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Dependence of wind farm performances on the terrain topography FEDERICO BERNARDONI, Department of Mechanical Engineering, University of Texas at Dallas, Richardson, TX USA, MATTEO ZANGRANDI, Department of Aerospace Science and Technologies, Politecnico di Milano, Milano, IT, UMBERTO CIRI, Department of Mechanical Engineering, University of Texas at Dallas, Richardson, TX USA, MAURIZIO QUADRIO, Department of Aerospace Science and Technologies, Politecnico di Milano, Milano, IT, STEFANO LEONARDI, Department of Mechanical Engineering, University of Texas at Dallas, Richardson, TX USA — Atmospheric turbulence affects wind turbine performances in terms of both power production and blade loads. One of the main sources of turbulence for onshore wind farms is the presence of terrain topography. The purpose of this study is to correlate the characteristics of the terrain topography, represented as sinusoidal roughness, with wind farm performances. To reproduce the effect of different terrain topographies, a set of precursory large eddy simulations has been performed with a wavy terrain of varying streamwise and spanwise wavelengths. The terrain is modeled with the immersed boundary method. A cross-section from the precursor simulations was used as inflow condition upstream of a wind farm made by an array of 4×4 turbines. The rotating actuator disk has been used to reproduce the turbines. Turbulence properties, integral scales and coherent structures have been analyzed before and after impinging on the wind farm. The wake recovery and the overall wind farm power production performances have been then correlated with the turbulence and with the upstream characteristics of the terrain.

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