Model of the Correlation between Lidar Systems and Wind Turbines for Lidar Assisted Control

Investigations for lidar assisted control to optimize the energy yield and to reduce loads of wind turbines increased significantly in recent years. For this kind of control it is crucial to know the correlation between the rotor effective wind speed and the wind preview provided by a nacelle or spinner based lidar system. If on the one side the assumed correlation is overestimated, the uncorrelated frequencies of the preview will cause unnecessary control action, inducing undesired loads. On the other side the benefits of the lidar assisted controller will not be fully exhausted, if correlated frequencies are filtered out. To avoid these uncertainties, this work presents a method to model the correlation between lidar systems and wind turbines using Kaimal wind spectra. The derived model accounts for different measurement configurations and for different turbine sizes. The method is evaluated in two steps: At first the model is compared to the results from a lidar simulator to prove that the model is able to reproduce the effect of volume measurement, limited measurement points and scanning time. In a second step the model is augmented by a model for the decay due to wind evolution and compared to real measurement data with promising results. In addition an example is given, how this model can be used to design an optimal controller for a lidar system with fixed parameters and a given turbine and how the pattern of a scanning lidar system is optimized for a given turbine to improve the correlation.

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