The impact of the yaw error on the performance of a horizontal axis wind turbine

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The Horizontal Axis Wind Turbines (HAWTs) need to be orientated into the wind direction in order to extract as much kinetic energy as possible. In medium-small wind turbines the yaw motion is often used also for power regulation purpose. The yaw control problem has been often underestimated among the design activities, both in the rotor modeling and in the related structural issues. The strategy to face this problem should include the optimal trade-off between aerodynamic efficiency and yaw-induced variable loads. Moreover, strategy is also closely dependent on the scale and the configuration of the analyzed wind turbine rotors, e.g. two-bladed ones are emblematic for their unsteady inertial loads during the yaw operation. The turbulent nature of wind makes the control task even more remarkable, because of the difficulty in the measure of the direction. The nacelle sensor commonly used is unfortunately affected by the interaction of the turbine itself with the air. This work tries to contribute to underline the key aspects useful in the yawing design of medium-small wind turbines in particular. The focus here is on a 60 (kW) fixed speed wind turbine produced in Italy, stall regulated and provided with active yaw control. The onsite experimental data are analyzed to evaluate the impact of the yaw system on the energy production and to validate a blade element aerodynamic model. It is also investigated the effect of the rotor over the direction sensor used in the yaw control at different wind speeds.

Biography
Daniele Vitali received his PhD in 2013 in Energy Engineering from Marche Polytechnic University (Ancona, Italy), where he is carrying on also his Post-doctoral studies. His research topics are mainly hybrid wind-solar micro generation systems and the overall simulation of horizontal axis wind turbines. He collaborates also with the WEST-LAB laboratory of the same University, which provides certification along with technical and scientific consulting to the companies of wind energy sector.

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