

Robust domain decomposition methods for high performance computation of industrial structures

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Abstract

The emergence of a new generation of architected materials opens up vast opportunities in the design of products, enabling to finely design the underlying microstructure to fulfill mechanical requirements. To make full benefit of this potential, virtual testing has to be massively adopted during the conception phase, which, in turn, often leads to large scale finite element problems which need robust and efficient HPC solvers. Non overlapping domain decomposition (DD) algorithms (such as FETI, BDD and their derivatives) provides an interesting framework to build such solvers by mixing direct and iterative methods at the various levels of current parallel computing hardware. Some recent developments around multipreconditioning are particularly promising in order to strengthen the robustness of historical DD methods on industrial use cases (heterogeneities, jagged subdomains...) together with improving their arithmetic intensity. Those algorithms make intensive use of key features (multithreading, null pivot detection, multiple right-hand-side...) of sparse direct solvers. We will show the practical use of Mumps in our implementation and discuss the strength and weakness of the underlying algorithms, with results coming from both academic and industrial 3D problems of various computing sizes.