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NUMERICAL INVESTIGATION OF LOCALISED SUCTION AS A MEANS FOR REDUCING THE IMPACT OF SURFACE IMPERFECTIONS ON BOUNDARY LAYER TRANSITION

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It is well known that steps and gaps occurring at the joints different structural elements of an aerodynamic surface have a detrimental effect on laminar flow. Using our in-house DNS-code ns3d we have performed numerical investigations aimed at quantifying the additional amplification of mostly two-dimensional Tollmien-Schlichting waves traveling over steps or gaps [1], [2]. It is common to quantify these as an additional N-factor ΔN to be used with the N-factor method for transition prediction in airfoil design. Another well-known fact is the observation that laminar boundary layers can be stabilized by suction through the wall.

Therefore, for the present investigations we used a generic flat-plate junction geometry with different step heights and a suction gap directly upstream of the forward facing step. Such a configuration could be easily incorporated in a surface panel junction or around maintenance openings on a wing.

Interestingly, the numerical results show that the concept is very effective [3], [4]. It is not only possible to eliminate the additional amplification by the roughness but to reduce disturbance amplification below the one expected for a smooth wall without suction as well. The influence of the most dominant parameters, like step height, step geometry, and suction rate will be shown in the presentation.

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