SUPER – Stuttgart University Program for Experiencing Research
Project Information

Institute's Information
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Duration of Project/Number of Students
June/July X
June/July/August
Number of Students 1-2

Project Information
Name of Project Film Cooling in Supersonic Flows
Beneficial Skills & Knowledge - Aerospace engineering studies
- Basic knowledge of computational fluid dynamics and Unix

Description of Work
A gain in rocket-engine power output is achieved by increasing the thrust-chamber pressure and temperature resulting in heat loads that exceed the temperature limits of today's available materials. Therefore, innovative and efficient cooling strategies have to be developed. A promising cooling technique is film cooling, which is considered a prerequisite for the safe operation of future high-performance rocket engines.

In this project, fundamentals of film cooling are investigated numerically using a highly accurate in-house code or the RANS solver 'TAU' developed by the German aeronautics and space research center (DLR). The cooling gas is injected through an open backward-facing step into the hot nozzle gas flow. Several parameters that influence the cooling performance, like e.g. the pressure gradient or the blowing ratio, shall be varied. The results will be analyzed and compared to corresponding experiments performed at the RWTH Aachen University, Germany.

Fig.1: Flow in an axisymmetric rocket nozzle.
Upper half: Mach number distribution; lower half: density gradient.
Fig. 2: Temperature field in the nozzle extension, upper half. Upper: with tangential cooling gas injection, see arrow; lower: no injection, only backward-facing step.

Literature: see ResearchGate - M. Keller; M. Kloker (University of Stuttgart)