Parallel anisotropic 3D mesh adaptation for unsteady turbulent Flows

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ABSTRACT

Aerodynamic characteristics of various geometries are predicted using a finite element formulation coupled with several numerical techniques to ensure stability and accuracy of the method. These kinds of simulations require increasingly refined meshes to capture the different features including turbulence effects. To perform such complex computations, adaptive meshing had been investigated. Despite, important progresses have been achieved in mesh adaptation, several issues have not yet been solved to make for instance dynamic mesh adaptation efficient for three-dimensional industrial cases with moving structures and large deformations.

As refining meshes isotropically results in excessive and expensive refinement, and anisotropic mesh adaptation has proved to be a powerful strategy to improve the quality and efficiency of finite element methods. A new anisotropic mesh adaptation method had been implemented to deal with boundary layers and flow detachments in fluid structure interaction simulations with complex geometries [1]. This is motivated by the need of capturing accurately sharp gradients normal to the walls and across shear layers that arises at high Reynolds number flows and/or at transonic speed in aerodynamics.

The adaptation method proposed consist in combining two metrics: a levelset-based metric field that will be used to ensure an accurate boundary layer mesh fitting curved interface and an edge-based metric that takes into account the variation of the solution in the volume mesh [2].

The levelset-based metric will be used first alone to generate a good initial mesh, and then coupled to the edge-based metric using a size gradation to guarantee a smooth variation between the boundary layer and the volume meshes during the computation. The intersected metric field is then used as input for the mesh generator; the mesh is iteratively adapted using local modifications (i.e. edge collapse, swap or flip operations).

REFERENCES

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