

The Meccano Method for Finite Element and Isogeometric Analysis

R. Montenegro^{(1)*}, J.M. Cascón⁽²⁾, E. Rodríguez⁽¹⁾, J.M. Escobar⁽¹⁾,
M. Brovka⁽¹⁾, J.I. López⁽¹⁾, J. Ramírez⁽¹⁾

⁽¹⁾ University Institute for Intelligent Systems and Numerical Applications in Engineering, SIANI, University of Las Palmas de Gran Canaria, Las Palmas de Gran Canaria, Spain, {rmontenegro,erodriguez,jmescobar}@siani.es, bmarina@tut.by, joseivanlopez@gmail.com, jabelr@gmail.com, <http://www.dca.iusiani.ulpgc.es/proyecto2012-2014>.

⁽²⁾ Department of Economics and History of Economics, Faculty of Economics and Management, Univ. of Salamanca, Spain, casbar@usal.es, <http://campus.usal.es/~sinumcc>.

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

- [1] R. Montenegro, J.M. Cascón, J.M. Escobar, E. Rodríguez, G. Montero, An automatic strategy for adaptive tetrahedral mesh generation, *Applied Numerical Mathematics* 59 (2009) 2203–2217.
- [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.