The Meccano Method for Finite Element and Isogeometric Analysis

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Abstract

In this work we present the application of the meccano method [1] to solid modelling to be used in finite element and isogeometric analysis [2]. We will show the resolution of elliptic and parabolic PDE in three-dimensional complex domains.

The discretization of the solid is obtained by constructing a volumetric parameterization of the solid. To do that, an adaptive tetrahedral mesh of the parametric domain is isomorphically transformed onto the solid by applying a simultaneous mesh untangling and smoothing procedure.

In the case of isogeometric analysis, the geometric approximation of the solid and the numerical solution have been accomplished by using T-splines that enables the local refinement. The control points of the trivariate T-spline are calculated by imposing the interpolation conditions on points sited on the inner and the surface of the solid, and using the volumetric parameterization.

Three-dimensional isogeometric analysis examples for complex solids are presented. In addition, we compare finite element and isogeometric solutions for several two-dimensional examples by using local adaptive strategies.

References

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- [2] J.M. Escobar, J.M. Cascón, E. Rodríguez, R. Montenegro, A new approach to solid modeling with trivariate T-splines based on mesh optimization, Comput. Methods Appl. Mech. Engrg. 200 (2011) 3210–3222.