Maximizing the Performance of Wind Turbines with Nonlinear Aeroservoelastic Power Flow Control

Rush D. Robinett, III and David G. Wilson
Sandia National Laboratories, Energy, Resources & Systems Analysis Center,
P.O. Box 5800, Albuquerque, NM 87185

***Abstract*— Maximum energy and power can be generated by a wind turbine by operating at the edge of dynamic stall. This paper applies a novel nonlinear power flow control technique to the nonlinear stall flutter problem that occurs when the wind turbine passes into dynamic stall. A nonlinear aerodynamic and structural model is developed that is representative of the first torsional mode of a nominal 5 MW rated power wind turbine blade. This model is analyzed using the power flow control technique to determine the limit cycle behavior of the nonlinear stall flutter condition of the first torsional mode. This model is further analyzed to determine the effectiveness of feedback control to generate nonlinear flutter suppression to ensure stability while maximizing the performance of the wind turbine. In addition, the limit cycle is shown to be a stability boundary for the nonlinear system.**