Unsteady Analysis of the Vorton Wake – Wing Interaction

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Extended Abstract

Panel methods represent a theoretical procedure widely used in the preliminary industrial design for fluid-dynamics applications. Typical fields of interest are aeronautical, naval, wind engineering. Generally, the flow field is assumed to be unsteady, inviscid and incompressible.
The difficulty for the analysis for the dynamics of the wake and for the interaction among bodies and wake is the drawback preventing the even more widespread use of the panel methods (e.g., for vertical axis wind turbines, rotors and propellers, interference of the wing wake with the horizontal plane) because modelling the wake by means of the classical vortex filaments that does not allow the analysis of wake-body intersection; but introducing introducing the vorton method for the representation of wake it is possible to analyse the phenomena of aerodynamic interference. A vorton is a point computational element similar but quite different from classical vortex filaments, vortex rings and doublet lattice usually used to model wakes in the potential methods: vortons introduced in the 1980s by Beale and Majda are characterized by the fact that the vorton positions and strengths are updated in a Lagrangian manner with no connection between the vortons.
The vorton wake approach has been introduced into PaMS (Panel Method Solver), a new unstructured BEM open-source method (DIAS 2003-2008), in order to analyse the effects due to wake of an oscillating wing on the pressure distribution over a downstream wing. In the Fig.1 the result is shown: the lift coefficient of the downstream wing presents a periodic function which has the same frequency of the normal force oscillation of the upstream wing.

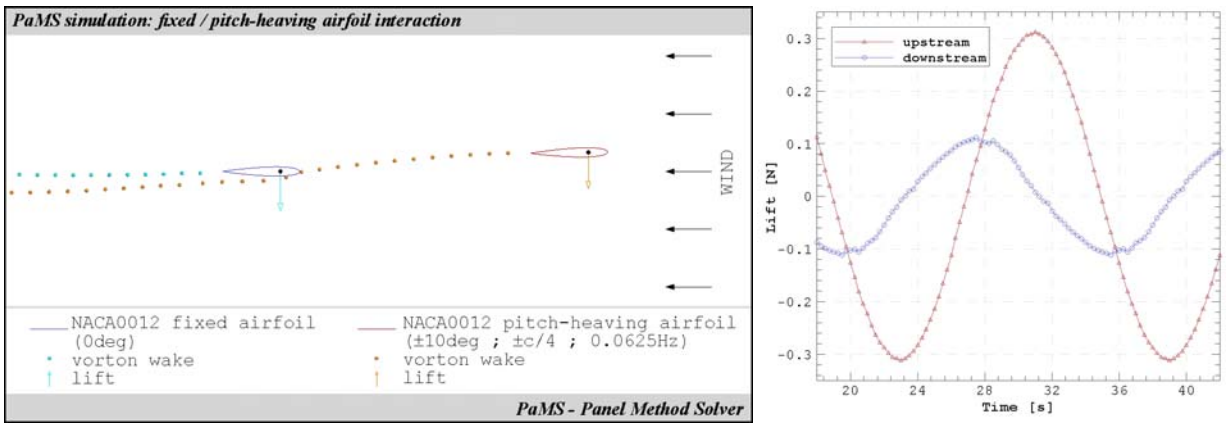

Fig. 1: fixed/pitch-heaving airfoil interaction

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[Caccavale, de Nicola, Nola, 2009] A vorton wake model for panel methods, Univ. of Naples