CONJUGATE HEAT TRANSFER INVESTIGATION IN AN INTERNAL COOLING CHANNEL WITH RIBS AT 45 DEG.

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The aim of the project is to determine the heat transfer coefficient in a rib-roughened internal cooling channel of a high pressure turbine blade. This investigation combines the effects of convection and conduction. The convection transfer phenomena take place between the cooling air and the channel walls whereas the conduction takes place through the wall thickness, especially in the vicinity of the ribs, leading to the so-called pumping effect. The heat exchange by radiation between the different walls of the channel is not considered in the present project.

A scaled-up model of the cooling channel was designed and manufactured. One of the walls, made of stainless steel was uniformly heated by Joule effect along its outer surface. The inner surface temperature distribution was quantified by means of an infrared thermography technique. In this way, the boundary conditions needed to solve the conduction equation inside the wall were defined. The solid wall temperature field was provided by using the commercial software, FLUENT.

A better physical understanding of the heat transfer will lead to a more realistic modelling as the heat transfer is not simply a superposition of different phenomena to be studied separately but is a true coupled interaction between the conduction and the convection. Most of the pure convection studies assume the heat flux to be equally distributed between the three surfaces of the rib while the conjugate approach clearly shows that only the top part of the rib extracts heat from the slab while the sidewalls have no or a negative effect on the cooling.

Flow measurements complete the characterisation of the investigated phenomenon. A detailed uncertainty analysis supports the results of the present work. The obtained results are analysed and compared with previous thermal and aerodynamic data.

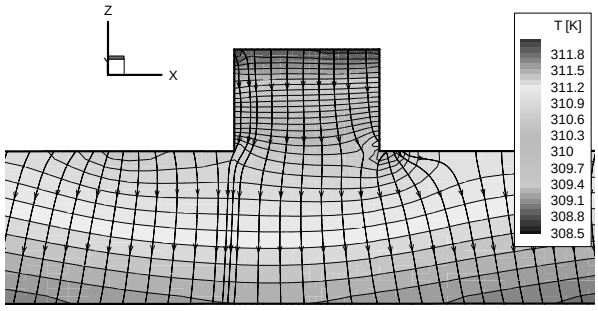

Figure 1: Temperature and ∇T *field inside the slab*