Multilevel low-rank approximation preconditioners

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This presentation will discuss a class of preconditioning methods for solving linear systems of equations that are based on exploiting low-rank approximations to certain matrices. These methods have a number of appealing features. Because they are essentially approximate inverse techniques, they handle indefiniteness quite well. Furthermore, they are amenable to SIMD compuations such those inherent to GPUs. The talk will first describe a recursive divide and conquer approach geared toward Symmetric Positive Definite model problems issued from Finite Difference discretizations of PDEs. Then two extensions of this general approach will be described. The first exploits Schur complements in a parallel computing Domain Decomposition (DD) framework. The second extends this DD approach further by considering so-called 'hierarchical interface decomposition orderings' which are essentially algebraic generalizations of 'wirebaskets' techniques used in Domain Decomposition methods.
For details see the references [1, 2, 3, 4].

Références

[1] Ruipeng Li and Yousef Saad. Divide and conquer low-rank preconditioning techniques. *SIAM Journal on Scientific Computing*, 35:A2069–A2095, 2013.

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[3] Yuanzhe Xi, Ruipeng Li, and Yousef Saad. An algebraic multilevel preconditioner with low-rank corrections for general sparse symmetric matrices. *SIAM Journal on Matrix Analysis and Applications*, 37(1):235–259, 2016.

[4] Yuanzhe Xi and Yousef Saad. A rational function preconditioner for indefinite sparse linear systems. Technical Report ys-2016-09, Dept. Computer Science and Engineering, University of Minnesota, Minneapolis, MN, 2016. To appear, SIAM J. Sci. Comput., 2017.

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