

IPID4all Research Exchange with University of Oldenburg

Feedback report

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CFD, VAWT design

Introduction

In IMFIA-Udelar one line of research is wind energy in urban environments, and micro wind turbine design and development, among other projects in the wind energy field as wind production forecasting, characterization of the wind resource in urban areas and others.

The internship proposed is a collaborative line of work with University of Oldenburg about design of micro wind turbines to be installed in urban environments. There are different lines being implemented related with urban wind energy application:

- Wind tunnel experiment results for different urban location in the capital city Montevideo, characterizing the wind condition in complex areas.
- Was built a testing bench for micro wind turbines, capable to essay up to 5 kW models where noise, wind speed and turbulence, quality of power generated and others variables of interest can be measured.
- A wind tunnel laboratory for wind turbine measurement has been installed. This laboratory will give new information for different geometries of wind turbines under development. In the current stage, different models of VAWT are being built for experimental essays in the wind tunnel of the School of Engineering – IMFIA - Udelar.

Experimental data like this and comparisons between different VAWT models are poorly documented in the literature. These data is very valuable at the moment of validate CFD modelling that was carried out during the stay in Oldenburg, enriching the investigation and defining the suitable modelling technics for these applications.

In particular, the department is aiming to improve the aerodynamics modelling skills, where this internship exchange was centred.

The exchange traced cooperation paths, unknown until now by the participant institutions. While these research stay was planned for a particular field within the wind energy (CFD, rotor design), further cooperation between the institutions could be for other topics of interest, in which both have activities (wind energy systems and farms, forecasting, turbulence, experimental, wind tunnel technics and results, etc.).

Research Undertaken

The internship was centred in improve computational fluid dynamics modelling skills, and its application to vertical axis wind turbines. Different meshes were created for Darrieus and Savonius rotors, using several grades of refinements.

OpenFoam was used to model the fluid dynamics with the rotor mesh spinning within the flow. Different parameters and turbulence models were tested in order to improve the results.

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Even that the velocity and pressure fields have an adequate behaviour, the performance of the rotor in terms of power exchanged with flow are no being close enough to the experimental results. Further modellations have to be made in order to improve the results and reach reasonable results.

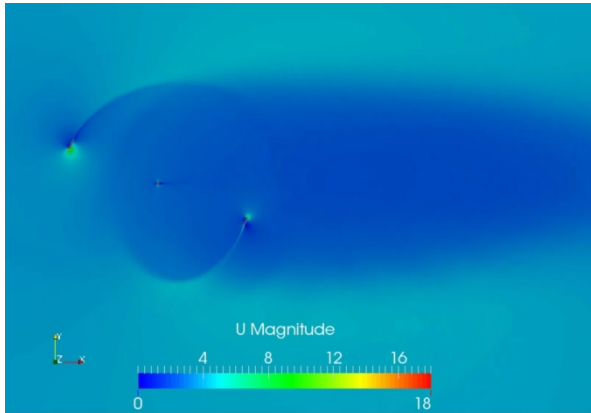


Figure 1. Darrieus simulation

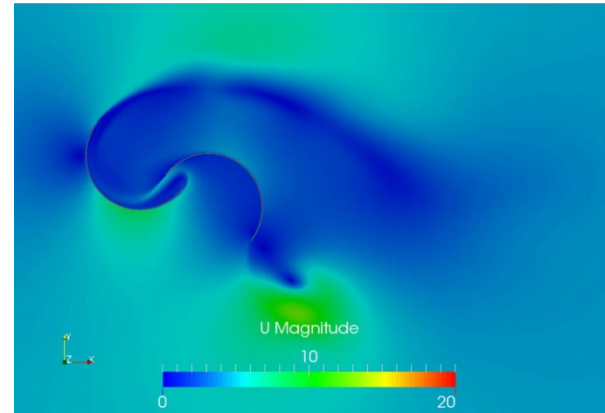


Figure 2. Savonius simulation

Personal Experience

The exchange was enriching from the point of view of the knowledge acquired in CFD theory and applications in OpenFoam. But also, was a valuable experience to know the operation and the structure of a big and important institute dedicated to the study of wind engineering and wind energy. I was able to discuss different topics and points of view with students from different countries and consolidated researchers.

Conclusions

The experience was excellent from the academic point of view as well as a personal experience living in another country. It is very valuable for researchers to have these possibilities of mobility and get new perspectives and improve particular skills and knowledge.

Outlook

During the stay in the University of Oldenburg my plan of thesis was presented for the master degree in Energy Engineering in UdelaR, Montevideo, Uruguay. In this plan (that was already accepted) the supervisor of the thesis is Ivan Herraez, my supervisor during my IPID4all research exchange in Oldenburg.

Acknowledgement

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