TEMPLE UNIVERSITY
Department of Mathematics

Applied Mathematics and Scientific Computing Seminar

Wednesday, 29 October 2014, 4:00 p.m.
Room 617 Wachman Hall

(refreshments and social at 3:45 p.m)

Flexible Krylov Solvers for Shifted Systems

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Abstract. Inverse problems involve estimating parameters from physical measurements; for example, hydaulic tomography aims to use measurements of hydraulic head to reconstruct images of the subsurface properties for better understanding of contaminant transport. For inverse problems involving time-dependent (and multiple frequency-dependent) partial differential equations, the solution of shifted linear systems can be a major computational bottleneck. In this talk, I will focus on fast solvers for linear systems of the form $(K + \sigma_k M)x_k = b$ for $k = 1, \ldots, N_\sigma$. Krylov subspace solvers are particularly attractive for these systems because of the shift-invariant property of Krylov subspaces. By exploiting this property, only a single Krylov basis is computed and the solution for multiple shifts can be obtained at a cost that is similar to the cost of solving a single system. We have developed flexible Krylov solvers for shifted systems, which use multiple shift-and-invert preconditioners of the form $K + \tau_j M$ with $j = 1, \ldots, N_\tau$ and $N_\tau \ll N_\sigma$. For the applications that I will describe, we observe up to a $20\times$ speed up. I will demonstrate these performance gains on synthetic data sets from transient and oscillatory hydraulic tomography.

Joint work with Tania Bakhos and Peter Kitanidis.