Interpolation with restrictions between finite element meshes for flow problems in an ALE reference

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ABSTRACT

The need of remeshing when computing flow problems in domains suffering large deformations has motivated the implementation of a tool which allows the proper transmission of information between finite element meshes. Since the Lagrangian interpolation of results from one mesh to another is a dissipative method, a new conservative interpolation method has been developed.

This work stems from the formulation presented at [1], where an accurate projection of transmission conditions between two subdomains was the main motivation for the development of an interpolation method based on the conservation of relevant physical magnitudes. Now, this methodology has been extended from boundary values to a more general formulation for the interpolation of results between random 2D and 3D finite element meshes, stressing the application to flow problems in moving domains which require remeshing. A series of constraints, such as the conservation of mass, momentum or energy, are applied to the interpolated arrays through Lagrange multipliers in an error minimization problem, so the resulting array satisfies these physical properties while staying as close as possible to the original interpolated values in the L^2 norm. Unlike other conservative interpolation methods which require a considerable effort in mesh generation and modification, such as in the rezoning procedures or the supermesh method, the proposed formulation is mesh independent and is only based on the physical properties of the array being interpolated. From a computational point of view, the interpolation is based on a parallelized octree search, and the performed corrections on the interpolated values are neither coupled with the main calculation nor with the interpolation itself, for which reason the computational cost is kept at a minimum.

REFERENCES

[1] HOUZEAUX, G and CODINA, R. 2001. Transmission conditions with constraints in finite element domain decomposition methods for flow problems. Communications in Numerical methods in Engineering, 17(3):179–190.