(IP) A factorization based framework for building scalable algebraic preconditioners

X.S. Li [1]

Factorization based preconditioning algorithms, most notably incomplete LU (ILU) factorization, have been shown to be robust and applicable to wide ranges of problems. However, traditional ILU algorithms are not amenable to scalable implementation. In recent years, we have seen a lot of investigations using low-rank compression techniques to build approximate factorizations. A key to achieving lower complexity is the use of hierarchical matrix algebra, stemming from the $\mathcal{H}$- and $\mathcal{H}^2$-matrix research. In addition, the multilevel algorithm paradigm provides a good vehicle for a scalable implementation. The goal of this talk is to give an overview of the various hierarchical matrix formats, such as hierarchically semi-separable matrix (HSS), hierarchically off-diagonal low-rank matrix (HODLR) and butterfly matrix, and to explain the algorithm differences and approximation quality. We will illustrate many practical issues of these algorithms using our parallel libraries STRUMPACK and ButterflyPACK, and demonstrate their effectiveness and scalability while solving the very challenging problems, such as high frequency wave equations.

[1]Lawrence Berkeley National Laboratory