Adaptive and Parallel Local Mesh Generation Method and its Application

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Abstract

In this talk, we develop a mesh adaptive algorithm that combines a posteriori error estimation with bubble-type local mesh generation (BLMG) strategy for elliptic differential equations. The proposed node-based adaptive mesh generation method consists of four components: mesh size modification, a node placement procedure, a node-based local mesh generation strategy and an error estimation technique, which are combined so as to guarantee obtaining a conforming refined/coarsened mesh. The advantages of the BLMG-based adaptive finite element method, compared with other known methods, are given as follows: the refining and coarsening are obtained fluently in the same framework; the local a posteriori error estimation is easy to implement through the adjacency list of the BLMG method; at all levels of refinement, the updated triangles remain very well shaped, even if the mesh size at any particular refinement level varies by several orders of magnitude.

Further, the parallel version of BLMG method employing ParMETIS-based dynamic domain decomposition method is also developed. The node-based distributed mesh structure is designed to reduce the communication amount spent in mesh generation and finite element calculation. Several numerical examples are carried out to verify the high efficiency of the algorithm.

Keywords: Node placement, Mesh size function, Local mesh generation, Error estimator, Parallel.