

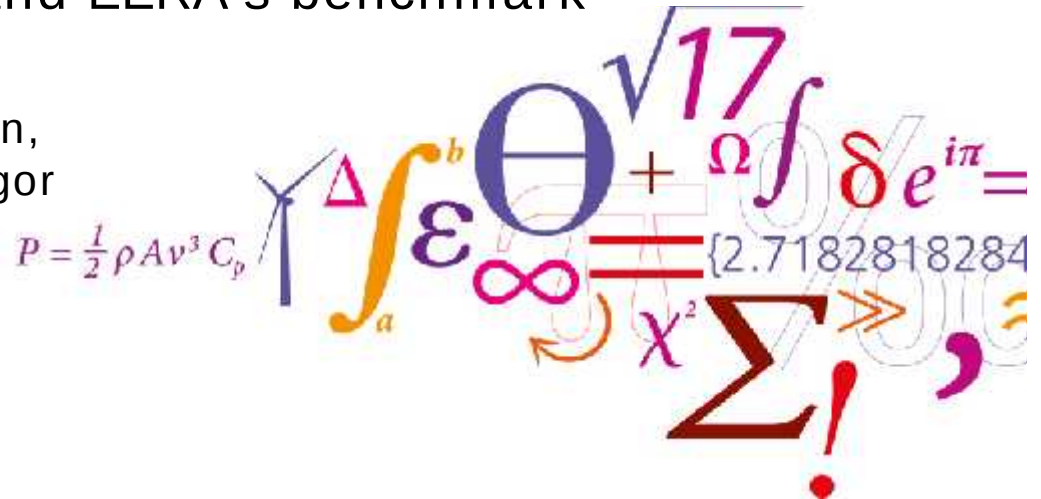


ScanFlow

High-resolution full-scale wind field measurements of the ECN's 2.5 MW aerodynamic research wind turbine using DTU's 3D WindScanner and SpinnerLidar for IRPWind's and EERA's benchmark

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Research topics and originality

We aim to establish a unique turbine power performance and induction zone benchmark experiment by operating a DTU developed high-resolution nacelle integrated 2D SpinnerLidar installed in a research wind turbine at ECN.

Concurrently, three ground-based short-range WindScanner lidars from DTU will be deployed to perform 3D wind velocity field observations Cf. WindScanner.dk and WindScanner.eu



ECN Test Site (EWTW)

ECN Wind turbine Test station Wieringermeer

- Prototype turbines and masts
 - 6 prototypes: 2MW-5MW, D=100m-120m
 - 4 IEC compliant meteorological masts
- Research turbines and mast
 - 5 ECN research turbines East-West
 - IEC compliant meteorological mast
- Measurement pavilion
 - Data gathering and transfer to ECN



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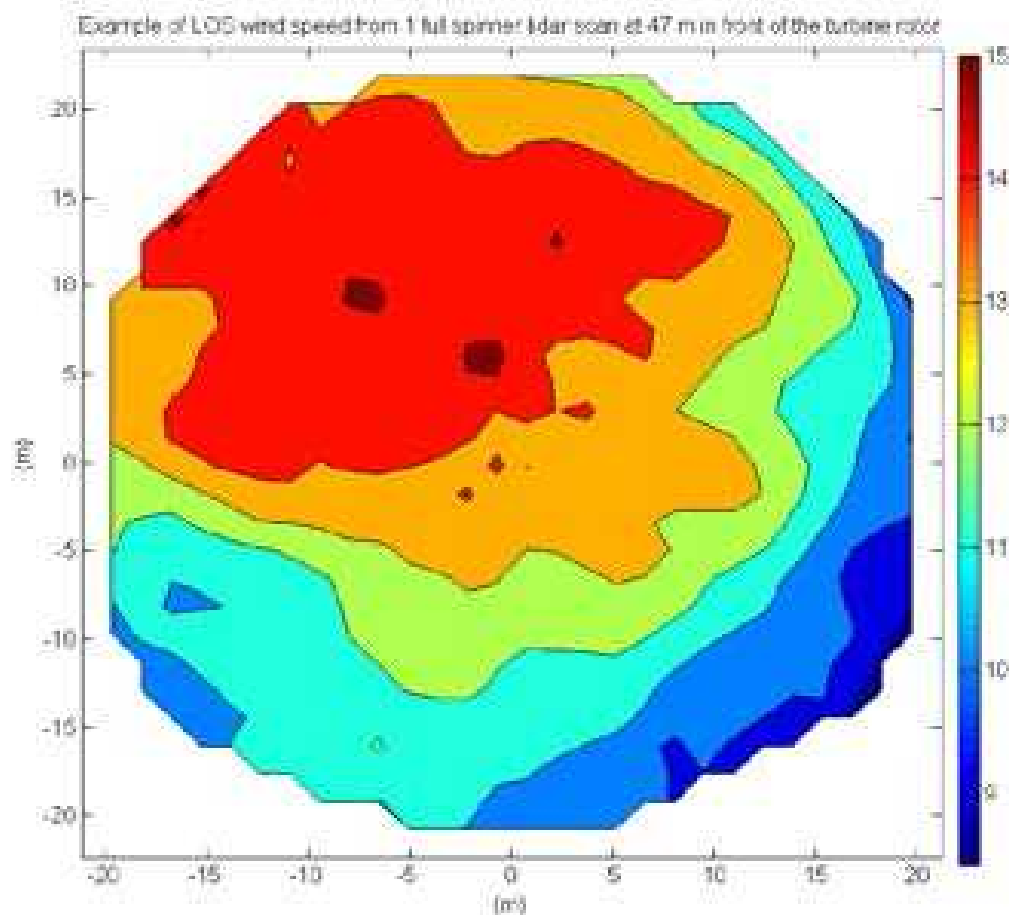


DTU 2D SpinnerLidar on Risø Campus NordTank during the UniTTE¹ field test 2015



¹Wagner R, Vignaroli A, Angelou N, Sathe A, Meyer Forsting A R, Sjöholm M, Mikkelsen T 2015
MEASUREMENT OF TURBINE INFLOW WITH A 3D WINDSCANNER SYSTEM AND A SPINNERLIDAR
DEWEK 2015 pp 7–10

A single 2D SpinnerLidar measurement during UniTTE 2015 (4 s sampling period)



Experimental evaluation ECN 2016: Synchronized 3D scanning short-range WindScanners



Outcome

- The ScanFlow project will provide a state-of-the-art inflow dataset useful for evaluation of aerodynamic models ranging from engineering-like up to computational fluid dynamics models, models of the inflow and induction zone.
- A proof-of concept testing of the new advanced software for wind reconstruction using the LINCOM model based on the anti-Cyclop buster methodology program will be applied. The idea of the latter is to extract all three wind components of the inflow in front of the rotor from a single SpinnerLidar.
- The result will be compared with the “true” ground based measurements of the three wind speed components (u, v, w) from the three short-range WindScanner lidars that will measure from the ground.
- The benchmark will be available through an open access e-science platform also beyond project time.

Main components of ScanFlow

- The WindScanner SpinnerLidar from DTU will observe during 6 weeks the inflow approaching the research wind turbine.
- The raw data will be transformed into 3D inflow wind velocity fields upwind the rotor plane by methods developed at DTU and compared against 3D short-range WindScanner observations from DTU during few weeks; thereby establish a limited dataset proof-of concept demo.
- The turbulence will be assessed from an expression combining the rotor equivalent wind speed and the power fluctuations of the wind turbine and will be compared to turbulence observed from the WindScanner and turbulence observed from mast observations.

Work Packages

- WP1 (DTU) Preparation of short range WindScanners at DTU
- WP2 (ECN) Preparation of measurement campaigns
- WP3 (ECN) 6 week measurement campaign of the SpinnerLidar (nacelle), including installation, dismantling and shipment
- WP4 (DTU) 2 week measurement campaign of the short range WindScanners (ground based), including installation, dismantling and shipment
- WP5 (DTU) Post-processing of collected data. Proof of concept three wind components SpinnerLidar
- WP6 (ECN) Public database with wind turbine, meteorological and WindScanner data. Workshop with database announcement
(18-20 January 2017 EERA DeepWind Conference, Trondheim)

Gantt diagram, Deliverables and Milestones

Extension
Feb. 2017

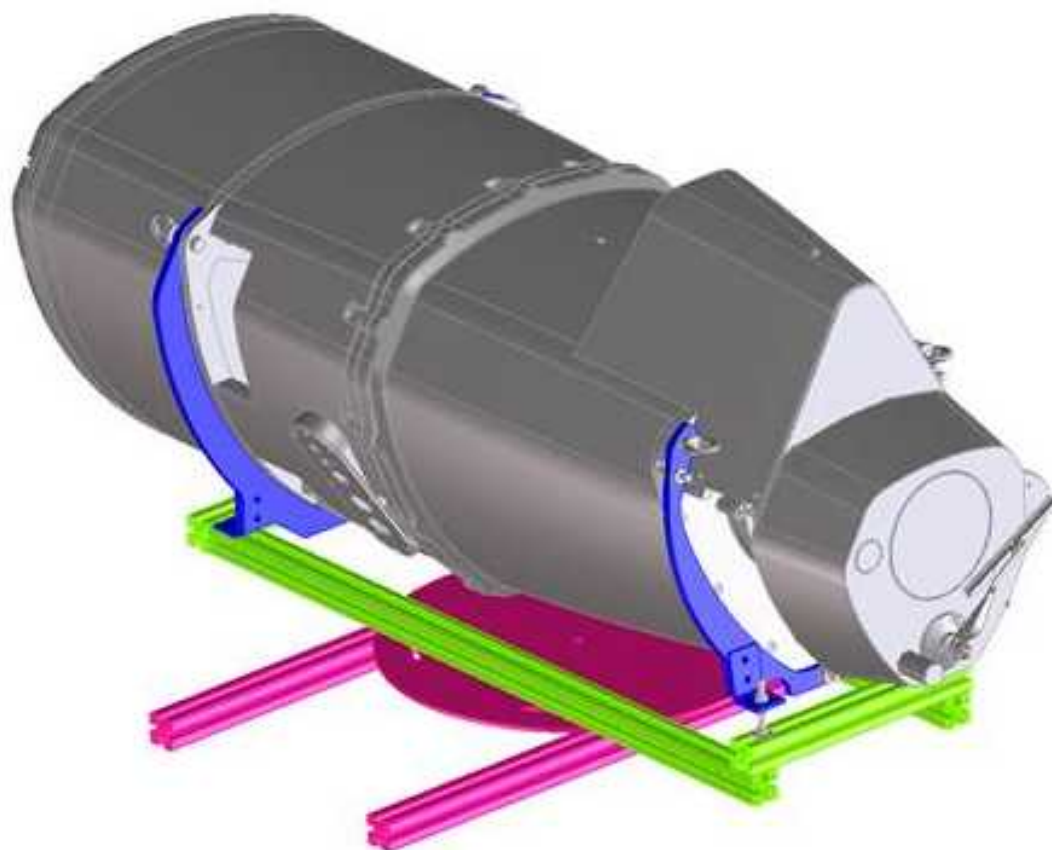
	June	July	Aug	Sep	Oct	Nov	Dec	Lead
WP1: Prepare WindScanners	X	X	D1					DTU
WP2: Experiment detail plan			D2					ECN
WP3: Nacelle campaign				X	M2			ECN
WP4: Ground campaign				M1				DTU
WP5: Post-processing data					X	X	D3	DTU
WP6: Database/publication				X	X	M3	D4, D5	ECN

D3, M3, D4, D5

- D1: Nacelle-based and ground-based lidars ready for experiment
- D2: Final experimental plan published
- D3: Report on the experiment and proof of concept
- D4: Final workshop with external colleagues from EERA and industry invited
- D5: Final project report

- M1: Collected 2-weeks of three ground-based WindScanner data
- M2: Collected 6-weeks of nacelle-based WindScanner inflow data
- M3: Open database launched

Progress on the SpinnerLIDAR mounting bracket



Dissemination



- The dissemination strategy is to produce 100% open access to the benchmarks on inflow conditions. This will include the 10-minute wind turbine information on power production and the collected WindScanner data.
- The Transfer of Knowledge will be through the dedicated web-sites of
 - ✓ IRPWIND <http://www.irpwind.eu/>
 - ✓ WindScanner.eu <http://www.windscanner.eu/>
 - ✓ WindBench <https://windbench.net/>
- Final presentation at EERA DeepWind Trondheim 2017

Key Performance Indicators (KPIs)

- Obtain 6 weeks measurements with WindScanner SpinnerLidar at ECN wind turbine test field
- Obtain data from three ground-based short-range WindScanner lidars during a two week campaign
- Deliver the wind turbine 10 minute data power production, pitch angle and rotational speed to public database.
- Deliver WindScanner 10 minute data to public database.