

عنوان مقاله:

Aerodynamic Noise Computation of the Flow Field around NACA 0012 Airfoil Using Large Eddy Simulation and Acoustic Analogy

محل انتشار:

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خلاصه مقاله:

The current study presents the results of the aerodynamic noise prediction of the flow field around a NACA 0012 airfoil at a chord-based Reynolds number of 100,000 and at 8.4 degree angle of attack. An incompressible Large Eddy Simulation (LES) turbulence model is applied to obtain the instantaneous turbulent flow field. The noise prediction is performed by the Ffowcs Williams and Hawkings (FW-H) acoustic analogy. Both mean flow quantities and fluctuation statistics are studied. The behaviour of the turbulent vortical structures in the flow field from the perspective of the turbulent boundary layer development is visualized. Power spectral density of the lift coefficient is presented. The computed non-dimensional mean velocity profiles in the boundary layer compared reasonably well with the theoretical predictions. The boundary layer transition from a laminar state to a turbulent state is also brought into focus. The skin friction coefficient and the rms streamwise velocity fluctuations predicted a transition zone from $x/c=0.23$ to $x/c=0.45$. Then, the research focuses on the broadband noises of the turbulent boundary layers and the tonal noises that arise from the vortex shedding generated by the laminar boundary layers. The spectra computed from the acoustic pressure are compared with the experimental data. The effect of observer location on the overall sound pressure level (OASPL) is investigated and the results indicate that the OASPL varies logarithmically with the receiver distance, as was expected.

کلمات کلیدی:

acoustic analogy, aerodynamic noise, boundary layer transition, turbulence

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