5 February 2019

Minutes of
IEA Wind Task 32 Workshop #13:
Floating Lidar Follow-up

Date of workshop: 13 November 2018
Venue: Bremerhaven, Germany
Workshop leader: Julia Gottschall, Fraunhofer IWES
(co-lead: Oliver Bischoff, Detlef Stein)

Participants

Alkistis Papetta	*Fraunhofer IWES*	Hector Wilson	*Carbon Trust*
Andrea Rouanet	*Leosphere*	Jochen Cleve	*Ørsted*
Andreas Stolten	*Siemens Gamesa RE*	Julia Gottschall	*Fraunhofer IWES*
Andrew Clifton	*SWE / Univ. Stuttgart*	Julian Harland	*EOLOS*
Bastian Schmidt	*DNV GL*	Lifen Song	*Titan Techn. Corp.*
Beatriz Canadillas	*UL International*	Matt Smith	*ZX Lidars*
Bernhard Lange	*Fraunhofer IWES*	Okan Sargin	*Wood*
Bernd Meyerer	*OpticSense GmbH*	Oliver Bischoff	*SWE / Univ. Stuttgart*
Breanne Gellatly	*AXYS Technologies*	Patrick Schwenk	*Offshore Wind Consult.*
Detlef Stein	*Multiversum*	Rafael Tavares	*DNV GL*
Erik Patschke	*Fraunhofer IWES*	Rainer Reuter	*OpticSense GmbH*
Giorgio Fortunato	*Titan Techn. Corp.*	Rajai Aghabi	*EOLOS*
Hans Verhoef	*ECN part of TNO*	Will Laird	*Wood*

Agenda / Minutes

An agenda was distributed in advance to the event and followed closely.

The workshop started at 10:00 with welcome words and short introductions by the workshop leader [see slide set *01_IEA-Workshop-13_slides.pdf*], Bernhard Lange from IWES representing the host, and Andy Clifton as IEA Wind Task 32 operating agent introducing the task [see *01a_IEA-Workshop-13_slides.pdf*].

Julia Gottschall gave a summary of Workshop #1 on Floating Lidar Systems, which was held in Blyth in February 2016 and can be seen as the precursor to this workshop. A particular focus was set on the so-called “gaps” and corresponding requirements for improved maturity that were identified by the participants in the 2016 workshop – these were:

- (Gap 1) Uncertainty,

- (Gap 2) Lack of investors' confidence,
- (Gap 3) No standard for validation,
- (Gap 4) Missing alternative validation methods,
- (Gap 5) Insufficient measurement of Turbulence Intensity.

It was concluded that some of these gaps could be closed in the meantime but some are still there. For closing the gaps, everything took much longer than initially expected. Significant parts of the work were shared by Task 32 participants and the Carbon Trust within the OWA (Offshore Wind Accelerator) Programme.

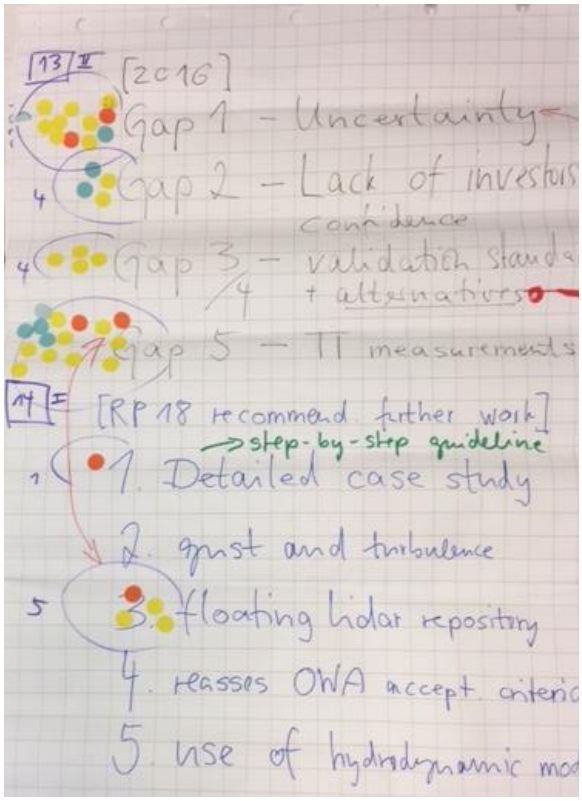
Oliver Bischoff gave an overview of RP 18 on Floating Lidars, which has been one of the key outcomes of Task 32 Phase 2, and its development through different steps [see *02_IEA-Workshop-13_slides.pdf*].

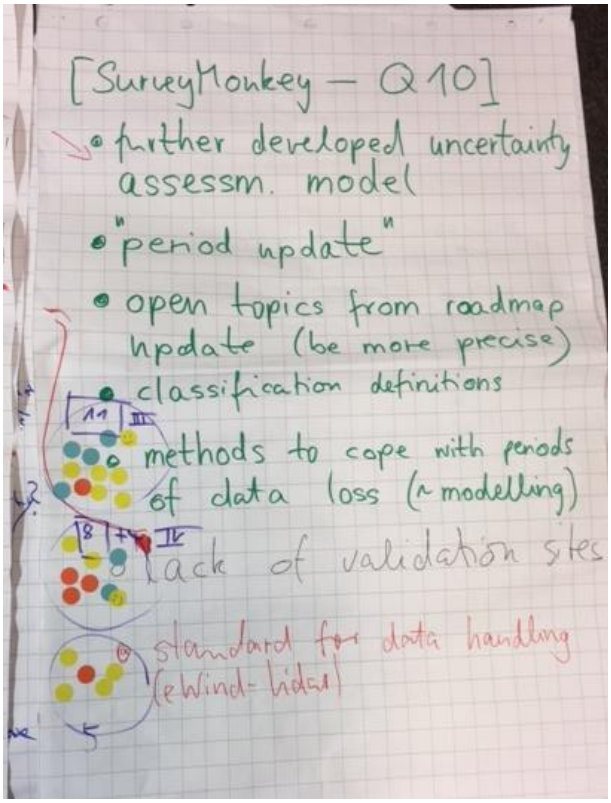
Before Detlef Stein introduced the "OWA Floating Lidar Roadmap" update [see *05_IEA-Workshop-13_slides.pdf*], which should be seen as one of the major Floating-Lidar guidelines together with RP 18, Hector Wilson explained the involvement of Carbon Trust and OWA in Floating Lidar and more general offshore wind activities [see *04_IEA-Workshop-13_slides.pdf*]. An open discussion completes the morning session. Several participants gave feedback regarding the RP 18 document:

- It was mentioned that the structure of the document seems appropriate and that it is a good start into FLS technology.
- But it was also indicated that some clients might not have read the RP completely or are not aware of the fact that these are recommendations only and not a standard but expect the FLS provider to be completely compliant with the RP.
- To approach this, it was suggested that a further webinar or some other guidance and explanation regarding the use of the RP might be helpful.

After lunch the participating FLS providers were invited to give a brief update on their technologies and asked to comment on the developments of the last few years (since workshop #1) and related challenges. Short presentations were given by representatives of AXYS, EOLOS and Fraunhofer IWES [see *AXYS_IEA-Workshop-13_slides.pdf*, *IWES_IEA-Workshop-13_slides.pdf*]. Every presenter was also asked to give some final statement after the presentation what they would like to see in an eventual update of the RP. It was indicated that more RP's related to the measurement of gusts and TI would be helpful as well as alternatives to the already known and used validation sites and alternative approaches to validate stage-3 systems.The following block was dedicated to Floating Lidar uncertainty estimations: Julia Gottschall gave a general introduction with references to the now available guidelines and recent OWA project results [see *01_IEA-Workshop-13_slides.pdf*]. Detlef Stein presented some representative example calculations [see *05a_IEA-Workshop-13_slides.pdf*]. And Oliver Bischoff introduced the "MALIBU approach" [see *05_IEA-Workshop-13_slides.pdf*].

The last one and a half hours were reserved for a workshop session and instructed discussions in smaller groups. The aim of these discussions has been to identify Floating-Lidar related topics for Phase 3 of Task 32 that starts with 2019. Candidate topics were collected during the course of the workshop and then prioritized by the participants (see photos below).





The resulting short-listed topics –

1. Lack of capability to measure gusts and TI
2. Further development of uncertainty assessment
3. Methods to cope with periods of data loss
4. Lack of sites for verification & alternative [FLS verification] approaches

– plus an optional bonus topic (to be defined by the participants) were then discussed in four separated groups. The task was to identify a possible mitigation (incl. how and by whom / which institution) for each topic.

Findings of the individual groups were presented in plenum and briefly summarized before the workshop was closed.

Condensed outcome of group discussions:

[Topic 1 – Gusts and TI]

More clarification is needed – (from the FLS OEM side) how big is the discrepancy between FLS and reference measurements [-> e.g. assessment of TI correlation for all trials], and (from the end-user side) what is the required accuracy.

It is well known that it is difficult to reproduce cup TI (and gust data) with lidars – no new issue for FLS. Adjusted lidar geometries may be a solution but unclear if we really need to go this step (… not, for instance, of we can get TI information well enough from models, or find a suitable correction/calibration for FLS data).

[Topic 2 – Uncertainty assessment]

More guidance is needed for applying the recommendations from the guidelines in practical case studies. A round-robin exercise (with accompanying discussions or a workshop) may help as well.

Leverage GUM, IEC 61400-15 and/or MEASNET experience.

A general barrier in lack of transparency by FLS user / industry in the field of FLS uncertainties is reported, preventing the collection and distribution of (benchmarking) results from FLS uncertainty assessments as well as experiences from applying uncertainty calculation approaches and guidelines.

[Topic 3 – Periods of data loss]

Instead look at redundancy and prevent the data loss. For gap filling there are (more or less standard) procedures that should be considered (cf. e.g. MEASNET). Impact on uncertainties need to be estimated properly in order to reach acceptance.

[Topic 4 – Verification]

Need to investigate alternatives to offshore met mast for this purpose – "golden FLS" for side-by-side comparison, TP lidar on turbine, lidar on available platforms -> what's the impact on the final uncertainties, how much effort (budget) can we save?

Specify rules and process that "make" a Golden Lidar or FL-Lidar, in terms of process showing, tracking and regularly confirming constantly "high" performance standard and capability for "low" reference uncertainty.

Consider tank testing or model approaches – can this be used here?

Consider and further develop the "risk-based approach" outlined in the guidelines as an alternative.

[Bonus topic – Confidence]

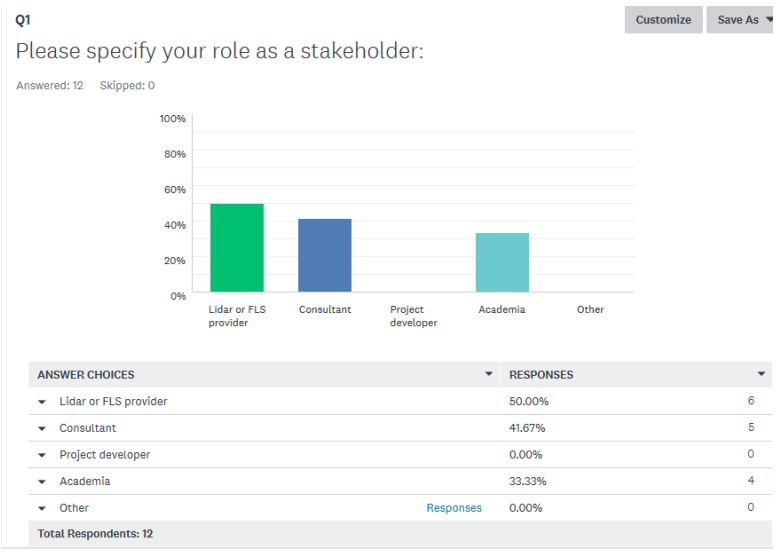
Figure out what is acceptable in terms of FLS applications for wind farm planning – based on realised projects, feedback from end-users / bank's engineers…

[Bonus topic – cross stakeholder / user agreement]

We need to learn from the users what they really require… in terms of (acceptable) FLS uncertainty levels, required degree of accuracy for TI data from FLS, etc.

Workshop Survey

The participants were asked to complete a workshop survey supported by SurveyMonkey during the workshop – in total 12 (complete) sets of answers were collected. For the outcome see the screenshots below.

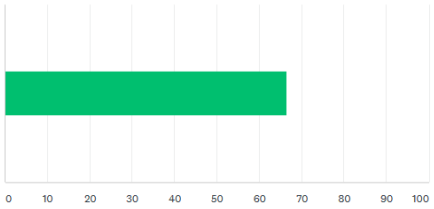


Q2

Customize Save As

How would you rate the present level of maturity of Floating Lidar technology in general? (Please use the definition of TRL between 1 and 9.)

Answered: 12 Skipped: 0



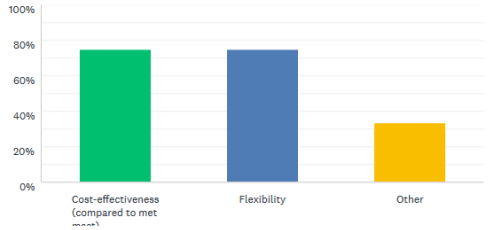
ANSWER CHOICES	AVERAGE NUMBER	TOTAL NUMBER	RESPONSES
Responses	67	798	12
Total Respondents: 12			

Q4

Customize Save As

Where do you see clear advantages of the technology in comparison to alternative technologies?

Answered: 12 Skipped: 0



ANSWER CHOICES		RESPONSES	
Cost-effectiveness (compared to met mast)		75.00%	9
Flexibility		75.00%	9
Other	Responses	33.33%	4
Total Respondents: 12			

Showing **4** responses

Faster deployment, Typhoon/Hurricane resistance
11/13/2018 11:21 AM

additional content of wind measures like alternative TI
11/13/2018 11:18 AM

more environmental friendly
11/13/2018 11:00 AM

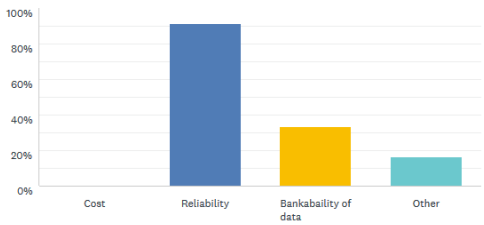
No alternative
11/12/2018 8:49 PM

Q5

Custom

Where do you have/see concerns?

Answered: 12 Skipped: 0



Showing **2** responses

Availability of good TI data

11/13/2018 11:25 AM

cost pressure competition vs. FLS reliability

11/13/2018 11:00 AM

Q6

Save As

Where do you see the most relevant technology gaps?(A gap is defined as an issue that needs to be resolved in order to increase the technologies technology's maturity.)

Answered: 11 Skipped: 1

Showing **11** responses

11/13/2018 11:26 AM View respondent's answers

Good TI data / Inflow

11/13/2018 11:25 AM View respondent's answers

Reliability of LiDAR system, power supply and lack of alternative data/control command transmission systems

11/13/2018 11:21 AM View respondent's answers

lack of open exchange of information and experience on the use FLS

11/13/2018 11:18 AM View respondent's answers

Reliability and availability

Handling of FLS offshore, meaning decrease weather dependency during lifting, etc.

11/13/2018 11:00 AM View respondent's answers

TI measurements (lidar tecnology in general), WFR models (bringing the most uncertainty)

11/13/2018 10:56 AM View respondent's answers

measurement uncertainty of the technology

11/13/2018 10:47 AM View respondent's answers

Stage 3 Units

11/13/2018 10:21 AM View respondent's answers

Technology to work continuously

11/12/2018 8:49 PM View respondent's answers

Q7

Customize Save As

How do you judge the current acceptance (e.g. by banks) of FLD* data to be used quantitatively for finance relevant wind resource assessments? (from 0 = not accepted at all, to 10 = fully accepted)

Answered: 10 Skipped: 2

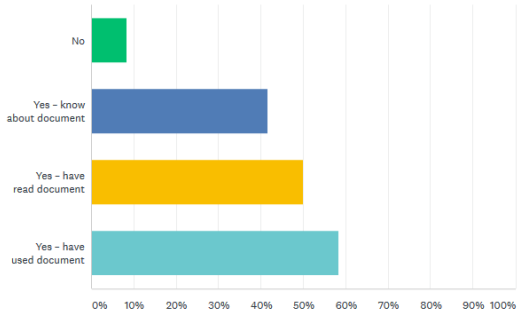
ANSWER CHOICES	AVERAGE NUMBER	TOTAL NUMBER	RESPONSES
Responses	64	637	10
Total Respondents: 10			

Q9

Cus

Do you know RP 18 (published by IEA Wind)?

Answered: 12 Skipped: 0

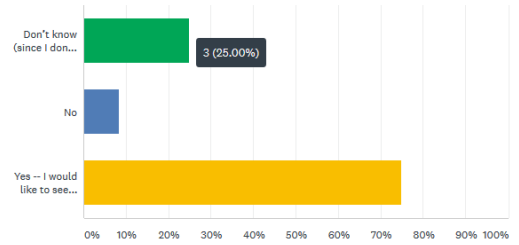


Q10

Cust

Do yo think there is a need for a further development of RP 18?

Answered: 12 Skipped: 0



Yes -- I would like to see... Responses 75.00%

RESPONSES (9) WORD CLOUD TAGS (0)

Add tags Filter by tag Search responses

Showing 9 responses

Further developed uncertainty assessment model
11/13/2018 11:26 AM View respondent's answers Add t

I don't know enough about all of the topics to know whether this is enough
11/13/2018 11:26 AM View respondent's answers Add t

Period update (not because there is something wrong but checking is everythin is still valid!)
11/13/2018 11:25 AM View respondent's answers Add t

1. Recommended practices for redundancy of control system and LiDAR system; 2. Add on chapters for wave and flow measurements
11/13/2018 11:21 AM View respondent's answers Add t

taking on board open topics from Roadmap update, more precise recommendations
11/13/2018 11:18 AM View respondent's answers Add

methods to cope with periods of data loss (for example modelation of data)
11/13/2018 11:00 AM View respondent's answers Add

step by step guideline for specific topics e.g. uncertainty
11/13/2018 10:47 AM View respondent's answers Add

an Update including Classification definitions
11/13/2018 10:21 AM View respondent's answers Add

Update