Universität Stuttgart
INSTITUT FÜR THERMODYNAMIK DER LUFT- UND RAUMFAHRT
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Master thesis

Numerical heat transfer investigation of a generic turbulator geometry

Optimization of thermally highly loaded cooling components plays an important role in today's aircraft engine development. As an example, the low-pressure turbine blades exposed to hot gas must be equipped with internal cooling channels with turbulators. A configuration with great potential for increasing the heat transfer coefficient (HTC) consists of a combination of ribs and protrusions.

Experiments with liquid crystals at the ITLR have shown that turbulators with curved surfaces (e.g. protrusions) cannot always be evaluated using classical methods. The convex wall curvature means that protrusions cool down faster than flat walls and consequently overestimate the HTC. Therefore, an approach based on transient numerical simulations should be developed, and should allow quantification of the existing three-dimensional heat conduction effects.

Thus, the aim of this work is to simulate the temporal cooling of a single protrusion using a model created in ANSYS CFX in order to derive suitable correlations that can be used to correct the experimental heat transfer data. Firstly, the geometry is to be meshed and the numerical model set up. Various HTC distributions and geometry variations will then be simulated in order to generate a sufficiently large pool of data. This pool sets the basis for the empirical-numerical correction model, which will then be tested in a real cooling channel.

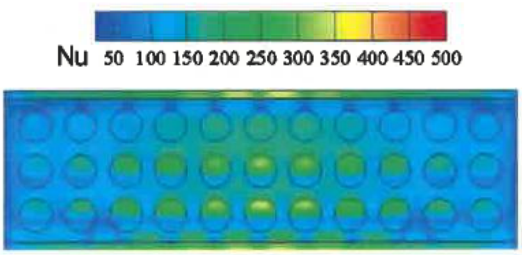

Fig. 1: Examplary Nu-distribution for a configuration with protrusions (Lan et al. 2011)

Tasks:

- Mesh generation and modelling in ANSYS CFX
- Parameter study for various numerical boundary conditions (HTC distributions) and geometry variations (r/H)
- Derivation of empirical-numerical correction functions
- Application in a real cooling channel

Previous knowledge in the field of heat transfer is desirable

Starting date:

Immediately

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