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The Use of Twist-Coupled Blades to Enhance the Performance of Horizontal Axis Wind Turbines

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Abstract

This paper reviews issues related to the use of aeroelastic tailoring as a cost-effective, passive means to shape the power curve and reduce loads. Wind turbine blades bend and twist during operation, effectively altering the angle of attack, which in turn affects loads and energy production. It is possible to build a small amount of desirable twisting into the load response of a blade with proper asymmetric fiber lay up in the blade skin. The tailored twisting can create an aeroelastic effect that has payoff in either better power production or in vibration alleviation, or both. Several research efforts have addressed different parts of this issue. Research and development in the use of aeroelastic tailoring on helicopter rotors is reviewed. Potential energy gains as a function of twist coupling are reviewed. The effects of such coupling on rotor stability have been studied and are presented. Fatigue damage estimates due to turbulent inflow have been computed for rotors employing several different control schemes, with and without twist-coupled blades. Energy otput and maximum loads are also computed and compared.