TEMPLE UNIVERSITY
Department of Mathematics

Applied Mathematics and Scientific Computing Seminar

Wednesday, 16 Novermber 2016, 4:00 p.m.
Room 617 Wachman Hall

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

Performance and Stability Tradeoffs in Large-Scale Krylov Subspace Methods

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Abstract. Communication-avoiding (or s-step) Krylov subspace methods can reduce the number of global synchronizations required per iteration by a factor of $O(s)$ compared to standard implementations, making them particularly attractive for solving large-scale problems on parallel machines. Although these s-step variants are mathematically equivalent to the standard Krylov methods, in finite precision their numerical properties can differ significantly. It is therefore necessary to 1) better understand the theoretical behavior of s-step Krylov methods in finite precision, and 2) use this understanding to develop techniques for achieving both performance and stability.

In this talk, we first give background and a brief derivation of s-step Krylov methods and then discuss the theoretical tradeoffs between performance and accuracy. We focus mostly on CG and GMRES, although the discussion is also applicable to other s-step Krylov methods. We then present some recent work in the development of variable s-step Krylov methods, in which the blocking factor s may change in each outer iteration. Using connections with the theory of inexact Krylov methods, we develop a technique for automatically selecting the blocking factor s in a way that maintains the attainable accuracy of the method. We conclude with a brief perspective on the use of Krylov subspace methods in the exascale era and beyond.