Wind turbine load validation using lidar-based wind retrievals

We define and demonstrate a procedure for carrying out wind turbine load validation based on measurements from nacelle-mounted scanning lidars. Two coherent Doppler lidar systems, a pulsed lidar and a continuous-wave lidar, are mounted on a 2.3-MW wind turbine equipped with load measurement sensors. Wind measurements from a meteorological mast mounted at 2.5 rotor diameters distance are used as reference. The study shows how lidar measurements are processed and applied as inputs to aeroelastic load simulations, and the results are then compared with simulations where the wind inputs have been determined using the meteorological mast data in compliance with the IEC61400-13 standard. For the majority of simulation cases considered, the use of nacelle-mounted lidar measurements results in load estimation uncertainties lower or equal to those that are based on measurements from cup anemometers on the mast. These results demonstrate the usefulness of nacelle-mounted lidars as tools for carrying out load validation without the need of meteorological masts.