Latest trends and future for wind turbines test facilities

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Summary
'Next generation' of solutions for wind turbine components testing facilities is needed in terms of reliability and robustness for mechanical systems, realistic boundary conditions guaranteed for specimen testing and high-precision advanced control systems.

1. Introduction

In the time of the latest fifteen years the size of the wind turbines has risen dramatically and, as a result, this growth is accompanied by increasingly demanding requirements for the test facilities. See [1] and [2].

Fig. 1: Test facility

2. Mechanical system

The load application systems are evolved designs in terms of robustness and efficiency, resulting in optimised cost-effective components with outstanding performance in the application of both static and dynamic loads.

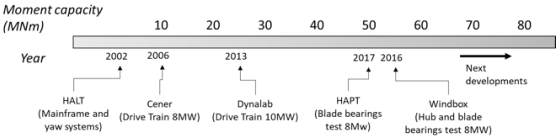

Fig. 2: Test capacity

For the design of these elements, sophisticated calculations based on complex integrated Finite Element models are performed (See [3]). Early unit prototypes are used to avoid infant failures. Whole facility is re-created in virtual reality, which allows the verification of the correct dimensioning and geometric validity for assembly and maintenance purposes.

3. Boundary conditions

Realistic conditions in the testing are wanted by manufacturers that need to demonstrate to wind farms developers the wind turbines behaviour. High fidelity emulation of interface stiffness becomes crucial to replicate the real boundary conditions at complex mechanical components testing. Either real neighbouring components or emulators can be used to replicate actual load distributions.

4. Control system

Reliable, robust, synchronized and high-precision, fully-customized control systems are required. Flexible field component interfaces are handled by high-performance hardware platforms that directly and synchronously tackle an unlimited number of actuators and sensors.

Laboratory prototypes are constructed to develop advanced model based control systems, coping with the mechanism complexity and compensating non-linearities as friction or servovalves dynamic behaviour and safely pre-check on-site system integration.

Fig. 3: Scaled prototypes

Hardware in the loop real-time simulations are recommended for complementing non-linear mechatronic/electric systems when prototypes are not viable.

5. References

[1] Lasa M, Pérez I, Sanz J CENER. Ariño J, Bilbao A, Vizcargüénaga A, Zarraoa A, IDOM S.A.U. Innovative Wind Turbine Testing Centre in Spain. EWEA, 2003.
[2] Ariño J, Eletxigerra I, Bilbao A, García B, Vega O. Multi-Megawatt Nacelle Laboratory Testing A paradigm for success? AWEA, 2016.
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