11th World Congress on Computational Mechanics (WCCM XI)
5th European Conference on Computational Mechanics (ECCM V)
6th European Conference on Computational Fluid Dynamics (ECFD VI)
July 20–25, 2014, Barcelona, Spain

MESH ADAPTATION FOR VISCOUS SIMULATIONS

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Key words: *Mesh adaptation, RANS, Boundary layer, Complex geometries, Shock/boundary layer interaction.*

Capturing accurately the whole flow field around a complex geometry remains a challenge for viscous simulations [11].

The scope of this paper is to address this issue from a meshing point of view. Viscous simulations require a specific meshing strategy for near-wall regions where the flow speed varies dramatically along the normal direction and does not vary tangentially. A commonly used method consists in using structured boundary-layer meshes.

We first propose to review the standard approaches [1, 2, 3, 4, 5, 6, 7, 8, 9, 10] devised to generate boundary layers meshes: moving mesh methods consisting in moving the front layer in an existing volume mesh, local remeshing methods where patterns are inserted in an existing volume mesh. This review includes the following points of comparison: robustness, compliance with anisotropic mesh adaptation, CPU time.

We then extend these approaches to devise a mesh adaptation strategy around complex geometries. We start our study with simple shapes such as cubes, wedges with multiple corners, etc. An example of a simple structured mesh adaptation is depicted in Figure 1. In addition, we investigate which meshing strategy better succeeds in capturing shock/boundary layer interactions. We give an example of an unstructured approach in Figure 2.

The relevance of each new approach is assessed by running RANS validation cases, including some provided by NASA [12] and the ERCOFTAC database [13].

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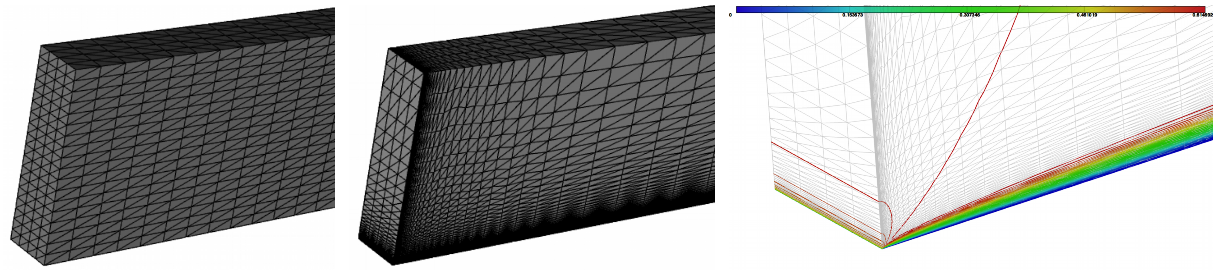

Figure 1: Simple structured boundary layer mesh adaptation. Left: Initial mesh. Middle: Final adapted mesh. Right: Speed isolines.

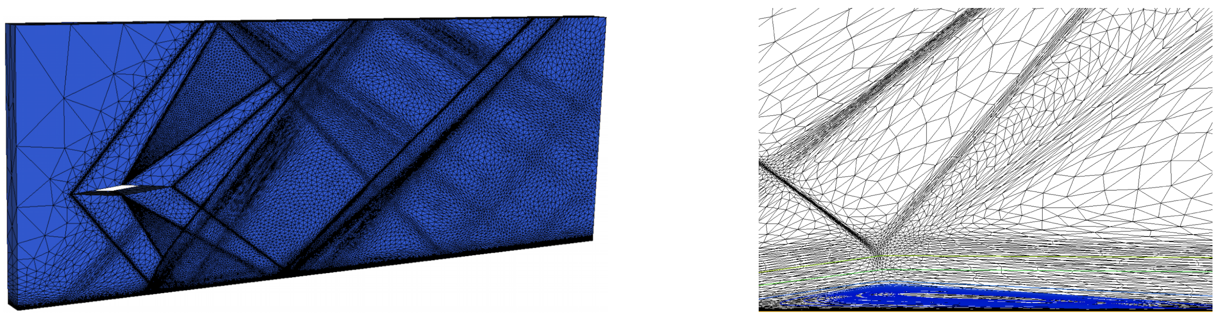

Figure 2: Unstructured mesh adaptation of a shock/boundary layer interaction. Left: the final adapted mesh. Right: close view of the interaction between the shock and the boundary layer.

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