Efficient Treatment of Complex Geometries and Moving Bodies using Single-Block and Multi-Block Overlapping Grids

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Abstract

The overlapping grids method, also known as the Chimera method, is reviewed and discussed in the context of a methodology for the solution and analysis of flows around complex geometries and moving bodies. The overlapping grids method is a way of assembling multiple grids and treating them as a single grid. Basically, this method consists of three major steps: (i) the first step consists in generating a set of structured component grids that cover the computational domain and overlap where they meet (grid generation); (ii) the second step consists in an algorithm for determining how to cut holes in the different component grids where overlapping occurs (hole cutting); (iii) and finally, an algorithm for interpolating the field data back-and-forth between the various overlapping grids (inter-grid communication). Topics to be addressed include the solution of the incompressible Navier-Stokes equations and Euler equations, in cases when the boundaries move according to a prescribed law of motion or when the boundaries remain fixed. Some results dealing with adaptive mesh refinement will also be presented. Current limitations of the approach and best practice guidelines for the generation of overlapping grids are also discussed.

Keywords: Overlapping grids, Chimera grids, Moving bodies, Adaptive mesh refinement, Multi-Block.

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