World Academy of Science, Engineering and Technology
International Journal of Civil and Environmental Engineering
Vol:11, No:12, 2017

Dynamic Mode Decomposition and Wake Flow Modelling of a Wind Turbine

Authors : Nor Mazlin Zahari, Lian Gan, Xuerui Mao

Abstract : The power production in wind farms and the mechanical loads on the turbines are strongly impacted by the wake of the wind turbine. Thus, there is a need for understanding and modelling the turbine wake dynamic in the wind farm and the layout optimization. Having a good wake model is important in predicting plant performance and understanding fatigue loads. In this paper, the Dynamic Mode Decomposition (DMD) was applied to the simulation data generated by a Direct Numerical Simulation (DNS) of flow around a turbine, perturbed by upstream inflow noise. This technique is useful in analyzing the wake flow, to predict its future states and to reflect flow dynamics associated with the coherent structures behind wind turbine wake flow. DMD was employed to describe the dynamic of the flow around turbine from the DNS data. Since the DNS data comes with the unstructured meshes and non-uniform grid, the interpolation of each occurring within each element in the data to obtain an evenly spaced mesh was performed before the DMD was applied. DMD analyses were able to tell us characteristics of the travelling waves behind the turbine, e.g. the dominant helical flow structures and the corresponding frequencies. As the result, the dominant frequency will be detected, and the associated spatial structure will be identified. The dynamic mode which represented the coherent structure will be presented.

Keywords : coherent structure, Direct Numerical Simulation (DNS), dominant frequency, Dynamic Mode Decomposition (DMD)
Conference Title : ICFMHE 2017 : International Conference on Fluid Mechanics and Hydraulic Engineering
Conference Location : Kuala Lumpur, Malaysia
Conference Dates : December 11-12, 2017