OPTIMAL SEMI-STRUCTURED GRID GENERATION IN RIDGES AND GAPS

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Hybrid semi-structured/unstructured grids are today the only viable solution for the CFD simulation of a large number of flows, characterized by the presence of strong gradients along a certain know direction (such as the diffusion layers along solid walls) and relatively weak gradients in the other directions. In this framework, semi-structured layers of high aspect ratio elements (quadrilaterals in 2D and prisms or hexahedra in 3D) are generated in the direction of the strong gradient. This provides the necessary grid resolution to capture the flow quantity variations in the direction of the strong gradients, while keeping the element size in the other directions to a much larger value (2-3 orders of magnitude larger) in order to produce a grid of reasonable size. For the regions far from the strong gradients, like the bulk flow, isotropic unstructured tetrahedral elements are employed to provide the desired flexibility and automation in the grid generation process.

However, it has been observed by several researchers that the well-established method for semi-structured grid generation using one point normal for each surface point can produce unphysical results around sharp convex corners (i.e. pressure jumps). Furthermore using one point normal produces less than optimal grids in concave regions which could lead to further inaccuracies in the flow simulation.

A novel method will be presented to solve the above deficiencies and generate optimum quality semi-structured grids around corners and ridges. The method operates on hybrid quadrilateral/triangular surface grids which themselves can be highly anisotropic. Extra point normals can be automatically created if it is required by a user criterion (e.g. angle difference between face and point normals), or adjacent normals can be merged in the case of concave ridges to create a more structured looking grid in that area. In this way, good quality grids are created in these difficult regions of the geometry, while keeping the element number to the absolutely minimum. The method will be demonstrated with several academic and real life complex configurations.

References

[1] A. N. Athanasiadis and H. Deconinck, “Object-oriented 3 dimensional hybrid grid generation”, Presented at the 3^{rd} *Symposium on Trends in Unstructured Mesh Generation*, August 2001.