1. MOTIVATION

NTNUs Blind Tests on turbine performance have shown significant uncertainties in predicting turbine performance.

The highest uncertainties have been found for Turbine 2 operating in the turbulent wake of an upstream turbine.

Need for a database of aerodynamic lift and drag coefficients for various Re-numbers taking into account different turbulence levels in the incoming flow

More accurate prediction of wind turbine performance

2. METHODS

Surface and wake pressure measurements on 2D airfoils in the wind tunnel

Wind tunnel experiments
  - Multi-channel dynamic pressure measurements up to 30kHz
  - Pressure distribution on wing surface and in airfoil wake
  - New 2D NREL S826 wing section under construction
  - Initial test measurements on a symmetrical NACA0015 airfoil

Numerical simulations
  - Xfoil is a 2D panel method that predicts airfoil performance including the effect of changing the turbulence level in the incoming flow

3. INITIAL RESULTS

3.1. EFFECT OF TURBULENCE IN INCOMING FLOW

Effect of increased turbulence level in incoming flow on 2D airfoil performance is used to investigate influence on 3D rotor power production

Significant influence on turbine performance

3.2. DYNAMIC PRESSURE MEASUREMENTS ON AN AIRFOIL

Wind tunnel study on dynamic surface pressure fluctuations on a NACA0015

Large variations in experimental results of lift coefficient C in stall region (a)

Significant dynamic lift fluctuations in lift between a=12°-16° observed (b)

Visualization of surface pressure fluctuations in transition and deep-stall

Major fluctuations near the suction side’s leading edge in transition region (a=12°)

Hardly any pressure fluctuations for attached flow (a=11°) and deep stall (a=20°)

REFERENCES