The influence of the Wind Speed Profile on Wind Turbine Performance Measurements - DTU Orbit (16/05/2019)

The influence of the Wind Speed Profile on Wind Turbine Performance Measurements

To identify the influence of wind shear and turbulence on wind turbine performance, flat terrain wind profiles are analysed up to a height of 160 m. The profiles' shapes are found to extend from no shear to high wind shear, and on many occasions, local maxima within the profiles are also observed. Assuming a certain turbine hub height, the profiles with hub-height wind speeds between 6 m s\(^{-1}\) and 8 m s\(^{-1}\) are normalized at 7 m s\(^{-1}\) and grouped to a number of mean shear profiles. The energy in the profiles varies considerably for the same hub-height wind speed. These profiles are then used as input to a Blade Element Momentum model that simulates the Siemens 3.6 MW wind turbine. The analysis is carried out as time series simulations where the electrical power is the primary characterization parameter. The results of the simulations indicate that wind speed measurements at different heights over the swept rotor area would allow the determination of the electrical power as a function of an equivalent wind speed where wind shear and turbulence intensity are taken into account. Electrical power is found to correlate significantly better to the equivalent wind speed than to the single point hub-height wind speed.

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