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Recent advances on MUMPS: MUltifrontal Massively Parallel Solver for the direct solution of sparse linear equations

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The scientific library MUMPS (for MUltifrontal Massively Parallel Solver) solves large systems of sparse linear equations, AX=B, in a robust and efficient way on high performance computers. The matrix A is a large square matrix and X and B are vectors or matrices whose sparsity can also be exploited. MUMPS is an open source software, distributed under the CeCILL C licence which can be downloaded from http://mumps-solver.org.
In many areas of numerical simulation, the solution of sparse linear systems is a critical and expensive part of the simulation and numerically difficult problems often lead to longer calculation times, memory used and power consumption. Today, we want to solve linear systems of increasingly large sizes (several hundred million unknowns) allowing complex problems to be addressed while maintaining performance and numerical stability.
In the recent years, we have worked on a low-rank method called Block Low-Rank (BLR) to exploit data sparsity and proved that we can reduce the complexity of sparse solvers in terms of the number of floating-point operations and memory usage of the numerical phases. We have also show that low- rank approximations exhibit remarkable properties that allow for the use of mixed precision arithmetic without loss of accuracy. We also describe recent work done with XKblas library (CeCILL-C free license) to address GPU-based architectures such as NVIDIA Grace Hopper, AMD MI250 and AMD MI300.

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