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Numerical simulation of the aerodynamic performance of a supercritical wing subjected to a hybrid electroactive morphing associating cambering and multi-parametric vibration effects

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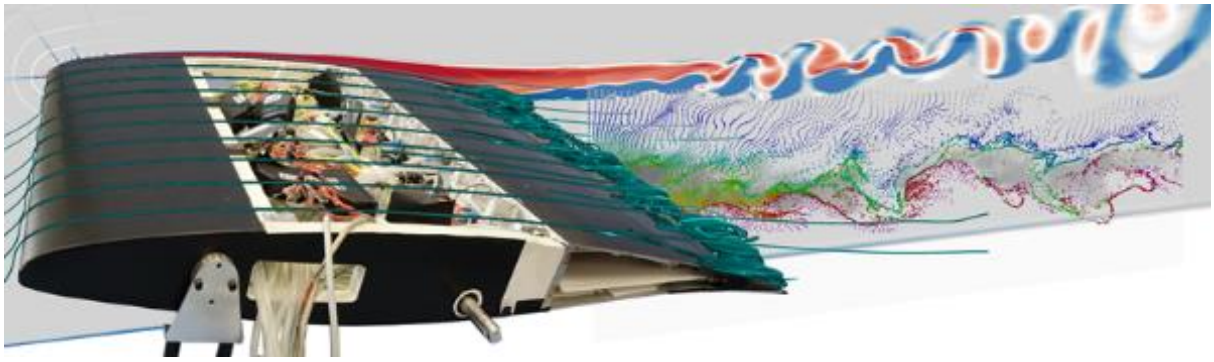
The present article investigates numerically the effects of electroactive morphing on an A320 airfoil through Hi-Fi simulations at Reynolds number of 1 Million, incidence of 10° and Mach number of 0.06 corresponding to a low subsonic regime of take-off. The same parameters have been used for physical experiments carried out in the S4 wind tunnel of IMFT around the A320 morphing wing, [1], fig. 1a. Different time and length scales are studied through *hybrid electroactive morphing* [2], involving low frequency cambering at large amplitude thanks to Shape Memory Alloys (SMA) and higher frequency vibrating trailing edge (HFVTE) at low amplitude thanks to Macro Fiber Composite (MFC) piezoactuators. The simulations have been carried out using the NSMB (Navier Stokes MultiBlock) code and the OES-Organised Eddy Simulation for the turbulence modelling [3]. The HFVTE is studied through constant actuation frequency and wobulation as presented in a companion paper. Thanks to the simultaneous association of cambering actuation by means of SMA and through HVTE, a considerable increase of lift has been obtained. This benefit has been further increased by using wobulation of the HVTE actuation (Fig. 1), by a suitable frequency modulation law.



(a)

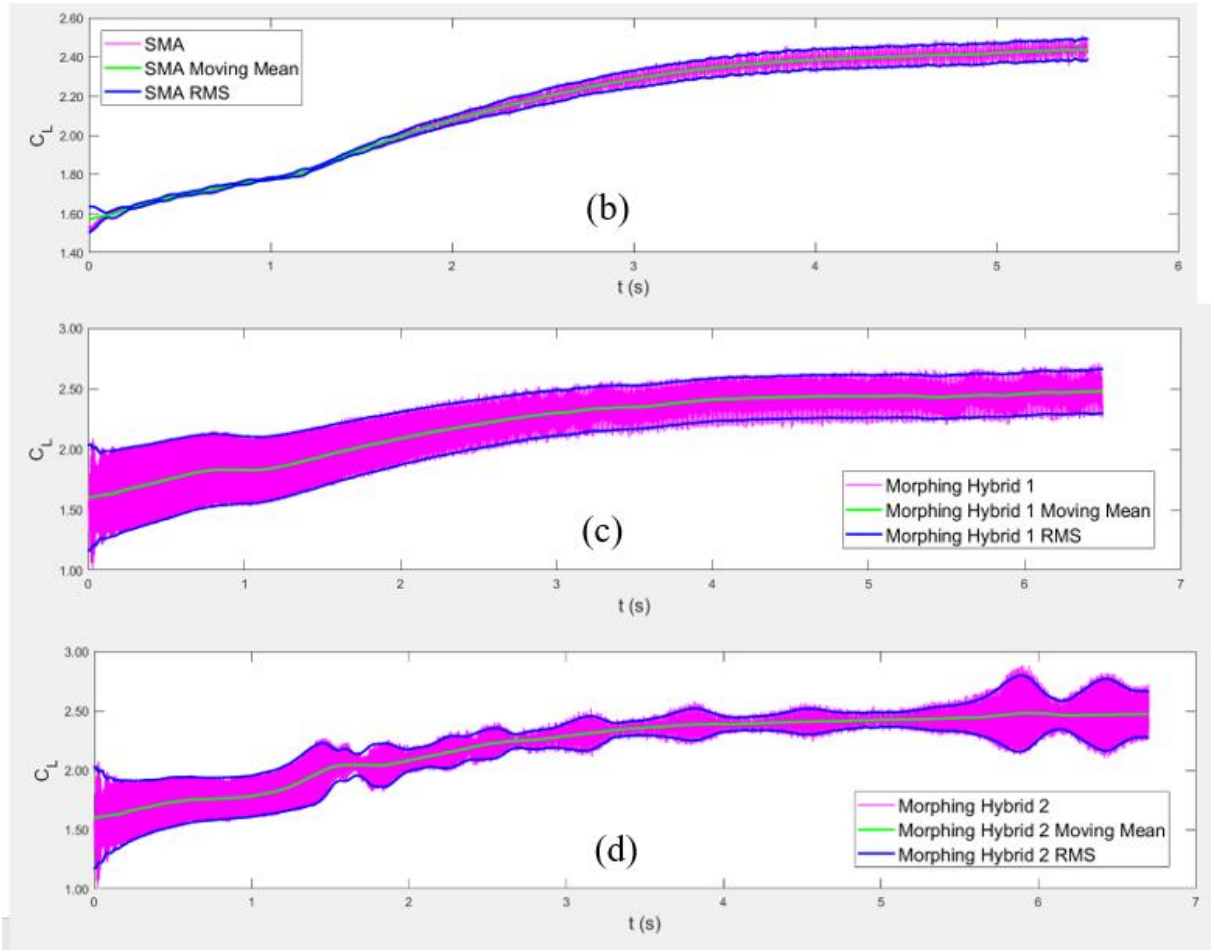


Figure 1. A320 morphing wing (a) by means of low frequency cambering through Shape Memory Alloys (SMA) and trailing edge vibration (HVTE) in the frequency range of (150 - 300) Hz. (b); Effects on the lift increase through Shape Memory Alloys cambering beyond 60% of the chord with a 10%C downwards trailing edge deformation (cb); Hybrid electroactive morphing associating simultaneously SMA and HVTE; (d) Hybrid morphing with wobulated HVTE using an initial frequency vibration of 150 Hz and a linear frequency increase with slope of 20Hz per second.

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