Mortar FEs on Overlapping Meshes : Application to Magnetodynamics

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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

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