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Reliability of Long-term Lidar-based Wind Measurements for Various Wind Energy Applications JAY PRAKASH GOIT, Department of Mechanical Engineering, Kindai University, Japan, SUSUMU SHIMADA, TETSUYA KOGAKI, National Institute of Advanced Industrial Science and Technology, Japan
— In this work, we conduct a long-term measurement campaign (approximately one year) using a profiling Lidar, in order to investigate whether Lidars can be used as a reliable alternative to meteorological masts for wind energy applications. It is found that the Lidar-measured wind speed showed good agreement with those measured using sonic anemometers mounted to the neighboring meteorological mast, with the coefficient of determination ($R^2 > 0.99$). However, comparison of the standard deviations shows larger degree of variations, with R^2 between 0.92 and 0.97. Turbulence intensities computed for the 90th percentile of the standard deviation show that the Lidar-measured turbulence intensities are larger by roughly 2% than those measured by the sonic anemometer. But the gust factors for peak wind speeds converge roughly to 1.9 during strong wind speed for both the devices. Finally, wind speed and turbulence distribution for the Lidar and sonic anemometer are used to compute fatigue load for NREL 5-MW reference wind turbine using aeroelastic simulation. The 20 years lifetime DELs for the Lidar wind speed are higher than those for the sonic anemometer wind speeds, by 6% for the blade root bending moment and by 13% for the tower based bending moment.

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