Numerical Simulations of Dynamic Stall at Low Reynolds Number

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ABSTRACT

A direct-forcing immersed boundary (DFIB) numerical model is described for the simulation of dynamic stall behavior around the Eppler 387 airfoil in the low Reynolds number flow. A ray-casting method is purposed to define the airfoil geometry. The governing continuity and NavierStokes momentum equations and boundary conditions are solved by a modified DFIB method. The current method is validated against numerical results from alternative schemes and experimental data on static and oscillating airfoil. A base flow regime and different vortices patterns are observed, in accordance with other previously published investigations. Also, the effect of the reduced frequency; the pitch oscillation amplitude and the Reynolds number are studied. It is demonstrated that the DFIB model provides an accurate representation of dynamic stall phenomenon. Furthermore, the results show that the dynamic stall behavior around the Eppler 387 is different than the NACA 0012 in shedding phase and the reduced frequency influence the flow field too much.

Keywords: Direct-forcing immersed boundary method, fluid-structure interaction, oscillating airfoil, dynamic stall.