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Adaptive Mesh Refinement approaches for First Order Non-Fitted Boundary Conditions methods

Isabelle Ramière[1], Frédéric Lebon[2] and Daria Koliesnikova[1,2]

[1] CEA, DEN, DEC, SESC, LSC, F-13108 Saint-Paul Lez Durance, France.
isabelle.ramiere@cea.fr, daria.koliesnikova@cea.fr

[2] Aix-Marseille University, CNRS, Centrale Marseille, LMA, Marseille, France.
lebon@lma.cnrs-mrs.fr

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Adaptive mesh refinement methods are currently commonly used when dealing with immersed boundary methods, especially to improve the accuracy of first-order non-boundary fitted approaches. Two main approaches can be distinguished : adaptive methods (h-, p-, r-adaptive methods as well as their combinations : typically hp- or hr-adaptive methods) and local multigrid methods (typically LDC, FAC or FIC methods).

In a solids mechanics framework, we propose to compare in terms of memory space and computation time, AMR methods based on local reduction of the mesh step. The methods to be compared are the two h-adaptive strategies [1], namely the remeshing (conforming mesh) and the hierarchical (non-conforming mesh) strategy, and the Local Defect Correction multigrid method [2]. The Zienkiewicz and Zhu a posteriori error estimator [3] is used to automatically detect the elements to be refined as well as to define the density function required for the h-adaptive methods.
The test cases under study derive from nuclear engineering simulations of the mechanical pellet-cladding interaction. This interaction implies discontinuous contact conditions which lead to very localised stress concentrations. These discontinuous boundary conditions are approximated by the mesh, which is *a priori* uniform and not fitted to the problem data. This leads to a first order mesh-step method. For industrial modelling and performances reasons, the finite element discretization is done with quadrangular linear elements. This constraint may penalize the performances of the remeshing h-adaptive method, which is the most performed adaptive method nowadays.

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