The 8th European Congress on Computational Methods in Applied Sciences and Engineering
ECCOMAS Congress 2022
5-9 June 2022, Oslo, Norway

NON-REFLECTING BOUNDARY CONDITIONS ON UNSTRUCTURED GRIDS

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Keywords: *Unstructured grids, Non-reflecting Boundary Conditions*

In simulations of external flows the boundaries of the computational domain can be placed usually far-off the region of interest. In contrast, simulation of internal flows encountered in turbomachinery design often require to place the "far-field" boundaries very close to the region of interest. This makes simulation results of the flow in turbomachinery much more sensitive to the implementation of the numerical treatment of far field boundary condition than in the case of external flows. Accurate non-reflecting boundary conditions have been developed by Giles [1] for the two-dimensional case and extended to the three-dimensional case in [2] in the context of flow simulations in turbomachinery. The latter essentially applied the results for the two-dimensional case on circumferential bands of surface elements at constant radial height. The grid generation process for structured cartesian grids can account for such a band structure easily. In case of unstructured grids it may be difficult to enforce a banded structure of the grid elements on the boundary due to restrictions of the grid generation tool or requirements on the grid elements quality.

To carry over the properties of the non-reflecting boundary conditions on structured grids to unstructured grids independently of the grid generation process we construct an auxiliary grid by prescribing sections bounded by lines of constant radius on the boundary and build an auxiliary grid on these sections based on the original grid. The boundary conditions are then applied on this auxiliary grid with well defined bands. We studied the influence on the solution of the radial distribution of the prescribed bands and different approaches to interpolate the flow solution between the auxiliary grid and the original grid. For an academic test case we compared the reflection properties on a structured and an unstructured grid.

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