RWTH AACHEN UNIVERSITY

Institute of Aerodynamics and Chair of Fluid Mechanics

Bachelorarbeit / Masterarbeiten

Numerical analysis of control of shock-wave / boundary layer interaction using air-jet vortex-generator

Flow fields around aerospace transportation and propulsion systems are characterized by frequent occurrence of shock wave / boundary layer interactions. A strong shock wave imposes a large adverse pressure gradient on the boundary layer and can induce large scale separation. This interaction can lead to high local fluctuating pressure and thermal loads, detrimental to the physical structure. Hence, effective control of these phenomena is necessary for cheaper and more efficient air and space transportation.

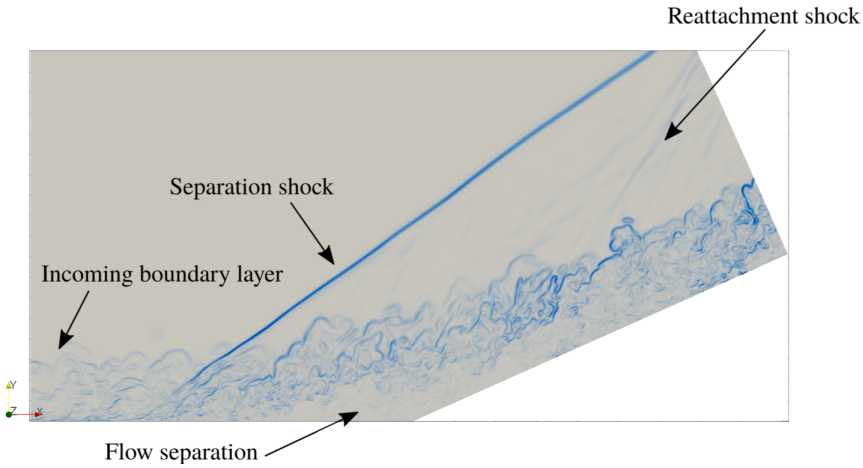

Figure 1: Numerical schlieren of the shock-wave / boundary layer interaction in a compression ramp flow

A promising approach is based on the injection of air jets into the boundary layer. The streamwise vortices generated by these air-jets redistribute the momentum within the boundary layer, making it more resistant to separation. The effectiveness of air-jet vortex generators in mitigating flow separation has been verified in subsonic, transonic and supersonic flow conditions. However, further studies are essential to understand the underlying governing mechanism. In the framework of this proposed thesis, state-of-the-art numerical techniques will be used to study the influence of air-jet vortex generators on shock-wave / turbulent boundary layer interactions.

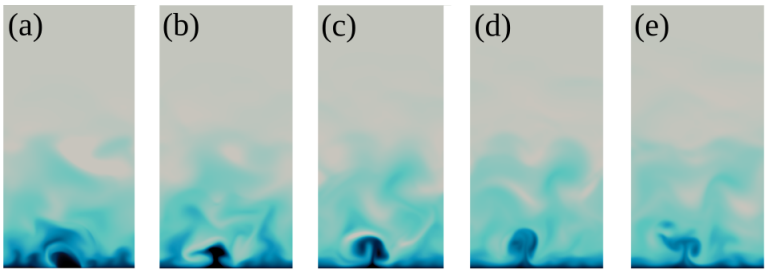

Figure 2: Flow field in the vicinity of the air-jet vortex generator. Sub-figure (a) is at the location of jet injection, (b-e) are the downstream locations.

Requirements

- Good knowledge of fluid mechanics and CFD.
- Experience with C++/FORTRAN and Python/Matlab.
- Knowledge and experience on machine learning would be very beneficial.
- Preference to write the Bachelor/Master thesis report in English.

Tasks

- A brief literature survey on separation control in high speed flows.
- Develop the in-house code m-AIA.
- Perform high-fidelity numerical simulations.
- Analysis and post-processing of the obtained data.
- Discussion of the results and comparison with literature.
- Submission of final thesis report.

Contact:

If you have any questions / are interested and would like to know more about the project, feel free to send an email with your CV or pass by our office.

Dr. Robin Sebastian
AIA - Institute of Aerodynamics
and Chair of Fluid Mechanics,
RWTH Aachen University,
Wüllnerstr. 5a,
52062 Aachen, Germany.
Tel: : (+49 241) 80 95188
Email: r.sebastian@aia.rwth-aachen.de

Dr.-Ing. Anne-Marie Schreyer
AIA - Institute of Aerodynamics
and Chair of Fluid Mechanics,
RWTH Aachen University,
Wüllnerstr. 5a,
52062 Aachen, Germany
Tel: (+49 241) 80 95188
E-Mail: a.schreyer@aia.rwth-aachen.de