Control methods for lifetime extension

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Summary
As more wind turbines come close to the end of design life time the end of life strategies need to be evaluated. Extending the life time seems to be a financially attractive option for the operators and research is focusing on such strategies [1]. Present work focuses on evaluating retrofit control concepts, namely individual pitch control and down regulation, for life time extension purposes.

1. Introduction

The life time of wind turbines is limited mainly by the fatigue loading of different components.

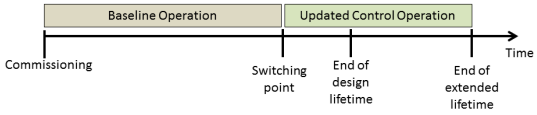

Fig. 1: Retrofit control application strategy

The fatigue reserves are determined by the design margins as well as the mismatch of the certification loads with the loads induced from the actual operating conditions. Adopting load mitigation control strategies after some period of operation can increase these fatigue reserves and reduce the fatigue consumption rate.

Both the financial and technical feasibility of such an approach have to be evaluated. The present work focuses on the technical feasibility, identifying the benefits and tradeoffs of different control strategies. Ideally such a strategy would require minimal hardware changes on the turbine and lead to only load reductions without any adverse effects on key performance indicators and loadings. Two options would be individual blade control (IBC) and down regulation. These are evaluated, comparatively and combined, according to the load certification standards on the DTU 10MW onshore reference wind turbine. The simulations are done with the aeroelastic code FAST from NREL and evaluated according to DLC 1.2 conditions for IEC class IA. Lacking information on design and operating fatigue margins, the potential lifetime extension of the different components is calculated assuming no margins which is a highly conservative, initial calculation.

2. Methodology

IBC is implemented as a feedback control to blade root measurements using three decoupled controllers acting on top of the main collective pitch PI controller only in the full load region [2]. The main tradeoff for this application is the increased pitch actuation.

Down-regulation is an approach already used for wind farm control purposes (AEP increase via wake reduction and ancillary services). The rated power of the turbine is decreased while the performance in partial load is not affected, leading to load reductions but also to a reduction of the AEP [3].

3. Results

These two methods complement each other in load reductions when combined, while pitch actuator demands are decreased compared to the case where only IBC is implemented.

3. Acknowledgements

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3. References

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