Technische Universität Braunschweig

Studien- oder Masterarbeit

(deutsch oder englisch)

Comparative Analysis of Heat Convection Equations with CFD Simulations in Rocket Engine Design

At the Institute of Space Systems (IRAS) at the Technische Universität Braunschweig, research is focused on refining the tools used in preliminary rocket engine design. This thesis investigates the efficacy of using semi-empirical 1D heat convection equations, traditionally supported by NASA's CEA Tool for deriving bulk flow properties, against 2D combustion CFD analyses. The aim is to clarify the selection of frozen versus equilibrium properties at various stations in the nozzle and determine the appropriate transport properties for boundary-layer correlations.

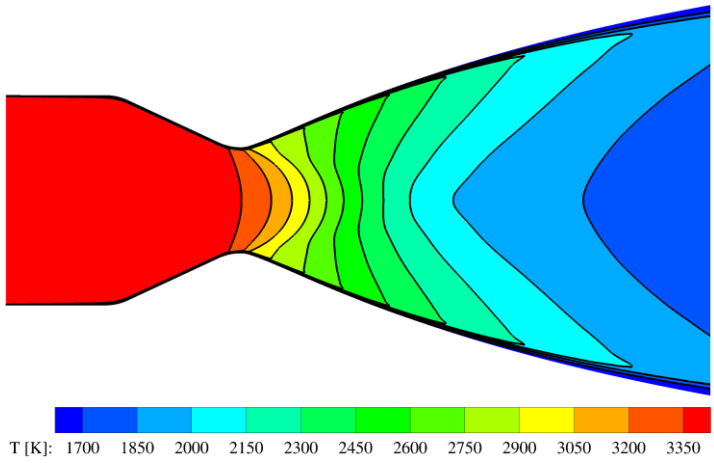

Figure 1: Temperature distribution of a generic nozzle configuration flow field (Schneider & Genin, 2016).

Tasks and Deliveries Include:

1. Conduct a literature review
2. Set up a 2D CFD simulation to analyze heat transfer to a wall at fixed temperature and compare these results with those derived from 1D heat convection
3. Identify the optimal parameters for different stations within the nozzle based on the simulation results.
4. Develop a guideline outlining which parameters to use for accurate thermal modeling.
5. Document the methodology, results, and guidelines in a comprehensive final report and presentation.

Skills and Knowledge:

- Proficient in CFD software and tools
- Familiarity with NASA's CEA Tool and semi-empirical methods in thermal analysis.
- A solid understanding of combustion simulation would be an asset.
- High motivation for thermodynamics
- Knowledge in heat transfer mechanics (Wärme- und Stoffübertragung) would be beneficial.

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