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Dynamic Surface and Flow-Field Measurements of a Pitching Wind Turbine Blade[1] JOHN STRIKE, MANJINDER SINGH, MICHAEL HIND, JONATHAN NAUGHTON, University of Wyoming — Dynamic pitching is used to study the unsteady aerodynamics of wind turbine blade airfoils. The dynamic flow field is characterized in a wind tunnel using surface pressure measurements coupled with Particle Image Velocimetry (PIV). To obtain the unsteady pressure distribution, a 10.16 cm chord DU97W-300 airfoil with 32 pressure ports has been coupled to a pressure transducer module through 1.07 m of 0.86 mm diameter tubing. Pressure data sampled at 500 Hz are used to estimate the unsteady surface pressure utilizing an optimal Wiener deconvolution method. PIV images are systematically acquired at different phases of the airfoil pitching cycle, and Proper Orthogonal Decomposition (POD) is used to reconstruct the unsteady flow field. To compare the current setup with previous studies that use the same airfoil geometry, pressure measurements are taken at a fixed angle of attack. The airfoils are then oscillated about mean angles of attack and amplitudes and frequencies up to 15 Hz that reflect the angle of attack range and reduced frequencies associated with wind turbines in the field. The combined measurements capture the links between flow-field structure and the observed surface pressures.

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