LARGE EDDY SIMULATION OF RIBBED DUCT FLOW USING FLUENT

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The flow in ribbed ducts represent a topic of paramount industrial interest. This geometry is representative of internal channels of turbine blades for cooling. The understanding of this flow is then very important for the optimisation of cooling process. The complexity of the flow requires 3D investigation, which is nowadays only possible with computational tools. The turbulent motion cannot be treated as a simple superposition of well understood turbulent phenomena and nowadays RANS simulations cannot provide a satisfactory result. Large Eddy Simulation (LES) seems to be a possible tool.

The simulation was carried out using Fluent 6.x a commercial general purpose code. The considered geometry is of a square section duct with successive ribs aligned normal to the main flow. Present set-up can be characterized by the hydraulic diameter *D* of the duct, the height *h* of the square sectioned ribs and the pitch *p* between the successive ribs. The *h/D* ratio is *0.3* and the *p/h* is *10* in the computed geometry. The Reynolds number is *40000* using the hydraulic diameter and the bulk velocity.

The results of LES are validated by comparison with PIV measurement in six planes. Agreements and disagreements between the two sets of data were described in detail in the report and some reasons will be proposed. Good overall agreement was found in the main features of the flow and the computational result was analysed in detail.

The average velocity-field were analysed using five different methods. Rotating structures were recognized and named using the *Q* criteria. Streamlines were used to show mixing of averaged flow-field in one pitch length. The streamlines helped to distinguish between important separated regions of the flow as well. Vector-fields were shown to improve the understanding of the important structures of the flow.

The six components of the Reynolds stress tensor were qualitatively analysed showing the regions of high turbulence value within the domain.

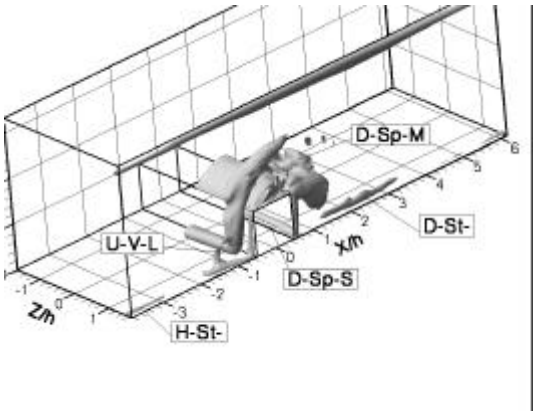

Figure 1: Classification of rotational structures around the rib

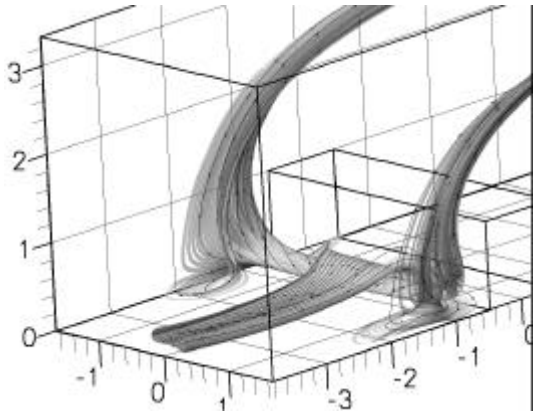

Figure 2: Stream-surface upstream the rib