Parallel mesh adaptivity driven by a posteriori error estimation within the context of large scale industrial problems

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ABSTRACT

The continuous increase of high performance computing resources opens up great possibilities in disruptive designs by enabling simulations on fine scale models. However, in order to fullfill efficiency, one needs not only to access efficient solvers, suitable to massively parallel clusters, but also to master the quality of the numerical results at an optimal cost.

In previous works, a new domain decomposition algorithm has been developed, combining the FETI dual domain decomposition method with an adaptive multi-preconditioned conjugate gradient algorithm. This new method, named Adaptive MultiPreconditionned FETI (AMPFETI) [1], has been shown to be robust enough to simulate large scale non linear industrial problems on a high number of computational cores.

The current work deals with adaptive mesh refinement procedures driven by discretization error estimates, whose development is the next step to fullfill computational efficiency. We develop a parallel remeshing algorithm tailored to the sub-structured formulation introduced by the domain decomposition framework. In particular, the algorithm preserves the subdomains interface shapes which enables to minimize the overall volume of communication and hinders the reuse of Krylov subspaces across time steps. We also extend the classical ZZ2 error estimator [2] in order to trigger the mesh adaptivity process for both heterogeneous and homogeneous problems.

The whole method will be presented and illustrated on an industrial use case.

REFERENCES

[1] Bovet, C. and Parret-Fraud, A. and Spillane, N. and Gosselet, P., Adaptive multipreconditioned FETI: Scalability results and robustness assessment, *Computers & Structures*, Vol. **193**, pp. 1–20 (2017), doi:10.1016/j.compstruc.2017.07.010.

[2] Zienkiewicz, O. C. and Zhu, J. Z., The superconvergent patch recovery and a posteriori error estimates. Part 1: The recovery technique. Int. *J. Numer. Meth. Engng.*, Vol. **33**, pp. 1331–1364, (1994), doi:10.1002/nme.1620330702.