Verification of a novel innovative blade root design for wind turbines using a hybrid numerical method - DTU Orbit (09/12/2018)

Verification of a novel innovative blade root design for wind turbines using a hybrid numerical method

To enhance the performance of horizontal axis wind turbines, it is proposed to place a cylindrical disc in front of the rotor in order to lead the incoming flow from the inner part to the outer part of the rotor blades. This is expected to increase the power output, as the kinetic energy is mainly captured at the outer part of the blades, where the relative wind speed is high. To assess the impact of this novel design idea, a hybrid numerical technique, based on solving the Reynolds-averaged Navier-Stokes equations, is utilized to determine the aerodynamic performance. The in-house developed EllipSys3D code, which is employed as basic numerical solver, is combined with an actuator disc representation of the wind turbine rotor and an immersed boundary technique for representing the upstream cylindrical disc. The impact of the disc on the rotor performance is assessed by systematically changing the size of the circular disc and its axial distance to the rotor. Based on a numerical study of a Megawatt size commercial wind turbine, it is found that up to 1.5% additional energy can be captured by placing a circular disc with a suitable diameter upstream of the rotor plane.

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