Reaction computations on trimmed locally refined meshes

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ABSTRACT

The reaction force is a fundamental quantity of a structural analysis that can be computed by the finite element method. Its calculation for conforming linear meshes is standard and implemented as sum of nodal forces. However, it is not straightforward how to transfer this approach to other kinds of basis functions, e.g. bases that do not form a partition of unity, as for the Hierarchical B-Splines [1]. Moreover, the computation of reactions on trimming curves subject to weak constraints is non-standard, as the support is immersed in the mesh and does not lie on its boundary.

In this work we present a generalization of the standard calculation of reactions for trimmed and locally refined meshes. In particular, we use the fact that the equilibrium information can be extracted by means of specific functions [2, 3]. We further consider trimming-specific aspects, such as badly cut cells and weak boundary conditions. Finally, we present various examples showing the capabilities of the method.

REFERENCES

[1] R. Kraft. "Adaptive and linearly independent multilevel B–splines." Surface Fitting and Multiresolution Methods, 1997.

[2] T. J.R. Hughes, G. Engel, L. Mazzei, M. G. Larson, "The Continuous Galerkin Method Is Locally Conservative." Journal of Computational Physics, vol 163, no. 2, pp. 467-488, 2000.

[3] I. Babuška, A. Miller, "The post-processing approach in the finite element method. 1. Calculation of displacements, stresses and other higher derivatives of the displacements." International Journal for Numerical Methods in Engineering, vol 20, no. 6, pp. 1085-1109, 1984.