Computational Methods for Large and Dynamic Inverse Problems

Julianne Chung

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In this talk, we describe efficient methods for uncertainty quantification for large, dynamic inverse problems. The first step is to compute a MAP estimate, and for this we describe efficient, iterative, matrix-free methods based on the generalized Golub-Kahan bidiagonalization. These methods can address ill-posedness and can handle many realistic scenarios, such as in passive seismic tomography or dynamic photoacoustic tomography, where the underlying parameters of interest may change during the measurement procedure. The second step is to explore the posterior distribution via sampling. We use the generalized Golub-Kahan bidiagonalization to derive an approximation of the posterior covariance matrix for "free" and describe preconditioned Lanczos methods to efficiently generate samples from the posterior distribution.