AEROTHERMAL PERFORMANCE OF AN INTERNAL COOLING CHANNEL WITH 45 DEGREES INCLINED RIBS

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In order to increase the thermodynamic efficiency of gas turbines, a higher temperature at the turbine inlet is desired. For this reason it is necessary to cool the blades in the first stages of the turbine. This experimental work studies the flow field inside a turbine blade cooling channel with one ribbed wall, using Particle Image Velocimetry.

The main objectives were to analyse and to characterize the aero-thermal behaviour of this highly three-dimensional flow and to create a reliable database for numerical code validation. The analysis is focused on the mean flow features, which are the most important in the development of the design tools. The measurements were done by respecting geometrical and flow similarity conditions into a scaled up model (D_h*=120mm)* of a turbine blade internal cooling channel. The ribs have a squared section and are inclined at *45* degrees with respect to the mean flow direction, introducing a blockage ratio of *10%.* Measurements were taken for a Reynolds number of *40000* and a pitch to rib-height ratio of *15*.

In order to provide a global view of the flow field between two consecutive ribs, measurements over mutually perpendicular planes were carried out. Due to the directional effects promoted by the inclined ribs on the flow, the velocity field shows a strong three-dimensional character. Analysing the experimental data, a non-symmetrical rib guided recirculating structure stands out as one of the main characteristics of the flow. Other structures present on the mean flow are also reported, with dimensions and locations for all of them.

The data were compared with the available wall heat transfer distribution, pointing out the relation between the aerodynamic and the thermal behaviour of the flow. The reattachment line and the recirculating zones, detected in the aerodynamic measurements, play an important role in the cooling process.

A preliminary wavelet analysis shows the existence of vortices in several instantaneous flow fields, presenting the characteristics of the main recirculating structure reported in the mean flow.