Advanced integrated control of large-scale wind power plants and wind turbines

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Publication date:
2019

Document Version
Publisher's PDF, also known as Version of record

Citation (APA):
Reducing operating costs
Enhancing WPP capability
Current state of the art

The goal of TotalControl is to move the WPP controller design philosophy from individual optimization of WT operation to a coordinated optimization of the overall WPP performance. The TotalControl project aims to achieve this by developing and validating advanced integrated WPP/WT control schemes conditioned on grid demands and wind turbine fatigue damage limits. For developing and testing of the different WPP controllers, a range of high-fidelity and medium-fidelity simulation models are used. These models are already available in the consortium, but will be thoroughly validated against full-scale measurements in the Lillgrund WPP. Due to the complexity and multi-scale nature of WPP flow dynamics, the high-fidelity CFD-based models are very expensive in simulation time, e.g. requiring supercomputing, and therefore not well suited as control design models.

### Wind farm control time scales

TotalControl is built on a hierarchy of controllers, each reacting at different time scales and control time steps. At the slowest control level the WPP is quasi-statically adapting its WT active and reactive power set points and WT yaw angles, adapting to slowly changing environmental conditions and market elements. A second control level is the WT controller, accepting power set points from the quasi-steady control levels. Finally, a fast WPP controller is considered which responds dynamically to faster events (turbulent gusts, requests for ancillary services, etc.) and uses feedback from the WTs. This controller uses model-predictive control for prediction of dynamic wake behavior and impacts on turbine loads. The dynamic WPP controller also contains a direct feedback control level related to the WPP internal power grid.

### References

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