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IMPACT OF SURFACE IMPERFECTIONS ON THE TRANSITION PROCESS OF LAMINAR BOUNDARY LAYERS

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ABSTRACT

This is intended as a mini-symposium on influences of steps and gaps or other surface imperfections on the transition process. This important task of the current laminar-wing research is investigated by various groups all over the world by using different numerical, theoretical and experimental approaches to predict design criteria. The event will provide the opportunity for an exchange of international researchers on the task of transition by surface imperfections on laminar wing-sections or generic configurations. As a mini-symposium, it is not only intended to present final results of past research tasks, but also for recent results or ongoing work and computational as well as basic theoretical or experimental work will be welcome.

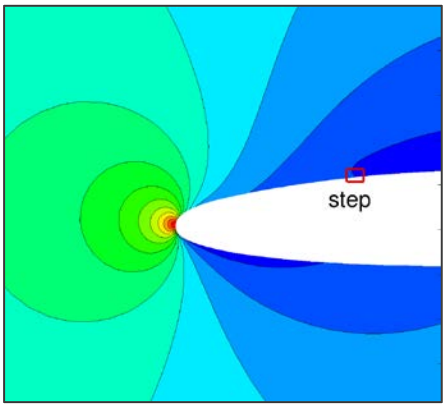
Commercial aircraft design criteria are significantly determined by economic and ecological aspects and the necessity to reduce fuel consumption, for example by a reduction of the total aerodynamic drag. Since the friction-drag of a laminar Boundary-Layer (BL) is generally lower in comparison to a turbulent one, an effective approach for drag-reduction is the application of laminar wings or artificial laminarization.

For manufacturing reasons, a realistic wing is not expected to be an ideal perturbation-free surface; therefore surface imperfections must be taken into account for the laminar-wing design with or without suction for Hybrid Laminar Flow Control (HLFC). Influences of surface bumps or steps by rivets or joints of wing-panels must be predictable within the design-loop by quick and simple criteria, due to their essential impact on the transition location. For this reason detailed analysis of the mechanisms behind these perturbations on BL-stability is an important task for future laminar aircraft research.

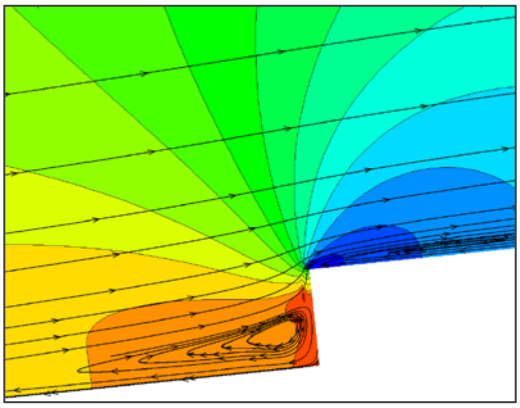
Linear Stability Theory (LST), as a reliable transition-prediction tool in aircraft industry. It is still restricted at surface imperfections, and recent corrections in such regions have shown promising results for generic configurations [1][2]. Nevertheless, these are still not globally applicable and the physical background of the approaches has to be improved, for example by direct numerical simulations [3] or detailed experimental insights. This statement holds for all kinds of perturbations, like surface-waviness, steps, gaps or rivets.

Theoretical and experimental work on this design-task has shown promising approaches within recent years [4] and different European and national projects were started to provide

deeper insight into the flow-physics behind transition by such perturbations. All contributions in this field will be welcome and we are looking forward to provide a forum for motivated researchers from all over the world.



Pressure distribution on a laminar wing with step



Pressure distribution and streamlines at a forward facing step

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