Hybrid vortex simulations of wind turbines using a three-dimensional viscous-inviscid panel method - DTU Orbit (09/11/2017)

Hybrid vortex simulations of wind turbines using a three-dimensional viscous-inviscid panel method

A hybrid filament-mesh vortex method is proposed and validated to predict the aerodynamic performance of wind turbinerotors and to simulate the resulting wake. Its novelty consists of using a hybrid method to accurately simulate the wakedownstream of the wind turbine while reducing the computational time used by the method. The proposed method uses ahybrid approach, where the near wake is resolved by using vortex filaments, which carry the vorticity shed by the trailingedge of the blades. The interaction of the vortex filaments in the near vicinity of the wind turbine is evaluated using adirect calculation, whereas the contribution from the large downstream wake is calculated using a mesh-based method. Thehybrid method is first validated in detail against the well-known MEXICO experiment, using the direct filament method asa comparison. The second part of the validation includes a study of the influence of the time-integration scheme used forevolving the wake in time, aeroelastic simulations of the National Renewable Energy Laboratory 5 MW wind turbine andan analysis of the central processing unit time showing the gains of using the hybrid filament-mesh method.

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