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Enhanced Actuator Line Simulation of a Wind Turbine by including the Conservative Load at the Blade Tip IVAN HERRAEZ, Faculty of Physics, ForWind, University of Oldenburg, D-26111 Oldenburg, Germany, DANIEL MICALLEF, Faculty for the Built Environment, Department of Environmental Design, University of Malta, Msida MSD 2080, Malta, GIJS A. M. VAN KUIK, Faculty of Aerospace Engineering, Technical University Delft, Kluyverweg 1, 2629HS Delft, The Netherlands, JOACHIM PEINKE, Faculty of Physics, ForWind, University of Oldenburg, D-26111 Oldenburg, Germany — At the tip of wind turbine blades, the radial bound circulation is transformed into chordwise circulation just before being released as trailing vorticity, giving rise to the tip vortex. The force acting on the chordwise circulation contains a radial and a normal component with respect to the blade axis. This load does not contribute to the torque, so it is a conservative load. Due to this, it is disregarded in the engineering tools used for the design of wind turbines. However, as we demonstrated in a previous work, the conservative load might influence the trajectory of the tip vortex. In order to see how this affects the blade loads, in this research we perform large eddy simulations with an actuator line model where the conservative load has been included. The conservative load reduces the angle of attack in the tip region as a consequence of the modified tip vortex trajectory. This has a negative influence on the lift and the power output. We conclude that the accuracy of engineering design tools of wind turbines can be improved if the conservative load acting at the tip is considered.

Ivan Herraez
University of Oldenburg

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