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# Aero-structural coupled optimization of a rotor blade for an upscaled 25 MW reference wind turbine

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One major challenge of the wind turbine industry is the reduction of the levelized cost of energy (LCoE) while following the strong demand for a higher annual energy production (AEP). To meet these goals, larger wind turbine sizes are required. The common method of upscaling existing wind turbine designs comes along with the problem of faster growing blade masses and costs compared to the AEP [1]. Investigations in new technologies to improve the structural efficiency of larger blades can be supported by aero-structural coupled optimizations [2]. The present work introduces a two-step aero-structural coupled design process to capture the multi-disciplinary trade-offs between costs and AEP, aiming at minimizing LCoE for a 25 MW wind turbine. In a first step, a preliminary aero-structural optimisation is carried out using simplified and fast methods. The output is then refined with respect to additional design criteria with an advanced optimization process, including an aero-servo-elastic coupled loads analysis. The process is applied to a 25 MW blade, upscaled from the IEA 15 MW reference wind turbine [3]. Based on the results of an utilization analysis, the structural design is adapted, and a stiffness optimization is performed. The optimum airfoil positions are identified to reduce the amount of material while limiting losses in the aerodynamic performance. The obtained blade designs are shown in figure 1 and facilitate a consistent AEP compared to the upscaled reference design. A mass reduction of 35% could be achieved, which results in a reduced LCoE of 1.7% compared to the purely upscaled blade design.

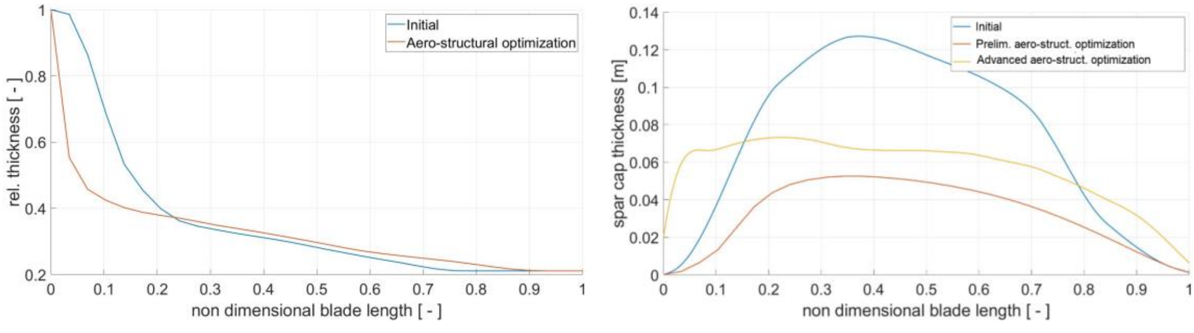


Figure 1: Rel. airfoil- (left) and spar cap thickness (right) of the aero.-struct. opt. design

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