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POTENTIAL AND LIMITATIONS OF WIND MEASUREMENT BASED FEEDBACK-FEEDFORWARD PITCH CONTROL FOR ROTOR SPEED REGULATION IN WIND TURBINES

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The development in the last decades of advanced technologies for the measurement of the wind speed, such as LIDAR (Light Detection And Ranging) sensors, has promoted the research in feedforward based control strategies for wind turbines. The objective is to use preview information in order to cancel the effect of wind disturbances, and thus improve the regulation of rotor speed with respect to feedback only strategies. This work aims to analyze the potential and limitations of the most relevant techniques studied in the literature. The performance is assessed by means of simulations performed with the aeroelastic code FAST (Fatigue, Aerodynamics, Structures and Turbulence) using a simplified wind turbine model. Considering that the wind speed is constant over the entire grid, feedforward control results show an improvement as the standard deviation of the aerodynamic torque is considerably reduced. However, in realistic turbulent wind conditions, the fluctuations of the aerodynamic torque increase compared to the results obtained with feedback only control. The tests realized in different wind conditions show that the spatial turbulence is the reason why expected results are not attained. Given that the problem is due to the wind information considered by the feedforwad control, different methods to estimate effective wind speed have been simulated. The improvements obtained with 5 point average measurement (taken at the hub and outer edges of the rotor plane) and 3 point average measurement (situated at 75% span of each blade) are compared to hub height only wind speed measurement results. Finally, the estimation of the effective wind speed based on the measurement of the rotor acceleration is shown to be the best option. Nevertheless, this is not a real feedforward control solution, as the data used has already affected the wind turbine and cannot be used as future prediction. The improvements observed in this case are related to an equivalent increase of feedback gains.