Implementation Of A Domain Scaling Approach For Turbomachinery Computations In OpenFOAM

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Abstract

In order to simulate turbomachines a coupling method between the different blade rows is needed. Up to now OpenFOAM has only the capability to do an unsteady computation, with a full annulus mesh and a sliding mesh interface between the blade rows. For calculations of multistage turbomachinery with a high mesh resolution this is inefficient due to very long computational times. These restrictions can be overcome by reducing the computational domain in each blade row.

In order to apply a periodic boundary condition at the azimuthal boundaries, it is required that the pitches of the simulated domains in each blade row are identical. Thus, the number of blades in each row have to be multiples of each other. The least common denominator of each blade number is then simulated. As there is normally no least common denominator of blade numbers per blade row in turbomachines, a scaling has to be performed. Hence, this method is referred to as *domain scaling method*. In the majority of cases the stator is scaled to a new pitch. By using this method, the flow quantities are directly transferred – without averaging – between the blade rows.

This method can be either used in steady or unsteady computations. As in steady computations no mesh motion of the rotating zones is performed, this approach is also known as *frozen rotor* method. Whereas in unsteady computations the relative mesh motion between the passages is considered.

The domain scaling method was mainly realised as an extension of the *overlapGgi* boundary condition. Therefore, the adjacent patches of the blade rows are copied in circumferential direction in order to get a full annulus interpolation surface of revolution. Between these virtual patches a GGI interpolation is performed to map the flow quantities between the two different mesh zones. The current realisation status with up to date results will be detailed in the presentation.

Key words: Rotor-Stator Interface, GGI, Dynamic Mesh, Rotating Reference Frames