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Communication-avoiding Krylov subspace methods

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Krylov subspace methods (KSMs) are numerical algorithms for solving large, sparse linear systems of equations and eigenvalue problems. Although they are commonly used and often highly optimized, most KSMs achieve only a small fraction of peak arithmetic performance of the computers on which they are run. This occurs on almost all computers, from workstations to massively parallel supercomputers. The cause is that the performance of most commonly used KSMs is bound by the speed of communication – moving data between processors or between levels of the memory hierarchy – rather than by the speed of arithmetic. Communication is much slower than arithmetic, and is only getting slower relative to arithmetic as hardware evolves.

In previous works, we proposed new "communication-avoiding" Krylov methods to address this problem. These require much less data movement between levels of the memory hierarchy, and between processors in parallel, than standard KSMs. In this talk, we will present new communication-avoiding Krylov methods, and discuss new numerical experiments and performance results for different platforms.