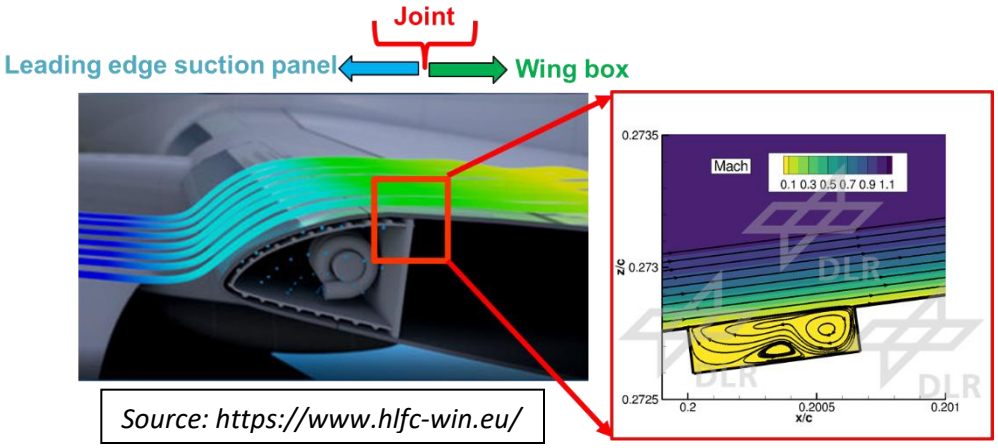
Deutsches Zentrum für Luft- und Raumfahrt
German Aerospace Center

Master Thesis Project

Institute of Aerodynamics and Flow Technology, Department of High Speed Configurations

Numerical Investigation of the Influence of Surface Irregularities on the Expected Laminar-Turbulent Transition Location on Transonic Wings.

Current EU-projects (BLADE, HLFC-WIN) investigate the feasibility of extending the laminar flow region on wings at realistic flight conditions. The delay in laminar-turbulent transition reduces the viscous drag, and therefore, leads to savings on fuel consumption (directly related with CO_2 and NO_x emissions). However, the presence of unavoidable surface irregularities (steps, gaps) on aircraft wings, may reduce the potential benefit of new designs. Therefore, the quantification of the influence of such irregularities on the expected laminar-turbulent transition location becomes a crucial task in the design process. In the proposed Master thesis, in-house DLR tools (Grid generator MEGACADS, Navier-Stokes solver TAU and instability analysis codes NOLOT-PSE/AHLNS) will be used to study the interaction of surface imperfections with the flow instabilities which may lead to the onset of laminar-turbulent transition. The study will investigate different kinds of geometries of surface irregularities.



Source: https://www.hlfc-win.eu/

Example of surface irregularity on a transonic HLFC wing. Mach number contours and sectional streamlines

Tasks:

- Literature review of laminar-turbulent transition and the effect of surface irregularities
- Getting familiar with in-house DLR tools and their numerical setup
- Computation of steady laminar 2.5D wing flows and succeeding instability analysis
- Evaluate the results with a detailed analysis of the flow characteristics
- Comparisons with experimental data from wind tunnel/in-flight tests

Requirements: studying Aeronautical/Mechanical Engineering or equivalent, good knowledge of aerodynamics / fluid dynamics and CFD. Experience in Linux environment is beneficial.

Starting: immediately
Duration: 6 months

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