Research in aeroelasticity EFP-2007 - DTU Orbit (11/01/2019)

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This report contains results from the EFP2007 project Program for Research in Applied Aeroelasticity. The main results from this project are: The rotor aerodynamics were computed using different types of models with focus on the flow around the tip. The results showed similar trend for all models. Comparison of 3D CFD computations with and without inflow shear showed that the integrated rotor thrust and power were largely identical in the two situations. The influence of tower shadow with and without inflow shear showed significant differences compared to BEM computations, which gives cause for further investigation. 3D CFD computations showed that the flow in the region of the nacelle anemometer measured the flow angle in the wake with errors up to as much as 7 deg. relative to the freestream flow angle. As long as the flow over a blade remains attached there is little difference between 2-D and 3-D flow. However, at separation an increased lift is observed close to the rotational axis. A correlation based transition model has been implemented in the incompressible EllipSys2D/3D Navier-Stokes solver. Computations on airfoils and rotors showed good agreement and distinct improvement in the drag predictions compared to using fully turbulent computations. Comparing the method of Dynamic Wake Meandering (DWM) and IEC, the IEC model seems conservative regarding fatigue and extreme loads for the yaw, driving torque and flapwise bending, whereas the loads on tower and blade torsion are non-conservative. An experimental method for measuring transition point and energy spectra in airfoil boundary layers using microphones has been developed. A robust and automatic method for detecting transition based on microphone measurement on airfoil surfaces has been developed. Transition points and the corresponding instabilities have clearly been observed in airfoil boundary layers. Predictions of the transition points on airfoils using the en method were in good agreement with measurements. The Riso-DTU airfoil design methodology was verified and showed that airfoils can be designed with very high lift-drag ratio, insensitivity of cl,max to leading edge roughness and differences in turbulence intensity, relatively high stiffness and high compatibility.

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