

Mortar FEs on Overlapping Meshes : Application to Magnetodynamics

¹A. Christophe, ²F. Rapetti, ¹L. Santandrea, ¹G. Krebs, Y. ¹Le Bihan

¹LGEP, UMR 8507 CNRS, Univ. Paris XI *et al.*, 91192 Gif-sur-Yvette cedex, Fr

²Math. Dept., UMR 7351 CNRS, Univ. Nice, Parc Valrose, 06108 Nice cedex, Fr

Abstract

The finite element (FE) method is frequently used in magnetodynamics as well suited to treat problems with complex geometries while keeping a simplicity in the implementation. However, some modelisations, as in eddy current (EC) non destructive testing (NDT), present the particularity to have moving parts. A global remeshing can be necessary which causes expensive CPU time. Domain decomposition methods allowing to take into account the movement without having to remesh the whole computational domain. The mortar element method (MEM), a variational non-conforming domain decomposition approach [1] offers attractive advantages in terms of flexibility and accuracy. In its original version for non-overlapping subdomains, the information is transferred through the skeleton of the decomposition by means of a suitable L^2 -projection of the field trace from the master to the slave subdomains. A MEM with overlapping subdomains has been proposed to coupled a global scalar potential defined everywhere in the considered domain and a local vector potential defined only in (possibly moving) conductors [2], and later applied to study electromagnetic brakes [3]. In this paper, a new FE-MEM able to deal with moving non-matching overlapping grids is introduced, in order to realize the bidirectional transfer of information between fixed parts and moving ones. With this variant, the field source can be in the moving part. Numerical examples are presented to support the theory (with both node and edge elements), going from problems with known solution, to state the optimality of the method, to EC-NDT applications, in order to underline the flexibility and efficiency of the proposed approach.

References

1. C. Bernardi, Y. Maday, A. Patera, "A new non-Conforming approach to domain decomposition: the mortar element method", *Seminaire XI du College de France, Brezis & Lions eds.*, in *Nonlinear PDEs and their applications*, Pitman, pp. 13-51, 1994.
2. Y. Maday, F. Rapetti, B. I. Wohlmuth, "Mortar element coupling between global scalar and local vector potentials to solve eddy current problems", dans "Numerical mathematics and advanced applications", *Enumath 2001 proc.*, Brezzi F. *et al.* eds., Springer-Verlag Italy (Milan) pp. 847-865, 2003.
3. B. Flemisch, Y. Maday, F. Rapetti, B. I. Wohlmuth, "Scalar and vector potentials' coupling on nonmatching grids for the simulation of an electromagnetic brake", *COMPEL (Int. J. for Comp. and Math. in Electric and Electronic Eng.)*, vol. 24, No. 3, pp. 1061-1070, 2005.