Universidad de Concepción

BOOK OF ABSTRACTS

WONAPDE 2007

Second Chilean Workshop on Numerical Analysis of Partial Differential Equations

CONCEPCION, CHILE

January 16-19, 2007

FUNDACION ANDES

CONICYT COMISIÓN NACIONAL DE INVESTIGACIÓN CIENTÍFICA Y TECNOLÓGICA

GOBIERNO DE CHILE

Automatic 3-D triangulations of complex geometries from a coarse hexahedral mesh

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Summary. This paper introduces a new automatic tetrahedral mesh generator on the adaptive finite element ALBERTA code. The procedure can be applied to 3-D domains with boundary surfaces which are projectable on faces of a cube. The generalization of the mesh generator for complex domains which can be split into cubes or hexahedra is straightforward. The domain surfaces must be given as analytical or discrete functions. Although we have worked with orthogonal and radial projections, any other one-to-one projection may be considered. The mesh generator starts from a coarse tetrahedral mesh which is automatically obtained by the subdivision of each cube into six tetrahedra. The main idea is to construct a sequence of nested meshes by refining only the tetrahedra which have a face on the cube projection faces. The virtual projection of external faces defines a triangulation on the domain boundary. The 3-D local refinement is carried out such that the approximation of domain boundary surfaces verifies a given precision. Once this objective is reached, those nodes placed on the cube faces are projected on their corresponding true boundary surfaces, and inner nodes are relocated using a linear mapping. As the mesh topology is kept during node movement, poor quality or even inverted elements could appear in the resulting mesh. For this reason, a mesh optimization procedure must be applied. The efficiency of the proposed technique is shown with several applications. On the other hand, authors are grateful for Spanish Government and FEDER support, grant contracts: CGL2004-06171-C03-03/CLI and CGL2004-06171-C03-02/CLI.

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