Measurement of wind profile with a buoy mounted lidar

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History

First Automatic Wind Turbine
1887 Maykirk Scotland

First Norwegian Wind Mill at Fram
Participants

Fugro OCEANOR

University of Bergen

Christian Michelsen Research

Statoil

Marintek
Project tasks

- Formulation of requirement and specification of the system
- Concept study
- Development of a prototype including hydrodynamic simulations
- Development of a compensation algorithm for the buoy motion
- Building of a prototype buoy
- Field test of the buoy
Present technology

FINO1 German Bight

Price NOK 50 mil
Measurement system

Wavescan buoy

ZephIR 300 lidar
Principles of operation:

- Laser radiation scatters from atmospheric aerosols
- A laser is focussed at a point incident with the aerosols
- Aerosols movement follows the wind
- Scattered radiation is ‘Doppler’ shifted by the wind speed
- The ‘in-line’ component of wind speed is measured
Benefits of the SEAWATCH Wind Lidar Buoy

- Wind profile, meteorological parameters, waves, current profile and other parameters can be measured from one single buoy

- The ZephIR can measure wind at 10m which is according to the WMO standard

- No recalibration is required for the ZephIR

- The Wavescan buoy is lightweight and small and is therefore easy to deploy and recover from vessels

- A standard single point mooring system is used
Test location Titran
Testing of Lidar buoy off the wind test centre
Preliminary results without compensation

Wind Direction at Buoy Mast
Smoothed Wind Direction
Wind speed and direction

Field Test - Wind speed at 53m

Wind Speed [m/s]

Date [dd/mm/2012]

Wind Direction at Buoy Mast
Smoothed Wind Direction
Wind speed for different heights

LIDAR Wind Speed

Wind Speed (m/s) at 218m
Wind Speed (m/s) at 53m
Wind Speed (m/s) at 10m
Scatter plot

All data

Bouy lidar vs ref lidar

$y = 1.01x$

$R^2 = 0.93$

Strong wind (before 5th April)

Bouy lidar vs ref lidar

$y = 1.04x$

$R^2 = 0.95$
Frequency distribution

Frequency of Wind Speed Difference (BUOY - LAND)

Normalized Frequency (%)

Difference BUOY - LAND (m/s)

Average 0.05, Median -0.01, St.dev 1.10, RMSE 1.10
Further work

- Comparing the buoy lidar data with the wind sensors at the met mast

- Include fuel cells for powering of Lidar
  Methanol cartridges to be located in wells below the solar panels
  Consuming 2 litres of methanol per day
  8 carriages from EFOY: Operational time 112 days
  4 special designed cartridges: Operational time 180 days

- Interfacing Geni to the Lidar

- Include compensation software in Geni

- Include “slam” Lidar

- Interfacing with the small scale wind model at Kjeller Vindteknikk
Fuel cell from EFOY
SEAWATCH Wind Lidar Buoy

Thank You