Project: Novel Aeroelsatic Tailoring Methods Via Multi-Disciplinary Optimisation

Key focus: blade design, bend-twist coupling, sweep, fibre tailoring, passive load reduction

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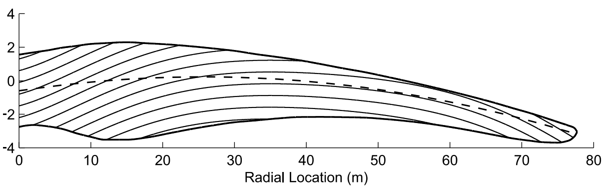
Background

Offshore wind is ever moving toward larger turbine rotors that generate greater power. Sizing, and hence cost, of many turbine components is defined by aerodynamic loads from the rotor. It is desirable to reduce the cost of components as much as possible, whilst increasing overall turbine size and power generating capacity. Therefore, reducing aerodynamic loads without severely impacting energy production is one way of minimising LCoE.

Project description

Aeroelastic tailoring allows wind turbine (WT) blades to passively alleviate loads, in addition to the active load alleviation incorporated in most modern WT controllers i.e. individual pitch control (IPC). Passive load alleviation is most often achieved by building in structural bend-twist coupling into the blade structure, either by geometric (i.e. sweep) or material (i.e. fibre steering) means. Such load alleviation has the potential to reduce extreme and fatigue loading on the blades, as well as other turbine components such as the drivetrain, tower and foundations. Alternatively, it opens up the potential to increase the size of the rotor without the associated increase in loads, thus improving energy capture.



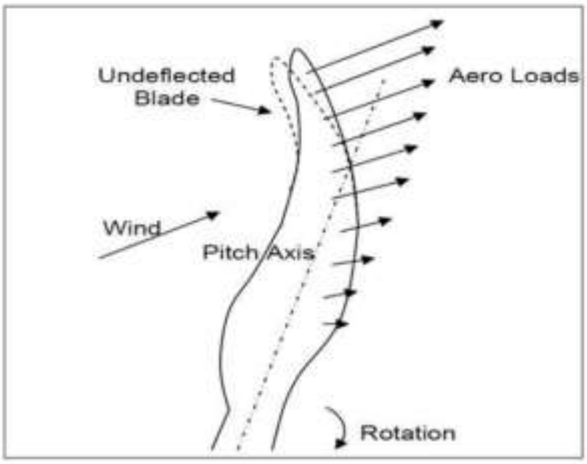


Figure 1 - Fibre tailoring and swept blade planform (left), and the mechanism of sweep bend-twist coupling (right)

Research outcomes/impact

The breakthroughs in this work are twofold, firstly, couplings from multiple sources will be considered for reducing LCoE and, secondly, the variables related to coupling will be included in the whole turbine optimisation problem. The outcome will be a tool capable of doing preliminary aero-structural rotor-turbine design considering aeroelastic tailored blades. The aero-structural design problem is large and requires much computing power, therefore, many techniques for improving computational efficiency will be included.

The impacts of this research for industry will be that global turbine concepts (i.e. 3 vs 2 blade, downwind vs upwind, specific site conditions etc) will be able to go through a fully optimised preliminary design phase using fewer employee resource and considering the aero-structural design trade-off. Additionally, the addition of aeroelastic tailoring effects will be available to consider at this design stage.

Project Sponsorship:

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