Mesh adaptivity applied to large deformations with geometrical model

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Topological mesh adaptivity can be required in problems involving large displacements or deformations of objects. For instance, in fluid-structure simulations in which the structure is highly deformable, the common node relocation techniques (elastic analogy, Laplace equation, ...) cannot always provide an acceptable mesh. Efforts have been made in previous works to implement efficient mesh adaptation algorithms that overcome these issues [3, 1, 2].

When dealing with complex geometries, a particular attention has to be paid to the adaptive operations performed at the geometrical boundaries. In this work, we present a simple and efficient technique to fullfill a geometrical model when adapting the mesh.

We start from an adaptive method described in [2] which first relocates the volume nodes of the domain according to an imposed displacement of the boundaries of the domain. The mesh is then adapted with the common mesh modification operators like edge splits, edge collapses and edge swaps in order to meet a length criterion for the edges and to preserve a minimal quality of the elements.

In this work, an additional step is inserted in the adaptation procedure which relocates new boundary nodes on the appropriate geometrical boundary and check the validity of the new mesh. Based on the curvature of the geometrical boundaries, edge swaps are then performed in order to improve the conformity of the mesh to the geometrical model. The procedure is also integrated into the open source package MAdLib [3].

Numerical examples are presented which demonstrate the capability of the proposed technique.

References

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