Dear Readers, Partners and Friends of the CWD,

The last few weeks have been marked by the close cooperation of various disciplines along wind turbine drive trains at the CWD. Their efforts have paid off: the completion of the assembly of our flagship FVA nacelle project means that we can now test a complete research wind turbine under wind and grid influence on our system test bench. We are very pleased to present the completely mounted large-scale CWD test bench to our cooperation partners. My heartfelt thanks go out to our employees and our industry partners for their help in achieving this milestone.

As the project continues, we will have unique opportunities to identify local loading in the individual drive train components and to validate the calculation models. For this purpose the nacelle is equipped with comprehensive measurement technology. We are very glad to invite you to join us on and to help us determine our integrative path of researching the system behaviour of wind turbine drive systems. I hope that our CWD Newsletter is a good catalyst for innovative ideas and that it stimulates cooperation.

I wish you a pleasant read and look forward to seeing you in Aachen.

Best Regards,

Christian Brecher

PS: If you have not already subscribed to the newsletter and are interested in doing so, please click on the following link: www.cwd.rwth-aachen.de/aktuelles/newsletter/.
News from the Test Bench

Commissioning of the FVA Nacelle

A significant milestone for the FVA (Forschungsvereinigung Antriebstechnik e.V.) nacelle research project was achieved at the end of May with the system test bench commissioning of a 2.7-MW wind turbine that we modified for research purposes. The mechanical, electrical and control modifications include a gearset developed at the CWD for a three-stage gearbox, the integration of a new generator with a full-scale converter system, the construction of an open research controller and the implementation of a new lubrication and cooling system. An aeroelastic rotor simulation allows real-time application of dynamic wind loads to the rotor flange in six degrees of freedom. There is an adjustable simulated grid at the grid connection point. Using signals from approximately 300 measurement points, the CWD scientists can now explain component relationships between external loads and internal loading of wind turbines.

A measurement data acquisition system projected at the CWD records both local loads on individual wind turbine components as well as the characteristics of the entire system. The key aspects considered during the selection of this data acquisition system were precision, robustness, modularity, expandability and, in the light of the wide range of devices under test, flexibility. A competent partner was found in Hottinger Baldwin Messtechnik, whose equipment will also be used in subsequent major projects. The data acquisition system provides both analogue inputs for connecting a wide range of sensors and the option to feed in a wide range of digital data via fieldbus protocols. All the data is synchronously recorded and stored. This equipment provides all the options necessary for successful research at the CWD.

From the Research Department

Tolerance-Field-Based Design of Tooth Flank Topography for the FVA Nacelles Gear

The main gearbox teeth in the CWD’s FVA nacelle were designed using a tolerance-field-based design strategy for tooth flank modification developed at the Laboratory for Machine Tools and Production Engineering (WZL). Such a process involves determining the gearbox requirements and then comparing the applicability of various gearbox concepts. The design of the main tooth geometries as well as of the bearing-shaft system is based on the selected gearbox concept. Overloading of the toothing due to elastic deformation of the gearbox components is compensated by tooth flank modifications.

The strategy developed at WZL allows predicting the operational behaviour of the actual tooth flank topology. It can therefore be precisely implemented during the design of the toothing. Thanks to the tooth contact analysis, optimum flank modifications are determined during the development phase: these take into account the tolerances for manufacturing and assembly deviations as well as gearbox deformation. This process achieves a high level of robustness against deviations in tooth meshing. With the aid of automated analysis algorithms, the targeted parameters like the load carrying capacity, efficiency and acoustics can be optimised for each load case.

Tolerance influences are assessed within stipulated limits in a “variant calculation” according to tooth flank modification parameters in order to find the most suitable variant. The automated assessment weights the individual results and torques, while also awarding scores for certain results. The stability is also assessed. This assessment inspects the limits of a predefined tolerance field, e.g. in accordance with DIN 3962, for an identified nominal design. This means it is possible to test the extent to which a nominal design reacts to possible manufacturing deviations and how, for example, stresses behave on the edge of a tolerance field. The tooth flank modifications are determined based on the overall score from all the individual results for a nominal design.

The developed methods achieve a high level of robustness against manufacturing and assembly deviations and misalignments, which will be analysed and confirmed in the pending investigations at CWD.
Spotlight

HBM is our new Cooperation Partner

The measurement technology company Hottinger Baldwin Messtechnik (HBM) is heavily involved at the CWD. As well as being involved in IEA Task 35, HBM solutions comprise the standard measurement system for the 200-measurement-channels system test rig. A 5-MNm torque sensor is also used in an EU research project.

Plabed – Planetary Bearing Design

As part of the Plabed project, which began in June, existing calculation models for mapping the load on planetary gear bearings will be improved and the loads on a test bench reproduced. The knowledge gained with regard to interrelationships of planetary gear bearings in the system will then be merged into a design guideline.

Inauguration of the FVA Nacelle at the CWD

On 31 May, the FVA nacelle, a 2.7-MW wind turbine that we modified for research purposes, was finally inaugurated with the presence of important guests from the research sector and industry at the CWD. The nacelle will help to improve the reliability of existing simulation models significantly.

Workshops

IEA Wind Task 35

The CWD dedicated 6 and 7 June entirely to the IEA Wind Task 35. This workshop was visited by Professors Shuju Hu, Yangfeng Meng and Ya Deng from the Chinese Academy of Science, Beijing.

Part of the task involved investigating how tests on system test rigs can best map loads that occur in the field. The aim is to develop recommendations for new system test methods and for standardising these on various system test rigs. During the Chinese delegation’s visit, critical loads were identified for investigation. The next step will be the adaptation of the IEC guidelines to system test rig testing.

In addition to the original goal of its visit, the Chinese delegation was also looking to exchange experiences with leading scientists from the CWD. After all, China is working on establishing a freely accessible system test rig for wind turbines. From 2020, devices under test with outputs of 10+ MW are to be tested under torque and non-torque loads, using hardware-in-the-loop tests.

Events

6th CWD Workshop

The 6th semi-annual CWD workshop, which includes industry participation, will take place at the CWD on 12 and 13 October. This year, experts from leading wind power companies will again visit Aachen to discuss current technical issues and identify potential research activities.

The focus will be on the fields of Rotor/ Lightweight Construction, Wind Turbine System Simulation and Certification of System Test Benches. We look forward to a productive exchange and hope to be able to match the success of the previous workshops!

CWD 2017

The many abstracts received promise a lot of interesting presentations at the next Conference for Wind Power Drives (CWD 2017), which will take place in Aachen on 7 and 8 March 2017. We are particularly excited about intensive exchange with regard to innovations in the research areas of Wind Turbine Gear Bearings, Wind Turbine Materials, Main Bearings and Blade Bearings, Wind 4.0 and Load Distribution in the Planetary Stage.

www.cwd.rwth-aachen.de/konferenz

Disclaimer

CWD | Center for Wind Power Drives
ACS | Institute for Automation of Complex Power Systems
Prof. Dr.-Ing. Antonello Monti
AIA | Institute of Aerodynamics
Prof. Dr.-Ing. Wolfgang Schröder
CWD | Chair for Wind Power Drives
Prof. Dr.-Ing. Georg Jacobs
IEM | Institute of Electrical Machines
Prof. Dr.-Ing. habil. Dr. h. c. Kay Hameyer
IRT | Institute of Automatic Control
Prof. Dr.-Ing. Dirk Abel
PGS | Institute for Power Generation and Storage Systems
Prof. Dr. ir. Dr. h. c. Rik W. De Doncker
WZL | Laboratory for Machine Tools and Production Engineering
Prof. Dr.-Ing Christian Brecher
Editorial and Contact:
Freia Harzendorf, M.Sc.
Center for Wind Power Drives
RWTH Aachen University
Campus-Boulevard 61 | D-52074 Aachen
Tel.: +49 241 80 92425
Fax: +49 241 80 92685
E-mail: news@cwd.rwth-aachen.de
URL: www.cwd.rwth-aachen.de