure data where estimation of the underlying high dimensional permeability field is of main interest. Based on separable decomposition, we propose a novel MCMC method. Along with MCMC, we approximate the posterior by variational approximation. The convergence of the posterior solution and its approximation is also established.