Nonlinear Dynamic Inversion Control for Wind Turbine Load Mitigation based on Wind Speed Measurement

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Wind energy has become an important energy source with worldwide growing capacities. Advanced control design can help to improve the energy generation and extend turbine lifetime. While the nominal control of wind turbine is already well handled by the state of the art, there is still much potential in the field of load reduction. Other aspects are key-technologies such as LIDAR systems that enable better on-line wind measurement.

This paper shows the potential of an advanced controller for wind turbine load mitigation. The controller is based on Nonlinear Dynamic Inversion control methods combined with Pseudo Control Hedging to account for the actuator limits and a two degree of freedom control system for the collective pitch control of the rotor blades. The controller uses wind speed measurement information to adjust to wind gust load. The simulation results show a large reduction of the gust load on the wind turbine using the proposed controller.

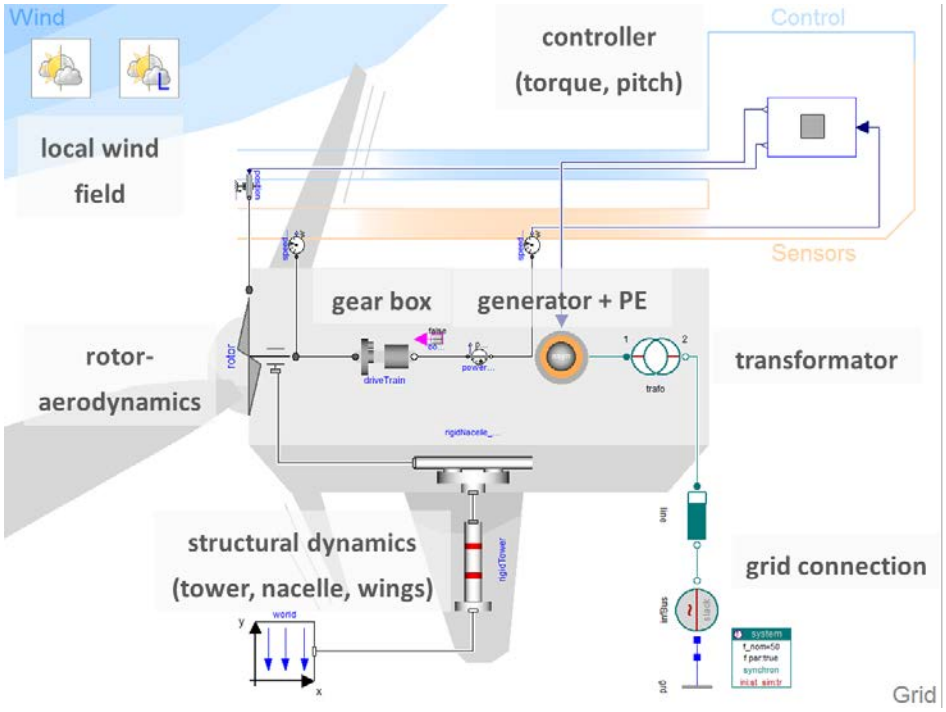

Figure 1. Top-level model diagram of a wind turbine.

For the design and development of this controller, a DLR library for wind-turbines has been used. Such a multi-domain Modelica library for wind turbines with non-causal and hence invertible models forms an optimal basis for the development of suitable NDI controllers.