

# Recent advances on solution phase of sparse solvers with multiple right hand sides

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## Abstract

The cost of the solution phase of sparse direct solvers is sometimes critical. It can be larger than the cost of the factorization in applications where systems of linear equations with thousands of right-hand sides must be solved. Depending on the applications, the right-hand sides may be known all at once or may depend on previous solutions. In the context of multifrontal solvers, we consider some important characteristics of the solve phase in terms of parallelism, and present algorithms to help reduce its computational cost. We first give results on applications with multiple sparse right hand sides and propose new algorithms to reduce the computational cost (numbers of operations).

Then, by considering the critical path in the assembly trees associated with 2D and 3D problems, we show that the complexity of the solve phase offers interesting properties in terms of parallelism, compared to the factorization, both in the case of full-rank and in the case of low-rank factorizations. Finally, we will give perspectives to improve the performance of the solution phase and expose problems that may arise with the integration of Block Low-Rank (BLR) approximations. For example, the increase in iteration number to get a sufficiently good solution when BLR approximations are used as a preconditionner, the factorization-oriented mapping of factors and its parallel algorithms are interesting problems that we propose to tackle.