Computational Mathematics Colloquium

Beating flops, communication and synchronization in sparse factorizations

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Abstract: Multiphysics and multiscale simulations often need to solve discretized sparse algebraic systems that are highly indefinite, nonsymmetric and extremely ill-conditioned. For such problems, factorization based algorithms are often at the core of the solvers toolchain. Compared to pure iterative methods, the higher computation and communication costs in factorization methods present serious hurdles to utilizing extreme-scale hardware. I will present several research vignettes aimed at reducing those costs. By incorporating data-sparse low-rank structures, such as hierarchical matrix algebra, we can obtain lower arithmetic complexity as well as robust preconditioner. By replicating small amount of data in sparse factorization, we can avoid communication with provablly lower communication complexity. By means of asynchronous, custermized broadcast/reduction, we can reduce the dominating latency cost in sparse triangular solution. The effectiveness of these techniques will be demonstrated with our open source software STRUMPACK and SuperLU. ¡br¿ ¡br¿ Bio: ¡br¿ Sherry Li is a Senior Scientist at Lawrence Berkeley National Laboratory. She has worked on diverse problems in high performance scientific computations, including parallel computing, sparse matrix computations, high precision arithmetic, and combinatorial scientific computing She has (co)authored over 100 publications. She is the lead developer of SuperLU sparse direct solver library, and has contributed to several other widely-used mathematical libraries, including ARPREC, LAPACK, STRUMPACK, and XBLAS. She received Ph.D. in Computer Science from UC Berkeley in 1996. She is a SIAM Fellow and an ACM Senior Member.

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