Xavier Guerrero-Pich et al., Adv Automob Eng 2015, 4:1
http://dx.doi.org/10.4172/2167-7670.C1.002

OMICS International
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International Conference and Exhibition on
Automobile Engineering

September 01-02, 2015 Valencia, Spain

Numerical study on active flow control using synthetic jet actuators over a NACA 4421 airfoil

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This paper presents the effects of using a Zero Net Mass Flux actuator (ZNMF) on a baseline 21 percent thick NACA 4421 airfoil for stall delay. The first part of the study presents the comparison of the CFD simulations with the available experimental data of the airfoil without considering the actuation of ZNMF. A very good agreement of the CFD simulations was obtained for the lift curve therefore validating the CFD model used. The original lift curve presented a stall around 13º angle of attack; this is why a range of angles of attack (α) near this value were studied at 7º≤α≤14º. In the second part of the study, the ZNMF was set up in the airfoil. The slot position was located at 17% of the chord, while its length was established in 2 mm. The ZNMF performance was studied at three different frequencies (f=45 Hz, 250 Hz, 500 Hz), the lower one corresponds to the shedding frequency when the angle of attack was 7º. During the study the following parameters were kept constant, Reynolds number based on the chord length was Re=3.106, velocity ratio was VmeanU∞=0.701 and momentum coefficient based on the half period mean velocity was cμ=0.03%. The results show a separation point downstream displacement of 4% versus the original position, whenever the frequency was 45 Hz, the rest of the frequencies studied produced an upstream displacement of the separation point. In addition, when studying the lift coefficient under dynamic conditions, it was observed that the oscillation amplitude suffered a small decrease when the ZNMF actuation frequency was 45 Hz.

Biography

Xavier Guerrero-Pich has obtained his Bachelor's degree in Aeronautical Engineering at ETSEIAT-UPC.

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