

IPID4all Doctorate Research Exchange at DTU Wind Energy - Riso, Denmark

Feedback report

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Topic: Wind field reconstruction with short range
lidars

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Introduction

This report is prepared as a result of the fruitful collaboration between the We-Sys research group and the remote sensing group at the Danish Technological University (wind energy section) funded by the IPID4All program. Looking at the problems to be answered in my PhD entitled “measurement and analysis of transient wind fields for real time prediction of wind turbine dynamics”, the research at DTU wind energy and We-Sys at Oldenburg have been complimentary with lots of collaboration and exchange visits in the past. The Technical University of Denmark has developed a new prototype short range 6” wind scanner that is capable of measuring the wind fields between distances of 20m-300m close to a wind turbine. The scanner is capable of measuring at a temporal resolution of 400Hz which makes it possible to capture the turbulence characteristics in the wind fields and the scanner can be programmed scan in any trajectory. DTU was building a new 6” short range wind scanner for ForWind continuing the collaboration between the two institutes. The exchange served as a base to get familiar with the device so as to conduct measurements with the device and also provided a base for myself to expand my professional working group and advance in my PhD.

Research Undertaken

As one of the new 6” short range wind scanners were bought by the University of Oldenburg, the exchange period provided an opportunity get acquainted with the device hardware, software and other systems. The exchange period provided an opportunity to work with measurement data from previous experiments conducted at DTU with the wind scanners. I was able to gain familiarity and know how on the short range wind scanners aided by the experienced personnel at DTU. As I will be working with data from these devices during the course of my PhD, the experience was very helpful.



Figure 1: The 6” windscanner obtained by Uni Oldenburg and the setup of 3D wind scanners (source: DTU)

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During the stay at DTU, I also had an opportunity to analyse the measurements made by DTU at a wind farm in the Netherlands where three short range ground based wind scanners measured a virtual met mast of height 10m-130m in the measurement plane of a “spinner lidar” mounted on the wind turbine nacelle facing upstream (figure 1 right). The aim of this set up was to validate the anti-cyclop buster wind field reconstruction program (LINCOP) which can be used to overcome the “cyclops problem” of lidar measurements. The ultimate goal of turbine mounted lidar system would be to provide information of the full wind fields before the winds arrive at the turbine. With this information, it will be possible to create a feed forward control concept for predicting the blade loads and extreme events. Validation of this model meant that full 3-D wind velocities can be obtained from a single line of sight spinner lidar measurement. I was one of the first persons to look at the measurements and hence I gained experience looking at and processing synchronised data in time and space from the multiple lidar devices. The measurements from the 3D wind fields measured by the wind scanners are compared to the results from the spinner lidar data processed through the LINCOP model on a virtual met mast. The initial results looks very promising with respect to resolving the three component velocities from a single lidar measurement. An idea was developed during the course of the stay to include the LINCOP model results into the reduced order inflow modelling methods that I am currently developing. The results are expected to be published in a conference and expanded further.

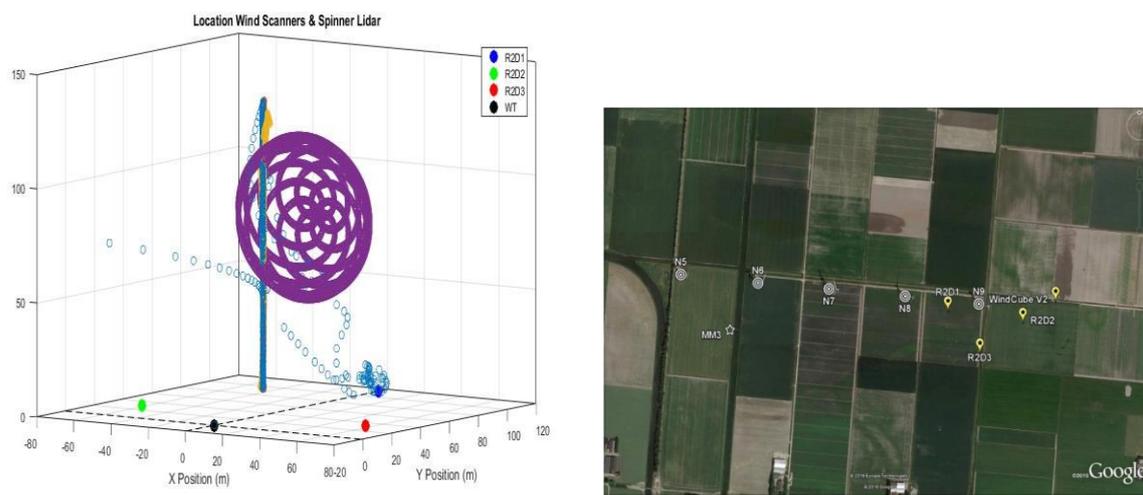


Figure 2: Locations and orientation of the lidar devices. The virtual met mast is created by the three wind scanners on the spinner lidar measurement plane.

Personal Experience

Apart from the research, the exchange provided me with many other opportunities both professionally and recreationally as it was completely new experience from Oldenburg. The new environment made it easy to establish new connections and learn about the focus of the different research groups at DTU. On a personal level, it was a very interesting experience moving to a new country and live in a big city like Copenhagen again. I was also able to visit the nearby countries like Sweden during my stay and I also had the opportunity to present at a conference.

Conclusions

The exchange at DTU wind energy using the IPID4All exchange program provided me with a great opportunity to interact and collaborate with experts working in the field of lidar wind field reconstruction. I was able to get some valuable input on my work which counts towards finishing my

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degree. The meetings with Prof.Dr.Torben Mikkelsen and others helped in progressing along with my work and achieve my goals for the exchange. I was also able to form connections and relationships with other PhD students at DTU wind energy.

Outlook

- My exchange is a part of succession of visits to DTU from PhD students at Uni Oldenburg. University of Oldenburg student Marijn Van Dooren went to DTU in 2015 under the IPID4All program. It is expected that there will be more collaboration and exchanges with DTU planned.
- A conference paper out of the measurement campaign at ECN and the validation of the LINCOM model is planned along with an extension to a paper.
- Further collaboration is expected in the manufacturing of the 6" short range wind scanners.
- Collaboration will be maintained with Prof.Dr.Torben Mikkelsen throughout the course of the PhD project.

The logo for DAAD (German Academic Exchange Service) consists of the letters 'DAAD' in a bold, blue, sans-serif font.

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