World Academy of Science, Engineering and Technology
International Journal of Aerospace and Mechanical Engineering
Vol:9, No:04, 2015

Large Eddy Simulation with Energy-Conserving Schemes: Understanding Wind Farm Aerodynamics

Authors : Dhruv Mehta, Alexander van Zuijlen, Hester Bijl

Abstract : Large Eddy Simulation (LES) numerically resolves the large energy-containing eddies of a turbulent flow, while modelling the small dissipative eddies. On a wind farm, these large scales carry the energy wind turbines extracts and are also responsible for transporting the turbines' wakes, which may interact with downstream turbines and certainly with the atmospheric boundary layer (ABL). In this situation, it is important to conserve the energy that these wake's carry and which could be altered artificially through numerical dissipation brought about by the schemes used for the spatial discretisation and temporal integration. Numerical dissipation has been reported to cause the premature recovery of turbine wakes, leading to an over prediction in the power produced by wind farms.An energy-conserving scheme is free from numerical dissipation and ensures that the energy of the wakes is increased or decreased only by the action of molecular viscosity or the action of wind turbines (body forces). The aim is to create an LES package with energy-conserving schemes to simulate wind turbine wakes correctly to gain insight into power-production, wake meandering etc. Such knowledge will be useful in designing more efficient wind farms with minimal wake interaction, which if unchecked could lead to major losses in energy production per unit area of the wind farm. For their research, the authors intend to use the Energy-Conserving Navier-Stokes code developed by the Energy Research Centre of the Netherlands.

Keywords : energy-conserving schemes, modelling turbulence, Large Eddy Simulation, atmospheric boundary layer
Conference Title : ICCFDM 2015 : International Conference on Computational Fluid Dynamics and Mechanics
Conference Location : Venice, Italy
Conference Dates : April 13-14, 2015