

Dynamic Simulation of Full-Scale Wind Turbine Nacelle System Test Benches



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(Dr. Pat Hegmann)

DYNAMIC SIMULATION OF FULL-SCALE WIND TURBINE NACELLE SYSTEM TEST BENCHES

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Verlagsgruppe Mainz Dez 2015, 2015. Taschenbuch. Book Condition: Neu. 211x149x12 mm. Neuware - A virtual replica of a system test bench for full-scale wind turbine nacelle is built up in the framework of this dissertation. The primary objective of the simulation study is to reveal the overall dynamics of the test bench and expose the difference between test bench dynamics and wind turbine field dynamics. The secondary objective is to make proper use of the developed models and design active control schemes for test bench operation. The virtual test bench is formulated in a multi-body simulation environment, with flexible drive train dynamics validated with experimental modal testing. The model also integrates the operation control and DUT control, having a similar hardware-in-the-loop architecture as the physical test bench. The data exchange between multi-body model and controllers is realized through co-simulation interface. Test scenarios with aeroelastic wind load calculation can be simulated. By comparing the interface force/torque response with the reference turbine model, it is found that the open-loop behavior of the tested nacelle explicitly differs from field operation. The changed boundary conditions of the tested nacelle are the root cause of the difference since the inertia and stiffness of the load application system largely differ from the original rotor system of the turbine. It is also found that the rheonomic joint is the reason why coupled rotor-drive train dynamics are lost when using the wind load software simulator. The difference of open-loop behavior is compensable via active control. A virtual rotor system can be artificially created to excited realistic load response inside the DUT as in field operation. However, the existing multi-body model has hundreds of states and thus computationally expensive. Therefore, low-order plant models in form of transfer elements were derived from the multi-body model by truncating high-order modes at...



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