ERC Seminar

Jonathan W. Naughton
Professor of Mechanical Engineering and Director, Wind Energy Research Center, University of Wyoming

February 5th, 2013
USU Granada Room, 11 am to 12 noon

Wind Energy and the Importance of Technology Development: Characterizing the Unsteady Aerodynamics of Wind Turbine Blades

Over the past decade, wind energy has become an important contributor to electricity generation in the United States. There are currently over 50 GW of installed wind power in the United States that accounted for more than 3.4% of the electricity consumed in the U.S. during 2012. Despite the recent success of wind energy worldwide, there are still many aspects of generating electricity from wind that we don't fully understand. Improving our understanding and applying this understanding to wind turbine and wind farm design would enable lowering the cost of energy and thereby make wind-generated electricity an increasingly attractive option.

As an example of where our understanding falls short, the unsteady aerodynamics associated with wind turbines will be discussed. Wind turbine blade flows are inherently unsteady due to the atmospheric environment in which they operate. Wind shear (velocity increasing with height), wind turbine yaw, and atmospheric turbulence all contribute to this unsteadiness. Despite the importance of unsteadiness, wind turbine blades are designed using airfoil data obtained in steady wind tunnel flows with corrections that attempt to capture the unsteady effects. The accuracy of these corrections is difficult to assess without experimental data with which to compare. As a result, an experimental study to characterize the effects of the unsteadiness on wind turbine blade flows was undertaken using dynamically pitched airfoils. Selected airfoils from the DU series airfoils developed by TU-Delft were investigated in a wind tunnel at the University of Wyoming. This presentation will discuss some of the challenges of carrying out such measurements, and current results will be presented. The results indicate that complex behavior is observed in these flows that can aid in understanding wind turbine performance. Data sets like that generated in this study will be critical to validating computational tools that promise to improve the means by which we design wind turbines.

Sponsored by the Graduate Studies, Research and International Programs and ASME student chapter