Management Center Innsbruck

Department of Technology & Life Sciences

Master's program Mechatronics & Smart Technologies

Report

composed as part of the course
WS 2024 Computational Methods of Fluid Dynamics
(MECH-M-3-CFD-NSM-VO)

about

Optimization Study of a flow heater

from

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Study program	Master's program Mechatronics & Smart Technologies
Year	MA-MECH-23-VZ
Course	WS 2024 Computational Methods of Fluid Dynamics (MECH-M-3-CFD-NSM-VO)
Name of lecturer	Manuel Berger, PhD
Submission deadline	February 14, 2024

January 7, 2025

Contents

Chapter 1

Meshing of the Domain

The meshing of the domain is a crucial step in the simulation process as it directly affects the accuracy of the results. The following setting were used:

- item size of 2 mm
- 5 inflation layers

The mesh of the whole domain for the basic geometry is shwon in Figure 1.1 while Figure 1.2 shows a detailed view of the meshing at the walls and heater element.

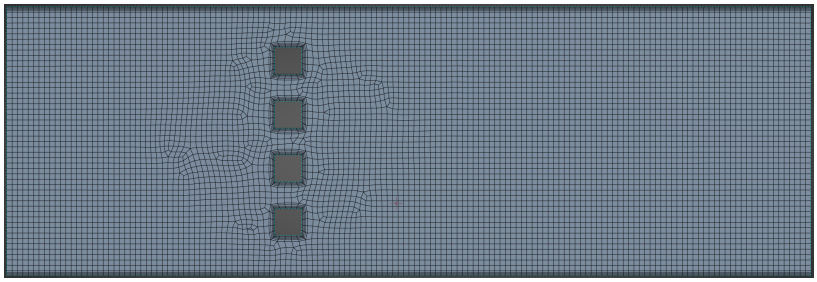

Figure 1.1. Full view of the base geometry meshing

1.1 Grid Convergence Study

To ensure the mesh independency of the results, a grid convergence study was performed. The mesh size was varied between 4 mm, 2 mm and 1 mm whilst keeping the number of inflation layers constant. To evaluate the results, the area-weighted average static temperature 25 mm before the outlet was used. The results are shown in Table 1.1 and Figure 1.3.

The grid convergence study yields an asymptotic range of convergence of 0.99911, a 0.19 % Grid Convergence Index (GCI) between 4 mm and 2 mm and a 0.08 % GCI between 2 mm and 1 mm mesh sizing and thus shows that the results can be seen as mesh independent for a mesh size of 2 mm.

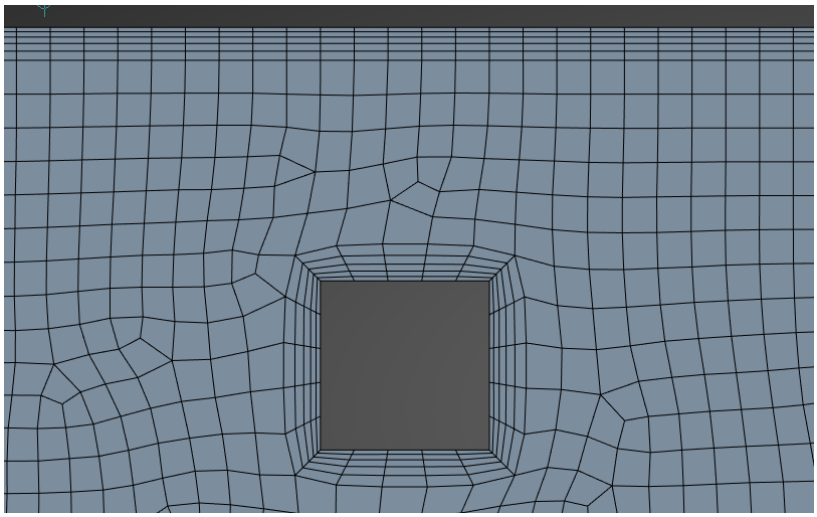

Figure 1.2. Detailed view of the base geometry meshing

Table 1.1. Grid convergence study

Mesh size	Temperature [K]
4 mm	305.62
2 mm	304.96
1 mm	304.69
Richardson Extrapolation	304.503

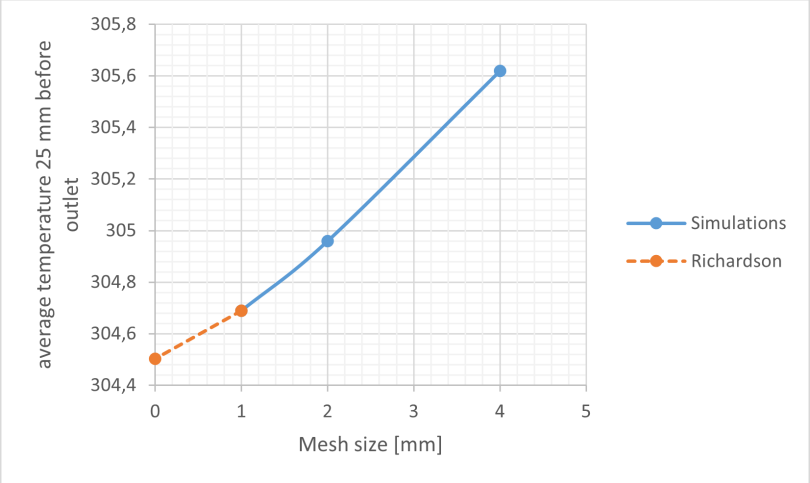

Figure 1.3. Grid convergence graph showing the variation of temperature with mesh size

Bibliography

List of Figures

Appendix A

MATLAB scripts

As attachment, all Matlab live scripts and Simiulink files used in in the context of this laboratory are submitted as *.mlx*-files and *.slx*-files. Additionally, the following live scripts are also directly attached to this report in written format:

- response_fitting_lab_data.mlx
- aerodynamic_state_observer_controller_init.mlx