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ADAPTIVE FINITE ELEMENT METHOD WITH A LOCAL ELEMENT PARAMETRIZATION OF NESTED MESHES

Ramirez J.[1,*], **Oliver A.**[1] **and Montenegro R.**[1]

[1]University Institute for Intelligent Systems and Numerical Applications in Engineering (SIANI), University of Las Palmas de Gran Canaria (ULPGC)
Campus de Tafira, 35017 Las Palmas de Gran Canaria, Spain
http://www.dca.iusiani.ulpgc.es/proyecto2012-2014
jramirez@siani.es, albert.oliver@upc.edu, rafa@dma.ulpgc.es

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This work presents a novel approach to solve a two dimensional problem by using an adaptive finite element approach. The most common strategy to deal with nested adaptivity is to generate a mesh that represents the geometry and the input parameters correctly, and to refine this mesh locally to obtain the most accurate solution.

As opposed to this approach, the authors propose a technique using independent meshes: geometry, input data and the unknowns. Each particular mesh is obtained by a local nested refinement of the same coarse mesh at the parametric space. This strategy is based on the parametrization obtained by the meccano method [1], where the computational mesh is an smoothed projection of a parametrization mesh in the physical space. This technique gives flexibility to generate different meshes with the necessary number of degrees of freedom for the unknowns without using the total number of degrees of freedom necessary for geometry and input data. The numerical integration in a given element of a solution mesh uses its nested elements of the geometry and input data meshes at the physical domain. In this process a local element parametrization of the geometry mesh is considered. The hierarchical composition of the meshes is used to integrate the different mesh data in an efficient way.

This technique is useful for problems in large domain regions where the mesh required by the geometry is much more huge than the one required by the solution itself. This technique can be useful for solving problems where only a reduced portion of the total domain is significant for the solution, i.e. a pollutant puff being transported in a large area [2].

A comparison between this technique and a standard adaptive strategy is presented in two dimensional test problems.

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