Quality assessment of Smooth Block-Unstructured Mixed Meshes for Aerodynamic Applications

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ABSTRACT

Generating smooth mixed block-unstructured meshes is a promising way to reduce mesh sizes for outer aerodynamic flow analysis. Beyond the core part of the mesh generation, the smooth meshing of the boundary layer region by structured hexahedrons and prisms, for the remaining flow field a triangulation method is needed that allows for a smooth transition between the different element types.

In the past the author et al. [1-4] reported new strategies to generate mixed meshes to significantly reduce mesh sizes without reduction of ac-curacy. The method relies on generating smooth structured hexahedral and prismatic elements for the resolution of boundary layers by a parabolic marching routine based on the face-weighted Laplace equation for a proper alignment and anisotropic stretching of cells resolving viscous flow regimes. Details of the method to generate structured hexahedral and prismatic mesh blocks are described there.

One final brick of the mixed meshing method, an anisotropic triangulation method to generate bounding element conforming tetrahedral meshes has been reported by the author in [5], where a special emphasis is put on a new sparse octree method for memory and time efficient propagation of the underlying propagation of the anisotropic metric information in the mesh domain.

The current contribution presents the necessary modifications to a Delaunay-type meshing kernel [6] to make use of anisotropic size information provided by the sparse octree. The core of the presented work is the assessment of the quality of generated meshes and therefore the benefits of the method. The publication will show grid studies for two common aerodynamic configurations, the ONERA M6 wing [6] and the Boeing CRM configuration [7], known from the 4th and 5th AIAA drag prediction workshops, including a subsequent grid refinement study.

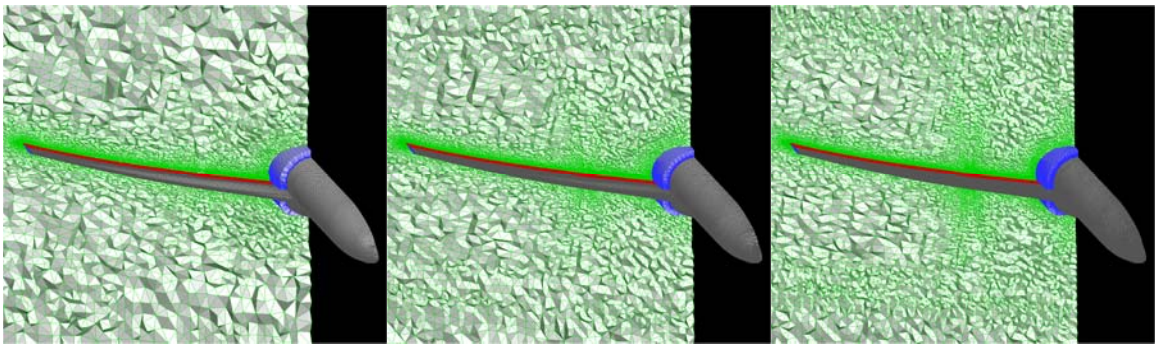

Figure 1: family of smooth mixed meshes with anisotropic tetrahedrons around the Boeing CRM configuration

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