The Implementing Agreement for Co-operation in the Research, Development, and Deployment of Wind Energy Systems

Use of lidars to measure non-standard flow effect on power curve measurement and resource assessment in the IEA Task 32

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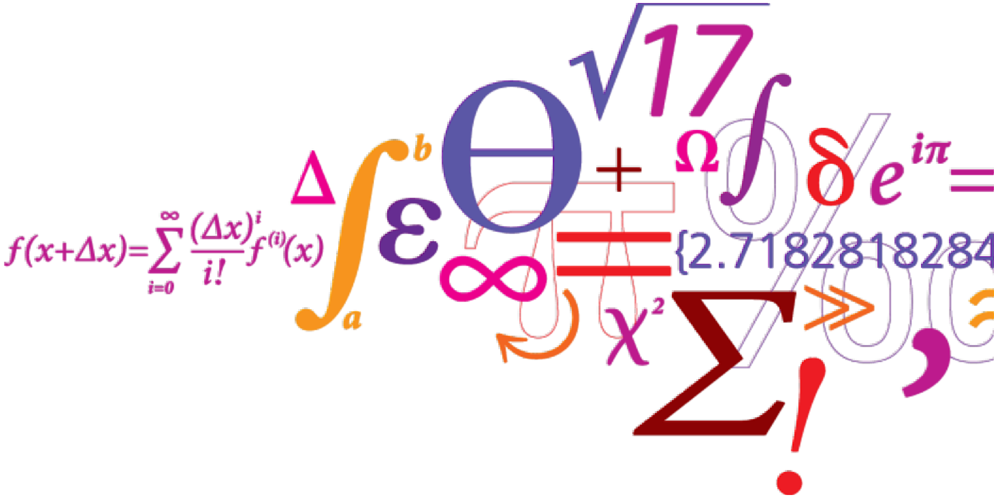
Working group
3rd meeting
30/05/2013
Hamburg, Germany



DTU Wind Energy
Department of Wind Energy

Mission of IEA Wind

IEA Implementing Agreement for Co-operation in the Research, Development, and Deployment of Wind Energy Systems.

"…to stimulate co-operation on wind energy research and development and to provide **high quality information and analysis to member governments** and commercial **sector leaders** by addressing **technology development** and deployment and its **benefits, markets, and policy instruments**." – IEA Wind Strategic Plan

IEA Wind Task 32 LIDAR: Wind lidar systems for wind energy deployment

The purpose of IEA Wind Annex 32 is to bring together the present actors in the research community and industry to create synergies in the many R&D activities already on-going in the lidar technology.

http://forwind.de/IEAAnnex32/index.php

Time line:
Official start: May 2012
Duration: 3 years
Kick off of the actual work: May 2013

Operating agents:
-ForWind – Oldenburg
- DTU Wind Energy
- University of Stuttgart
- NREL

Organisation of topics

SUBTASK I:
Calibration and classification of lidar devices

SUBTASK II:
Procedures for site assessment

SUBTASK III:
Procedures for turbine assessment

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1.1 The effects of shear and turbulence on the calibration

1.2 Classification and uncertainty

1.3 Calibrating nacelle lidar

1.5 Calibrating floating lidar

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SUBTASK II: Procedures for site assessment

- **2.2 Wind field reconstruction methods in complex flow with wind lidars**
- **2.3 Measurement of Wind Characteristics**
- **2.4 Using Lidar (wind profiles) as part of a wind resource assessment**

SUBTASK III: Procedures for turbine assessment

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SUBTASK III:
Procedures for turbine assessment

- 3.1 Exchange of experience in power performance testing using a ground-based Lidar acc. to 61400-12-1 ed. 2
- 3.2 Wind field reconstruction from nacelle based lidar measurements
- 3.3 Nacelle-based power performance testing
- 3.4 Load estimation using a lidar system

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What is WP 3.1 about?

Exchange experience in power performance testing using ground-based Lidar according to IEC 61400-12-1 CDV

→**What it is about:**

- Discuss the power curve measurement with the equivalent wind speed method
- Give recommendations about the implementation of the method
- Give inputs to the next revision of the IEC 61400-12-1

→ **What it is not about:**

- lidar calibration (WP 1.1 and 1.2)
- equivalent wind speed for AEP estimate (WP 2.4)

→ **Kick-off telephone meeting 18/04/2013**

Suggested outline for the expert report(1/2)

1. **Using the equivalent wind speed accounting for the shear in power curve measurement**
   - → state-of-the-art/experience
   - → pros and cons of the method
   - → how well does it work? (e.g. scatter reduction)
   - → recommended or mandatory in the next IEC version

2. **Implementation of the method**
   - →number of measurement heights
   - →spatial distribution
   - → comparison measurements to modeled shear and extrapolated profiles

3. **Including the veer**
   - → existing/proposed methods (e.g. IEC 61400-12-1 CDV Annex Q)
   - → benefits and disadvantages
   - → optional or mandatory in the next IEC version

Suggested outline for the expert report (2/2)

4. Implications for the uncertainty in power curve measurement

→ comparison of the uncertainty obtained with the different methods (1: hub height measurement only, 2: hub height measurement with shear indication, 3: equivalent wind speed)

→comments on the uncertainty estimation

→ recommended or mandatory in the next IEC version

5. Application of the equivalent wind speed method in complex terrain

→ site calibration with lidars

→ power curve

Who will participate in WP 3.1?

Confirmed participants

3E
Deutsche Wind Guard
DEWI
DONG Energy
DTU
ECN
GLGH
Kenersys
NREL
Oldbaum Services
Pentalum
Repower
Sgurr
SWE-Stuttgart University
Wind Consult
Zephir Lidar Ltd

What’s next in work package 3.1?

→Gather all material documenting the previous topics by June 2013

→June 2013: telephone meeting to distribute the topics in order to write the first recommendations.

What is WP 2.4 about?

Using lidars (wind profile measurement) for wind resource assessment

→Benefits of lidars for wind resource assessment

- can measure at hub height
- can measure the whole wind speed profile (lower-higher tip height)
- in the near future, power curve accounting for the wind shear using the equivalent wind speed method: how should they be used in resource assessment
- portable: easy spatial coverage

→ What it is not about:

- lidar calibration and classification (WP 1.1 and 1.2)
- Implementing the rotor equivalent wind speed method for power curve measurement (WP 3.1)

Preliminary plan

1. Vertical extrapolation (one lidar at one location for a full year _ flat terrain/offshore case)

1.1 Direct measurement at hub height instead of vertical extrapolation from measurement at 60m or so.

1.2 Include the full profile information

2. Horizontal extrapolation (complex terrain case)

2.1 Moving a wind lidar profiler around a site

2.2 Using a scanning lidar

Include the full profile information

- Necessity to account for the whole wind speed profile in resource assessment

- Overview of the various methods (REWS, machine learning method, others)

- Investigation of the REWS method:

- Test the transferability from one site to another (with different shears) of the REWS power curve
- Test improvement in AEP estimate using the REWS (power curve and wind speed distribution)
- What to do if we have the distribution of REWS at the assessed site but only the hub height power curve? And vice versa?
- How to implement this method in the resource assessment process, (i.e. how to apply a long term correction)?
- By how much do we expect improve the accuracy/reduce the uncertainty in the AEP estimate? Is it worth it compared to other sources of uncertainty?

Concluding remarks

- Common interests between the two groups

- Possible collaboration:

e.g. the results of the round robin exercise could be very relevant to the IEA task 32;

Exercise might be extended to a larger group;

Other suggestions?

Info IEA Task 32

If you want to follow: http://forwind.de/IEAAnnex32/index.php

If you want to participate: IEA-Annex32@forwind.de

Thank you for your attention