Numerical Analysis and Scientific Computing Seminar

Efficient solvers for Gaussian processes and Bayesian inverse problems

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Abstract: Gaussian processes (GPs) play an important role in many areas of scientific computing such as uncertainty quantification, reduced order modeling, and scientific machine learning. We consider the stochastic partial differential equation approach to GPs, where a major computational bottleneck is computing with fractional powers of elliptic differential operators that define the covariance operators of the GPs. We show how to address this computational challenge using an integral formulation for the fractional operator and efficient iterative methods for handling the resulting discretized system. The resulting approach makes it feasible to use GPs as priors in Bayesian inverse problems, which we demonstrate through synthetic and real-world inverse problems. We will also discuss a reduced basis approach for efficient sampling from GPs, where the covariance operator may be parameterized by multiple hyperparameters. This is joint work with Harbir Antil (George Mason).

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Mathematics
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