On the comparison of sparse multifrontal hierarchical and Block Low-Rank solvers

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Abstract

Matrices coming from elliptic Partial Differential Equations have been shown to have a low-rank property: conveniently defined off-diagonal blocks of their Schur complements can be approximated by low-rank products and this property can be efficiently exploited in multifrontal solvers to provide a substantial reduction of their complexity. Several matrix representations have been proposed to exploit this property within direct multifrontal solvers. The simplicity and flexibility of the Block Low-Rank (BLR) format make it easy to use in a general purpose, algebraic multifrontal solver. While its theoretical complexity has been shown to be significantly lower than in full-rank, it is higher than the complexity achieved by hierarchical formats, a more complex class of low-rank matrix representations. Among the hierarchical formats, the Hierarchically Semi-Separable (HSS) one has been used to design the most advanced to date low-rank multifrontal solvers. In this talk, we compare the BLR and HSS formats, both from a theoretical and experimental standpoint. In our numerical experiments, we use the BLR-based MUMPS and HSS-based STRUMPACK multifrontal solvers on a large set of matrices coming from a variety of real-life applications.