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Implementation of a Forth-Order Aeroelastic Coupling into a Viscous-Inviscid Flow Solver with Experimental Validation (for One Degree of Freedom) SIRKO BARTHOLOMAY, NÉSTOR RAMOS-GARCÍA, ROBERT FLEMMING MIKKELSEN, DTU, TECHNICAL UNIVERSITY OF DENMARK (DTU) - WIND ENERGY TEAM — The viscous-inviscid flow solver Q^3UIC for 2D aerodynamics has recently been developed at the Technical University of Denmark [1]. The Q^3UIC solver takes viscous and unsteady effects into account by coupling an unsteady inviscid panel method with the integral boundary layer equations by means of a strong coupling between the viscous and inviscid parts, and in this respect differs from other classic panel codes e.g. Xfoil. In the current work a Runge-Kutta-Nyström scheme was employed to couple inertial, elastic and aerodynamical forces and moments calculated by Q^3UIC for a two-dimensional blade section in the time-domain. Numerical simulations are validated by a three step experimental verification process carried out in the low-turbulence wind tunnel at DTU. First, a comparison against steady experiments for a NACA 64418 profile and a flexible trailing edge flap is presented for different fixed flap angles, and second, the measured aerodynamic characteristics considering prescribed motion of the airfoil with a moving flap are compared to the Q^3UIC predictions. Finally, an aeroelastic experiment for one degree of freedom –airfoil pitching- is used to evaluate the accuracy of aeroelastic coupling.

[1] A strong viscous–inviscid interaction model for rotating airfoils. Ramos-García, Néstor; Sørensen, Jens Nørkær; Shen, Wen Zhong. Wind Energy, 2013.

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