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Adaptive Blade Concept Assessment:

Curved Planform Induced Twist Investigation

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Abstract

Improving wind turbine blades via bend-twist coupling confronts two difficult challenges. The first is that off-axis fiber for the major structure is difficult to fabricate. Suitable fabrics with the primary fiber ~20 degrees off-axis are not commonplace and may present dimensional stability problems when handled, due to a tendency to shear when tensioned along their long dimension. These are ultimately cost issues. The second category of challenges is in the area of possible fatigue limits due to ending or curving angled fibers. Spar caps with angled fibers must either end those fibers at the edge or have them carry around a web type structure. Either approach implies additional stresses in the resin system binding the fibers and may lead to lowered fatigue allowables for design.

The vision driving this work was to look at the possibility of using novel planform and structural combinations to provide response similar to classical bend twist coupling, but without the use of off-axis lay-up in the structure. Sweep distributed along the span is used to create a moment that induces twist, and airfoil thickness reduction via carbon fiber spar caps is used to increase twist response to the induced moment. If a suitable magnitude of twist response can be shown using this approach, then the blade structure might be fabricated much as it is now, without off-axis spar cap fiber, and the benefits of bend twist coupling could still be obtained.