

# SIMULTANEOUS VOLUME PARAMETRIZATION AND ADAPTIVE TETRAHEDRAL MESH GENERATION WITH THE MECCANO METHOD

R. MONTENEGRO, J.M. CASCÓN, J.M. ESCOBAR, E. RODRÍGUEZ, AND G. MONTERO

**ABSTRACT.** We have recently introduced the meccano technique for constructing adaptive tetrahedral meshes of solids. The method requires a surface triangulation of the solid, a meccano and a tolerance that fixes the desired approximation of the solid surface. The name of the method stems from the fact that the process starts from an outline of the solid, i.e. a meccano composed by connected polyhedral pieces. The method builds a 3-D triangulation of the solid as a deformation of an appropriate tetrahedral mesh of the meccano. The main idea of the new mesh generator is to combine an automatic parametrization of surface triangulations, a local refinement algorithm for 3-D nested triangulations and a simultaneous untangling and smoothing procedure. In this paper, we present significant advances in the method. Specifically, we describe the procedure for a solid whose boundary is a surface of genus 0; i.e. a surface that is homeomorphic to the surface of a sphere. In this case, the meccano is a single cube, and we define an automatic parametrization of a solid surface triangulation to the meccano boundary such that the global mapping is the combination of six patch-mapping. A crucial consequence of our technique is the volume parametrization of a complex solid to a cube. The efficiency of the proposed technique is shown with several applications.

**Keywords:** Tetrahedral mesh generation, adaptive refinement, nested meshes, mesh untangling and smoothing, surface and volume parametrization.

**Mathematics Subject Classifications (2000):** 65M50, 65N50.

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R. MONTENEGRO, UNIVERSITY INSTITUTE SIANI, UNIVERSITY OF LAS PALMAS DE GRAN CANARIA, SPAIN  
*E-mail address:* [rafa@dma.ulpgc.es](mailto:rafa@dma.ulpgc.es)

J.M. CASCÓN, DEPARTMENT OF ECONOMICS AND ECONOMIC HISTORY, FACULTY OF ECONOMICS AND MANAGEMENT, UNIVERSITY OF SALAMANCA, SPAIN  
*E-mail address:* [casbar@usal.es](mailto:casbar@usal.es)

J.M. ESCOBAR, UNIVERSITY INSTITUTE SIANI, UNIVERSITY OF LAS PALMAS DE GRAN CANARIA, SPAIN  
*E-mail address:* [jescobar@dsc.ulpgc.es](mailto:jescobar@dsc.ulpgc.es)

E. RODRÍGUEZ, UNIVERSITY INSTITUTE SIANI, UNIVERSITY OF LAS PALMAS DE GRAN CANARIA, SPAIN  
*E-mail address:* [barrera@dma.ulpgc.es](mailto:barrera@dma.ulpgc.es)

G. MONTERO, UNIVERSITY INSTITUTE SIANI, UNIVERSITY OF LAS PALMAS DE GRAN CANARIA, SPAIN  
*E-mail address:* [gustavo@dma.ulpgc.es](mailto:gustavo@dma.ulpgc.es)