Reduced design load basis for ultimate blade loads estimation in multidisciplinary design optimization frameworks - DTU Orbit (17/10/2019)

The aim is to provide a fast and reliable approach to estimate ultimate blade loads for a multidisciplinary design optimization (MDO) framework. For blade design purposes, the standards require a large amount of computationally expensive simulations, which cannot be efficiently run each cost function evaluation of an MDO process. This work describes a method that allows integrating the calculation of the blade load envelopes inside an MDO loop. Ultimate blade load envelopes are calculated for a baseline design and a design obtained after an iteration of an MDO. These envelopes are computed for a full standard design load basis (DLB) and a deterministic reduced DLB. Ultimate loads extracted from the two DLBs with the two blade designs each are compared and analyzed. Although the reduced DLB supplies ultimate loads of different magnitude, the shape of the estimated envelopes are similar to the one computed using the full DLB. This observation is used to propose a scheme that is computationally cheap, and that can be integrated inside an MDO framework, providing a sufficiently reliable estimation of the blade ultimate loading. The latter aspect is of key importance when design variables implementing passive control methodologies are included in the formulation of the optimization problem. An MDO of a 10 MW wind turbine blade is presented as an applied case study to show the efficacy of the reduced DLB concept.

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