



Universität Stuttgart
Stuttgarter Lehrstuhl für Windenergie (SWE)
am Institut für Flugzeugbau

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Presentation of the research project “Lidar data correction for sites in complex terrain” (LoTar).

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Agenda

- Background and Motivation
- Project goals and structure
- Planned project work
- Possibilities to support the project

Background

- In the context of digitalization, there is an increasing need for **standardized and automatable solutions for the data preparation** of wind measurement data.
- There is a need for **common data standards** and semantics for data processing, analysis and exchange.
- Various activities e.g. IEA [Task 43](#) Wind Energy Digitalization, [OpenOA](#) or [brightwind](#) python library provide open tools.
- The LoTar project aims to contribute to **automated lidar data analysis** with focus on two key challenges

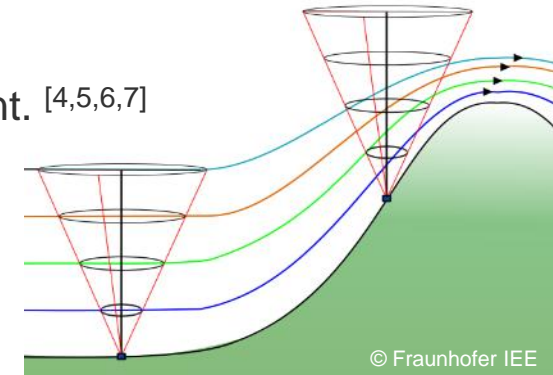
Two key challenges for lidar measurements

- **Lidar measurements in complex terrain**

- There are corrections for lidar measurements in complex terrain, but their accuracy is unclear. [1,2,3,5,6,8]
- There is only a small number of publications comparing lidar and mast measurements in complex terrain, so there is little knowledge about the uncertainties of the corrections of lidar measurements.

- **Lidar turbulence measurements**

- The accuracy of lidar turbulence measurement is not sufficient. [4,5,6,7]
- The accuracy of turbulence measurement is site dependent.

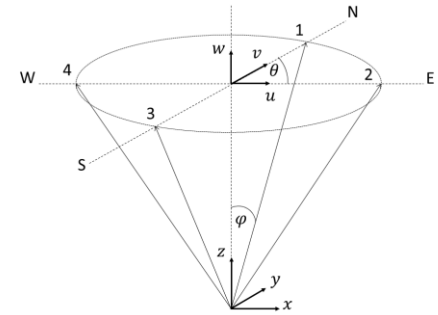


Project goal

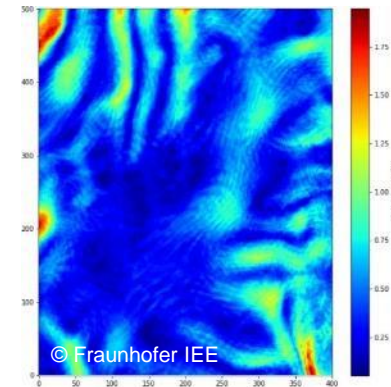
- **Overall project goal:**

Develop, test and disseminate an **open framework** for standardized and efficient processing of lidar data in complex terrain

- Better understanding of lidar error uncertainty in complex terrain
- Simplified correction / pre-estimation of lidar errors in complex terrain
- Development of a method for turbulence correction for lidar
- Analysis of geospatial data to identify the relationships between terrain characteristics and measurement errors

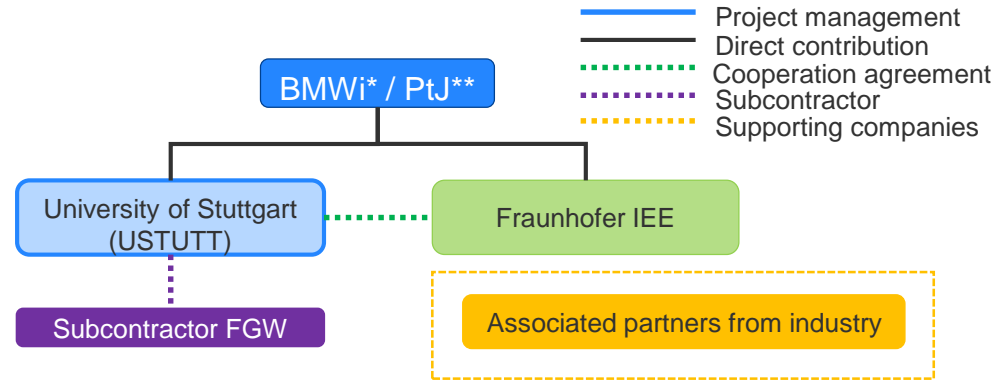


Example of a lidar uncertainty map

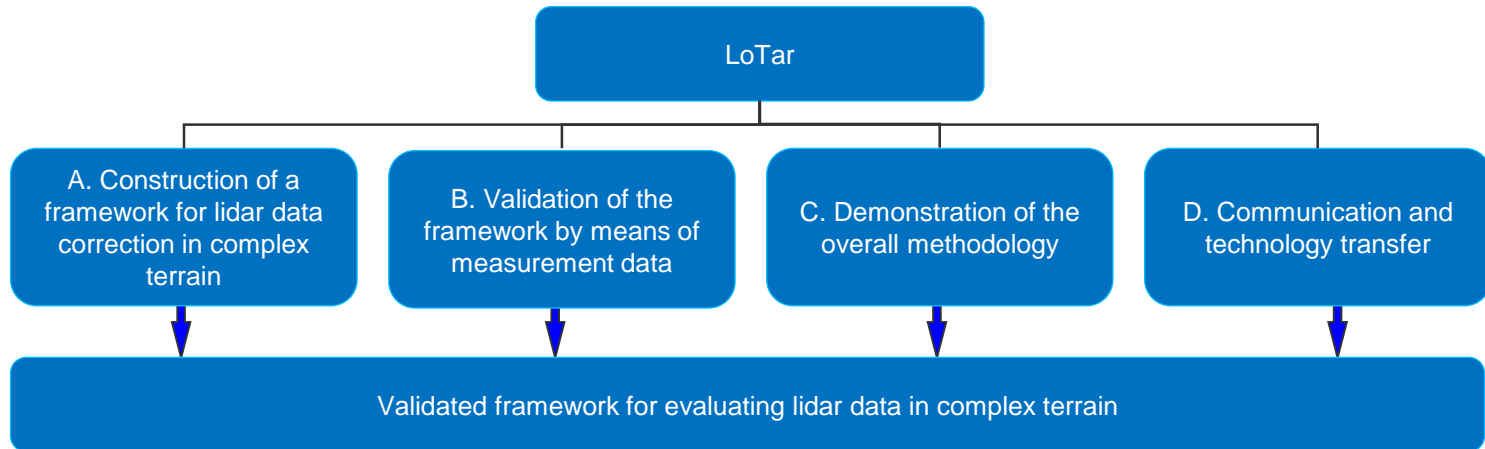


Project structure

- Coordinator: University of Stuttgart
- Start date: June 2021
- Duration: 3 years (until May 2024)

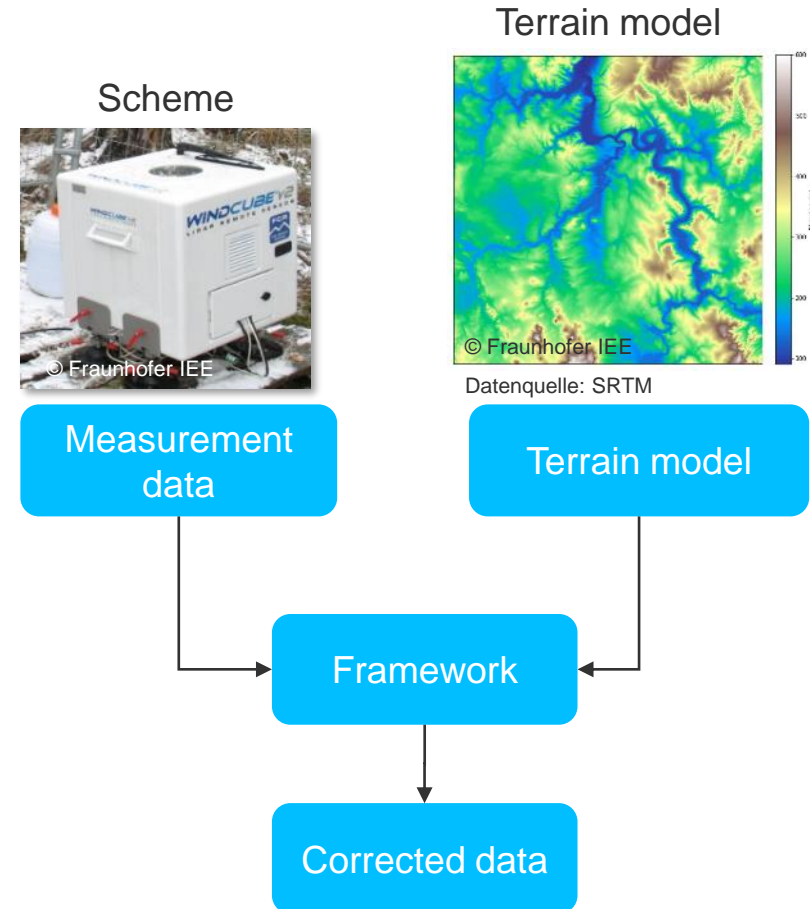


Work plan



What should the framework do?

- **Open source** (anyone can develop modules)
- Transparent implementation (no black box)
- **Python** with version management via GitHub
- **Modularized** data input and output
 - Lidar correction in complex terrain
 - Turbulence correction
 - ...
- **Consideration of industry requirements**



Planned work steps

- **Design of the framework** taking into account user requirements
- **Development of a modules**
 - for simplified preliminary estimation of lidar error in complex terrain
 - for turbulence correction of lidar measurements based on machine learning techniques
- **GIS analysis** for the classification of terrain characteristics in Germany
- **Acquisition of suitable measurement** data from existing measurement campaigns and **execution of own measurements** in complex terrain
- **Technology comparison** measurements with lidar devices of different types
- **Round-robin test** to determine the quality of the framework
- **Stakeholder involvement** (workshops) and discussion of the research results

We need data for the framework development

What we do

- **Three measurement campaigns are projected**
 - 2 Lidars + met mast (Autumn 2021)
 - 5 Lidars + met mast (Spring 2022)
 - 4 Lidars + met mast (Autumn 2022)
- All sites have different characteristics
- Short measurement campaign finished at „Rödeser Berg“
- Windcube V1 and Streamline against 200m met mast



Ways to support the project

What you could do

- **Provide measurements** where a lidar was next to a measurement mast (for at least 1 month).
 - Required data: Time series of lidar and measurement mast (time resolution: 10 minutes, period: as long as possible, at least 1 month), documentation of the measurement setup and (ideally) geodata
 - If necessary, data can also be provided anonymously
- **Participate in a measurement campaign** and provide a lidar
- Advice on design and participation in the Round Robin test planned by the project to correct lidar measurements in complex terrain
- **Completion of the project planned questionnaire** on the requirements and functional scope for the framework.



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Contact

Thank you very much for listening!

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