Optimal Aero-Elastic Design of a Rotor with Bend-Twist Coupling - DTU Orbit (18/08/2019)

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Passive Bend-Twist Coupling (BTC) can be used in blades to alleviate loads and generate more Annual Energy Production (AEP). However, BTC is inherently aero-elastic, thus difficult to incorporate into the design with sequential design process. Multi-disciplinary Design Optimization (MDO) is an attractive approach for overcoming these challenges. This paper presents the re-design of a 100kW BTC rotor using the MDO rotor design package HAWTOpt2. In the preliminary design phase, MDO was used to assess the differences between elastic BTC (i.e. off-axis fibers) and geometric BTC (i.e. sweep). This work found that aero-elastic design optimization without BTC was able to achieve a 16% improvement, then with sweep a 18% improvement and with material coupling a 17% improvement. Due to the reduced stiffness of off-axis fibers, material coupled designs had more difficulty satisfying the tip deflection constraint. The geometric BTC concept was chosen for the final design. The design optimization was repeated with additional manufacturing constraints. The final design achieved a 12% improvement.

General information
Publication status: Published
Organisations: Department of Wind Energy, Aerodynamic design, Wind turbine loads & control, Fluid Mechanics
Number of pages: 13
Publication date: 2018
Peer-reviewed: Yes

Publication information
Journal: Journal of Physics: Conference Series
Volume: 1037
Issue number: 4
Article number: 042009
ISSN (Print): 1742-6596
Ratings:
BFI (2018): BFI-level 1
Scopus rating (2018): CiteScore 0.51 SJR 0.221 SNIP 0.454
Original language: English
Electronic versions:
McWilliam_2018_J__Phys__3A_Conf__Ser__1037_042009.pdf
DOIs:
10.1088/1742-6596/1037/4/042009

Bibliographical note
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Source: FindIt
Source-ID: 2435911272
Research output: Contribution to journal › Conference article – Annual report year: 2018 › Research › peer-review