STS-06

Electroactive morphing effects through travelling wave actuation on the aerodynamic performance of a morphing wing by means of numerical simulation

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This study aims at investigating the flow around a morphing wing at high Reynolds number 1M and angle of attack of 10°. A separation of the boundary layer occurs at approximately 80% of the chord towards the trailing-edge (figure 1). Therefore, a formation of strong shearing downstream in the wake leading a the development of the von Kármán vortex shedding further in the wake. An increase of the viscous aerodynamic forces such as the drag can be observed in such configurations. A new morphing concept has been developed using an innovative interface with a controlled Smoothed Traveling Wave "STW" implemented on the wing's suction side. The objective of this work is to implement and validate the STW in the Navier-Stokes Multi-Block "NSMB" [1] solver, then to analyse different related parameters such as the range, the wavelength, the amplitude of deformation and the frequency of traveling wave i respect of the aerodynamic performance benefits. These parameters are optimised regarding the experimental prototype equipped by piezo-actuators using PVDF and CNT composites to enhance their piezoelectric properties and achieve suitable deformations. The SWT interacts with the separation of the boundary layer and a reattachment of the flow can be achieved under optimal parameters, leading to a thinning of the shear-layer in the wake and consequently increases the aerodynamic efficiency of the wing.

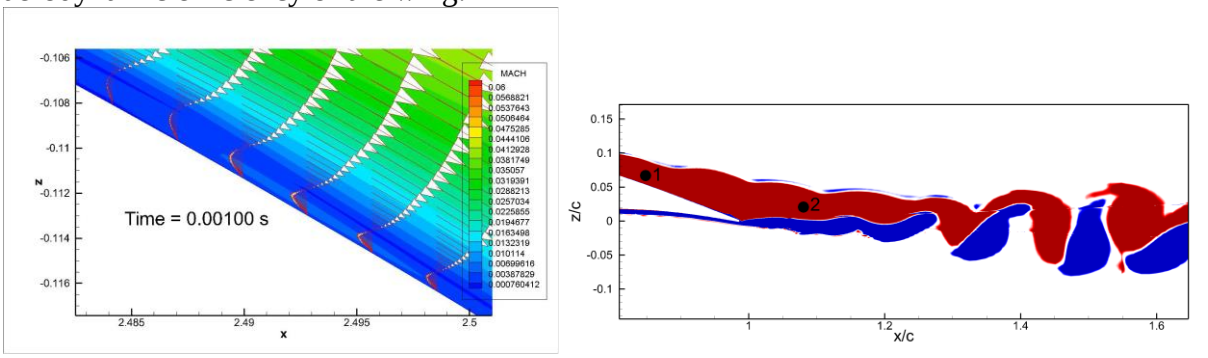

Figure 1: (left) Recirculation reduction effect through the SWT morphing, shear-layers and von Kármán vortex shedding effects in the wake.

REFERENCES

[1] Y. Hoarau, D. Pena, J. B. Vos, D. Charbonnier, A. Gehri, M. Braza, T. Deloze and E. Laurendeau. Recent Developments of the Navier Stokes Multi Block (NSMB) CFD solver. 54th AIAA Aerospace Sciences Meeting 4-8 January 2016 San Diego, California, USA https://doi.org/10.2514/6.2016-2056