

IPID4all Doctorate Research Exchange with University of Oldenburg

Feedback report

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Exchange topic: Experimental assessment of a yawed
wind turbine wake*

Host supervisor: Dr. Michael Hölling

Introduction

In order to reduce power losses in wind farms caused by wake effects, different active wake control strategies have been investigated in the recent years. One promising approach is an intentional yaw misalignment in order to deflect the wake deficit laterally and thus reduce its impact on downstream turbines. However, a detailed understanding of a yawed wind turbine's wake trajectory and its dependence on the various influence factors is needed before potentially applying the concept.

In order to judge effects turbine geometry, blade design and the influence of the wind tunnel test section, extensive wake measurements behind two different model turbines developed at ForWind in Oldenburg and at the NTNU in Trondheim were performed from September 2016 until February 2017 at NTNU's low speed wind tunnel facility. Therefore, Jannik Schottler and Michael Hölling from the University of Oldenburg visited Trondheim with in September 2016, testing their model wind turbine in NTNU's wind tunnel. Jan Bartl and Franz Mühle from NTNU complemented these tests with wake measurements on NTNU's model wind turbine. In a follow-up research visit by Jannik Schottler in Trondheim in January 2017 a preliminary evaluation of the data was performed and future plans for publications discussed.

Research Undertaken

In March 2017 Jan Bartl was visiting Oldenburg for two weeks. The motivation for the visit was to further plan and work on future publications of the acquired dataset of the wake flow behind two yawed wind turbine models. Therefore, several meetings with supervisors Dr. Michael Hölling and Prof. Joachim Peinke were scheduled. The fruitful discussions resulted in a clear plan for two future publications in wind energy related journals. Alongside, the data was further analysed with respect to incremental statistics and the influence of different turbulent inflows. An abstract for the Wind Energy Science Conference in Copenhagen in June 2017 was prepared and submitted during this exchange period.

Beyond the collaboration on the yawed wake project, the motivation of this exchange visit was to discuss further options for future collaborations. Meetings with different groups of the ForWind group were held. Besides existing contacts to the experimental group of ForWind Oldenburg, future collaborations with the CFD group were discussed. The exchange visit furthermore included a guided tour in ForWind's extraordinary new wind tunnel facility. The tour inspired for new experimental ideas in the future.

Personal Experience

From a personal perspective the exchange visit in Oldenburg was outstanding. I had the possibility to meet a big number of ForWind researchers from different groups and in different scientific positions. I experienced all the researchers as very positive, helpful and open people, which led to many inspiring discussions. Beyond that, I very much appreciate the personal and direct contact to the supervisors very much, who took the time for longer discussions and welcomed me. I took part in the

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weekly seminar, group meetings and the weekly lab breakfast meeting of the experimental group and immediately felt fully integrated. Beyond the very positive work environment, my hosts organised private activities in the evenings and weekends, that will I will always remember as very positive.

Conclusions

The exchange visit in Oldenburg was a very positive experience both from a personal and a scientific point of view. It was a great opportunity to connect to a number of researchers from one of Europe's best wind energy research environments. The collaborative research on the investigation of a yawed wind turbine wake was further progressing during the visit and new aspects of the topics have been discussed. The many new personal contacts as well as a first impression of the new research facility could be the basis for future collaboration with ForWind Oldenburg.

Outlook

There are two future publications in scientific journals related to wind energy planned. One of the publications led by Jannik Schottler will focus on the comparison between the wake flows generated by the two different wind turbine models. The second paper will focus on the features of a yawed wind turbine wake as such under different turbulent inflow conditions. In the beginning of March 2017, a conference paper titled "*Comparative study on the wake detection behind yawed wind turbine models*" including the experimental setup of this collaboration and first results was submitted to the Wake Conference to be held in Visby, Sweden, at the end of May 2017.

At this juncture, there are no further exchanges to Trondheim or Oldenburg planned for this project. Further meetings have been scheduled, however, at the Wake Conference in Visby, Sweden in the end of May 2017 and at the Wind Energy Science Conference in Lyngby, Denmark in the end of June 2017.

In general, there are a lot of possibilities for future exchange between the institutions. Both institutions have similar research fields and complementing infrastructures. Especially the topic of wake and performance measurements on model wind turbines is a common topic for the University of Oldenburg and the NTNU in Trondheim. Future collaborations could possibly also include simulations by the CFD group at ForWind Oldenburg.

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