3D wake measurements from a scanning wind lidar in combination with a fast wind field reconstruction model - DTU Orbit (12/10/2019)

High-resolution lidar wake measurements are part of an ongoing field campaign being conducted at the Scaled Wind Farm Technology (SWiFT) facility by Sandia National Laboratories and the National Renewable Energy Laboratory using a customized scanning “DTU SpinnerLidar” from the Technical University of Denmark. The purpose of the SpinnerLidar measurements at SWiFT is to measure the response of a V27 turbine wake to varying inflow conditions and turbine operating states. Although our fast scanning SpinnerLidar is able to measure the line-of-sight projected wind speed at up to 400 points per second, a single lidar is in principle never able to measure all three wind components (u, v, w) in the scan plane at the same time. This limitation is often referred to as the “lidar cyclops syndrome”. However, by processing the scanned line-of-sight wind speed data via a fast linearized Navier-Stokes CFD code “Lincom Cyclop-buster model,” the corresponding 3D wind vector field (u, v, w) can be reconstructed under constraints for conservation of mass and momentum. The resulting model calculated line-of-sight projections of the 3D wind velocity vectors will become consistent with the line-of-sight wind speed measurements from the SpinnerLidar. In this way, SpinnerLidar measured line-of-sight wake data from the SWiFT site at a range of downwind distances were used to calculate the three wind components u(x, y), v(x, y) and w(x, y) in the turbine wake in a number of downwind crosswind scan planes. Fig.1 shows: a) the experimental setup, b) the line-of-sight measured wind field in a crosswind plane 66.2 m downwind, and 3) the corresponding Lincom model reconstructed axial wind component u(x, y).

General information
Publication status: Published
Organisations: Department of Wind Energy, Meteorology & Remote Sensing, Sandia National Laboratories
Contributors: Mikkelsen, T. K., Herges, T. G., Astrup, P., Sjöholm, M., Naughton, B. T.
Number of pages: 1
Publication date: 2017

Host publication information
Title of host publication: WESC2017 – Wind Energy Science Conference, Book of abstract
Article number: 264
Electronic versions:
264.pdf
Research output: Chapter in Book/Report/Conference proceeding › Conference abstract in proceedings – Annual report year: 2017 › Research › peer-review