Experimental characterization of individual pitch controlled vertical axis wind turbine

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BOOK OF ABSTRACTS

WESC2017 – Wind Energy Science Conference
Technical University of Denmark, Lyngby
June 26th – 29th, 2017

Preface

Wind Energy Science Conference 2017 (WESC-2017) is held at the Technical University of Denmark in Lyngby during June 26-29, 2017. This conference is the first of a series of bi-annual conferences launched by the European Academy of Wind Energy (EAWE). The purpose of the conference is to gather leading scientists and researchers in the field of wind energy to present their latest findings. The conference aims at covering all scientific topics in wind energy, comprising from most fundamental aspects to recent applications. It provides a world-wide forum for scientists to meet each other and exchange information of all aspects of wind energy, including aerodynamics, turbulence, wind resource assessment, wind farms and wakes, aero-serve-elasticity, loads, structural mechanics, control, operation and maintenance, generator technology, grid integration, structural design and materials, new concepts, as well as community acceptance, environmental aspects, and economics.

This volume of abstracts comprises all presentations of the conference, including two plenary lectures, and nearly 370 contributed papers, presented in either oral sessions or during 13 mini symposia. The abstracts are sorted chronologically after the day of presentation, corresponding to the way they appear in the conference programme. At the end of the book you will find a list of presenting authors, listed alphabetically, and the page number where their abstract appear.

I like to thank the scientific committee and the local organizing committee for their work with the evaluation and selection process. In particular, I thank Marianne Hjorthede Arbirk for her invaluable help in preparing the conference and this book of abstracts.

Jens N. Sørensen, chairman WESC-2017
Lyngby, June 2017

Keywords or mini-symposium identification: Vertical Axis Wind Turbine, Variable Pitch

Experimental characterization of individual pitch controlled vertical axis wind turbine

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Research into the Vertical Axis Wind Turbine (VAWT) has been progressing over the last few years due to the large shift in design constraints for large floating offshore wind turbines by leveraging tools and experience from research beginning in the 1970s and lasting until the HAWT established market dominance in the 1990s. The beginning studies looking into the feasibility of large VAWT turbines on offshore floating platforms have been largely positive and suggest a large cost savings when comparing to equivalent HAWT turbines. These savings assume certain platform cost reductions as well as ease of operations and maintenance due to the possibility of systems being removed, like the active yaw system, and ease of access to significant components such as the gearbox and generator. In order to realize these cost gains, and perhaps identify more, it is necessary to improve the aerodynamic control of the rotor.

As of yet, the method to control aerodynamic loads on the wind turbine with the largest effect and proven reliability for use in field, is to vary the blade angle relative to the incoming wind, or blade pitch. With pitch control it is possible to tailor the loading of the turbine throughout the azimuthal sweep of the blades allowing the possibility of such things as aerodynamic braking, self-start capability, and allowing the possibility for advanced load control for greater power capture and wake manipulation. This work will outline the design and testing of a 1.5 meter Vertical Axis Wind Turbine with implemented individual pitch control within a controlled environment at the TU Delft Open Jet Facility. Experimental results show correlation of fixed and variable pitch angles on the measured torque and blade normal forces of the turbine. Figure 1 shows the turbine test configuration in the wind tunnel, and a representative dataset outlining turbine torque versus tipspeed ratio for multiple fixed pitch angles.

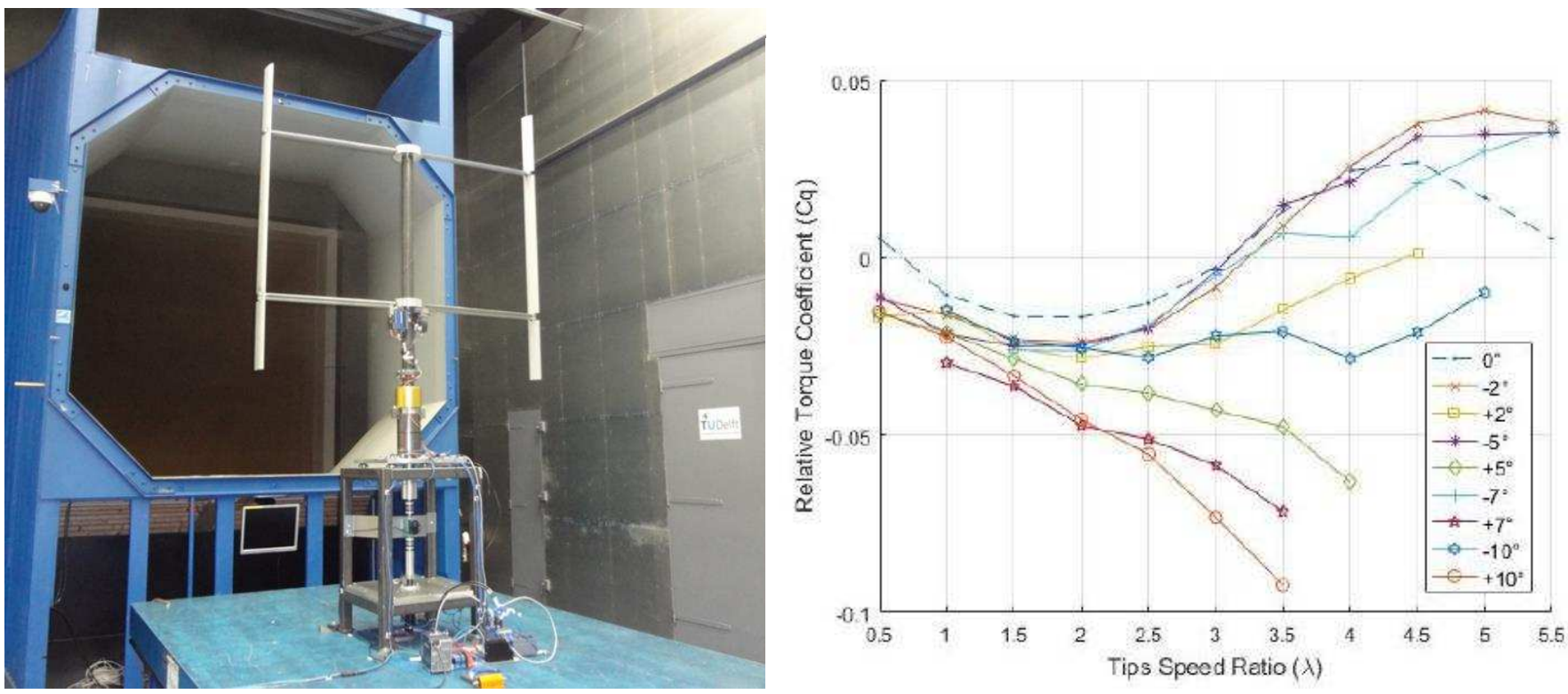

Figure 1. Test setup and sample results for PitchVAWT Wind Tunnel Testing at TU Delft Facilities.

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