An Adaptive Cartesian unstructured grid generation method for moving boundary applications

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Abstract

A geometric adaptation method is presented for automatic generation of moving boundary unstructured grids. The method has extended the applicability of the initial algorithm [1] to moving boundary applications. The grid generation procedure uses a Cartesian grid approach as a suitable ground for data structure access. In addition, the method requires minimum modification of the grid (and

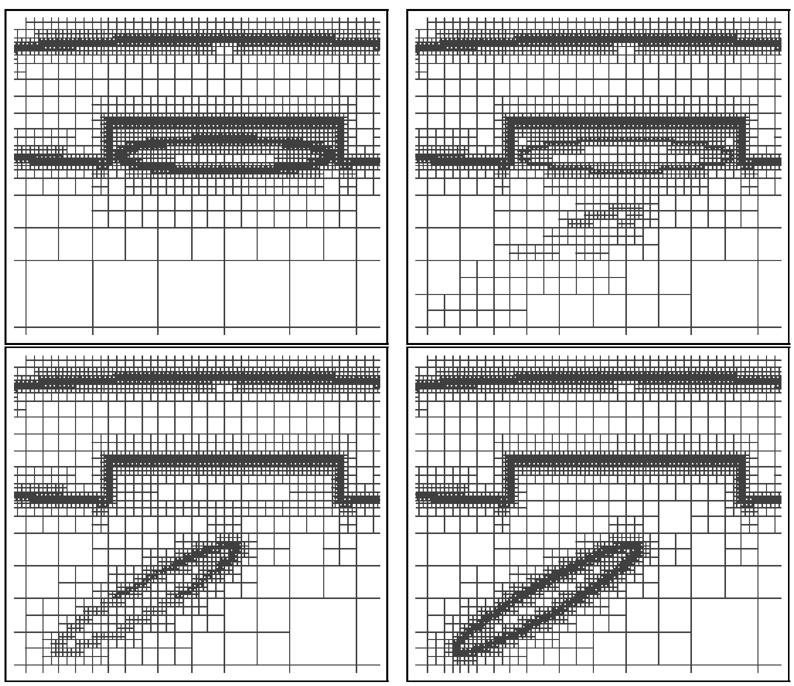

Figure 1: Sequences of geometric adaptation for a moving ellipse descending away from a bigger ellipse with a cavity

data structure) during the relative motion of the bodies, since the majority of the cartesian cells are unchanged throughout the moving process. Therefore, less computations and higher accuracy can be achieved due to minimum grid modification and flow variable interpolation. This would be very crucial particularly in unsteady moving body flow computations when large number of grid regeneration (or movement) are required. The whole procedure can be carried

out using the following steps :

a Generate the initial Cartesian grid for the first position.

b Triangulate Cartesian cells which are not located inside geometries with surface boundary alignment and carry out a steady state solution.

c Adapt the existing Cartesian grid to the new position by cell refinement and coarsening.

d Transfer the flow variables to the new grid, return to step b.

The above algorithm can be repeated for any relative position of bodies. The initial Cartesian grid will be adapted to the new position by geometric adaptation. The binary data structure of the method allows efficient geometric adaptation through cell refinement and coarsening. In this new algorithm Cartesian cells which are located inside geometries remain in the data structure and are handled like other cells and will be only detected in the triangulation process for each position. The process of geometric adaptation has been illustrated in Figure 1. To demonstrate the feasibility of this method, initial computations have been carried out for a moving ellipse descending away from a bigger ellipse with a cavity using 2D Euler equations at Mach number of 0.4 and angle of attack of zero (figure 2).

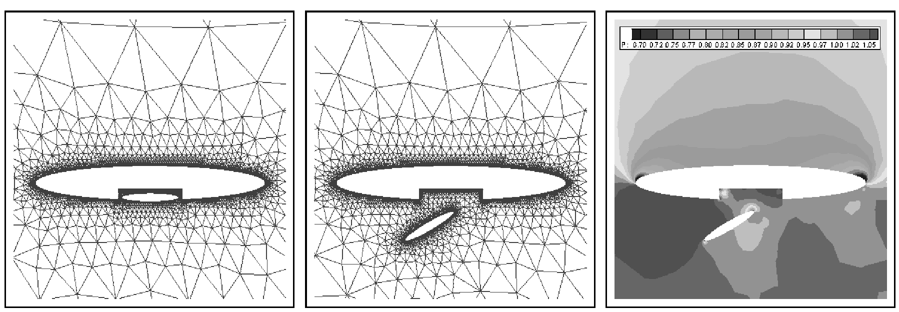

Figure 2: Smoothed grid for the first (Left), and second position(middle), and pressure contours for the second position(Right)

References

[1] A. Jahangirian and Y. Shoraka, Adaptive Unstructured Grid Generation for Engineering Computation of Aerodynamic Flows, *TCN CAE 2005 - MASCOT05*, Lecce, Italy, 2005.