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LOCALISED MULTIGRID ISOGEOMETRIC ANALYSIS WITH CONTROLLED ACCURACY

A. Chemin[1], T. Elguedj[1] and A. Gravouil[1,2]

[1] Université de Lyon, CNRS, INSA-Lyon, LaMCoS UMR5259,
20 Avenue Albert Einstein, F-69621, Villeurbanne, France, http://lamcos.insa-lyon.fr/
[alexandre.chemin, thomas.elguedj, anthony.gravouil]@insa-lyon.fr
[2] Institut Universitaire de France, http://iuf.amue.fr/

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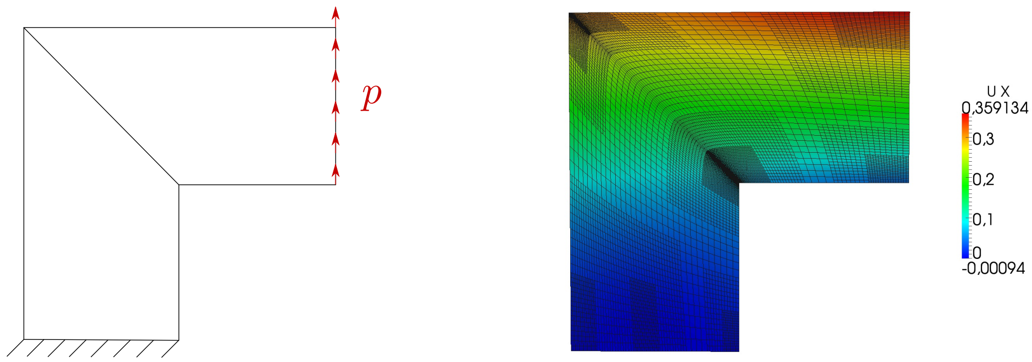
Many algorithms for calculation with automatic grid refinement exist and very efficients ones are based on the Full Multigrid with localization (FMG) scheme [1,5,6]. This iterative scheme uses multigrid resolution initialized with a solution calculated on a coarse grid. If a given level of accuracy is not satisfied, a finer grid is constructed and a multigrid resolution is applied recursively to the new set of grids. Such algorithms show better rates of convergence than classical iterative resolution methods such as Gauss-Seidel or preconditioned conjugate gradients.

A big obstacle using this kind of scheme with Finite Element Analysis (FEA) is to deal with the refinement of non-straigth geometric boudaries. FEA implies an approximation of the geometry constructed with the CAD software. Therefore, the construction of a fine grid from a coarse one without data on the exact geometry is not possible [2].

The introduction of IsoGeometric Analysis (IGA) [3] allows the calculation of mechanical problems using an exact representation of geometric boundaries. The use of IGA with FMG allows to circumvent the need to go back to the CAD geometry to refine curved boundaries.

Here, we propose an automatic grid refinement with controlled accuracy algorithm for 2D elastic problems in the static case using IGA with NURBS basis functions and based on FMG with localization algorithm. A preliminary calculation is done on the geometric mesh from the CAD software, a finer grid is constructed and the FMG resolution starts. The precision criterion used to initiate a refinement is based on the energy density error between two successive grids [4]. Prolongation operators used for that kind of approach are the natural ones, resulting from the standard geometric refinement algorithms used in CAD.



(a) Starting mesh with two elements and Boundary conditions

(b) Final mesh and one component of the displacement field

Figure 1: Results for the L-shaped plate

The algorithm is tested for several classical problems and shows very good rates of convergence.

Such a method can also be seen as an algorithm with automatic local grid refinement for IGA with controlled accuracy, avoiding propagation of refinement due to the tensor product structure of NURBS. The advantage of this method compared to hierarchical B-splines or T-splines is that we are able to perform local refinement for IGA in a less intrusive way for software already using a Galerkin formulation with NURBS basis functions.

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