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AEROELASTIC TAILORING IN WIND-TURBINE BLADE APPLICATIONS[1]

Paul Veers
Sandia National Laboratories
Wind Energy Technology Department
Albuquerque, New Mexico, 87185-0708

Gunjit Bir
National Renewable Energy Laboratory
National Wind Technology Center
Golden, Colorado, 80401-3393

Donald Lobitz
Sandia National Laboratories
Structural Dynamics Department
Albuquerque, New Mexico, 87185-0439

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. There are blades now in use that have significant aeroelastic couplings, either on purpose or because of flexible and light-weight designs. Since aeroelastic effects are almost unavoidable in flexible blade designs, it may be desirable to tailor these effects to our advantage. Efforts have been directed at adding flexible devices to a blade, or blade tip, to passively regulate power (or speed) in high winds. It is also 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. (Such coupling is akin to distributed δ_3 without mechanical hinges.) 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 here. The ability to design in twist coupling with either stretching or bending loads is examined also.

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