ECCOMAS Congress 2016
VII European Congress on Computational Methods in Applied Sciences and Engineering
M. Papadrakakis, V. Papadopoulos, G. Stefanou, V. Plevris (eds.)
Crete Island, Greece, 5–10 June 2016

AN AEROELASTIC ACTUATOR SECTOR METHOD FOR WIND TURBINES SIMULATION

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Keywords: aeroelasticity, LES, multibody dynamics, wind turbines

Abstract. Turbulent flow simulations in large wind farm domains demand excessive computational time. To reduce the cost of these operations, the complex wind turbine geometry is not fully resolved, but a turbine model is used instead. Two popular techniques are the Actuator Disk (ADM) and the Actuator Line Method (ALM) [1]. An Aeroelastic Actuator Sector Model (AASM) is proposed herein so that the transient wake characteristics are better captured than in ADM and the temporal restrictions are relaxed compared to ALM. In addition the structural dynamics can be computed in an efficient multiscale approach.

A pseudo-spectral in-house code (SP-Wind) [2] is coupled with a multibody dynamics code within a multiscale framework. During the fine time scale iterations, the nonlinear equations of motion are integrated, and the aerodynamic forces are computed in the deflected location of the blades. The forces of the deflected sector are spatially filtered before they are added to the flow equations. Moreover, we also experiment with additional time filtering.

Simulations of single wind turbines in a uniform flow field and large wind farms in turbulent flow regimes at rated wind speed are performed. The wake flow characteristics among the different turbine models are compared, and their efficiency is discussed. Results with and without time filter are presented. For the developed AASM, further simulations are performed employing a conditional sampling technique. This enables us to draw conclusions on coherent flow patterns that cause intensive structural response.

The authors acknowledge support from the European Research Council (FP7–Ideas, Grant No. 306471). The computational resources and services used in this work were provided by the VSC (Flemish Supercomputer Center), funded by the Hercules Foundation and the Flemish Government–department EWI.

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