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Session:

3D Numerical investigation of two element airfoil-flap with a morphing flap at high Reynolds numbers using hybrid models .

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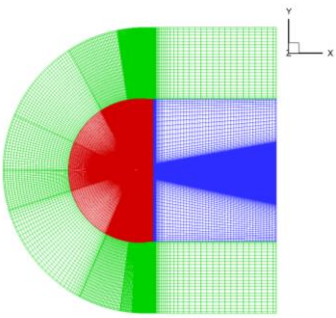
Introduction

A high-lift flap is used to improve the take-off and landing aerodynamic performance of aircraft. This study is a part of the SMS (Smart Morphing and Sensing) European project (www.smartmorphing.org/SMS) .It includes numerical simulations and physical analysis issued from the hybrid morphing, operating different time scales and associating different smart actuation approaches. This article focuses on the high-lift flap in take-off configuration of Airbus A320 at high Reynolds number, using adopted turbulence modelling. This design using smart material properties in interaction with fluid flow aims at simultaneously increasing the lift, reducing the drag and the aerodynamic noise of the aircraft wings of the future. The access to ongoing experimental studies in our research team contributes to the understanding of the physics and the performance of morphing. The study will use advanced numerical simulation approaches implemented in our research teams and used elsewhere in the European research institutes and aeronautical industry, and first part of the study, concerns simulations of the two-element A320 wing-flap in the take-off configuration with vibrating trailing edge is performed which optimal actuations will be accessed in relation to the fixed objectives, and applied in the experimental large-scale morphing prototype of the SMS project in full scale.

Results

The 3D simulations of the A320 airfoil in the take-off configuration with a chord c = 2.72m at upstream Mach number M=0.032 and Re = 2.25×10^6, the $\alpha = 8.2°$ will be



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carried out with the Navier-Stokes Multi-Block (NSMB) solver. A physical time step of 10^{-5} sec has been adopted at first set of 2D simulations. The 3D patch-grid have a C-H topology and a size of 20 M cells with a spanwise direction of 0.3m. Using at the $k-\varepsilon$ *OES* (Organized Eddy Simulation) model developed in IMFT, *SA DDES Wale* and *Delta_SLA*, Static and Morphing configuration will be compared. The ALE (Arbitrary Lagrangian Eulerian) is used for the grid deformation. The high frequency-low amplitude actuation is used, the amplitude is 0.35mm and the frequency range is [20-400Hz].

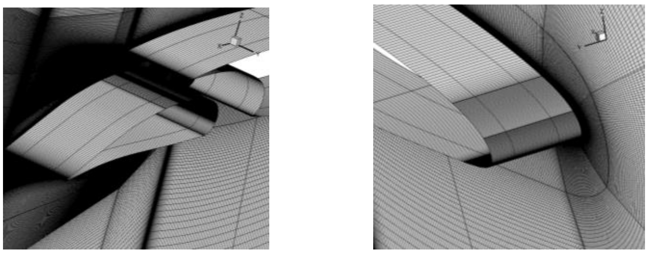

Fig. 1 Presentation of the A320 grid.

Conclusion

This article will show optimal morphing effects at different frequencies and amplitudes to explain how the morphing influences the development Von Karman as well as with the shear-layer Kelvin-Helmholtz vortices eddies in the wake and will also show the impact of the shape modification (camber control) on the vortex structures and instabilities in the near-wake leading to a reduction of the wake width and thinning of the shear layer resulting therefore to drag reduction [2]. An expected reduction in pressure drag and an increase in lift will be achieved [3].

References

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