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STUDY OF THE AERODYNAMIC PROPERTIES OF A WIND VAWT TURBINE BLADE AND EVALUATION OF THE EFFECT OF THE PITCH CONTROL

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► **To cite this version:**

Bouzidi Akram, Hubert Branger, Benoit Paillard, Sukanta Roy, Luneau Christopher, et al.. STUDY OF THE AERODYNAMIC PROPERTIES OF A WIND VAWT TURBINE BLADE AND EVALUATION OF THE EFFECT OF THE PITCH CONTROL. 13th EAWC on Wind Energy, Sep 2017, Cranfield, United Kingdom. 2017. hal-01629721

HAL Id: hal-01629721

<https://hal.science/hal-01629721>

Submitted on 6 Nov 2017

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Abstract

The recent growth of the offshore wind energy market has significantly increased the technological importance of the offshore vertical axis wind turbines (VAWT), with Pitch Control both as floating or fixed installations .

The project AEROPITCH co-investigated by EOLFI, CORETI and IRPHE aims at the development of a robust and sophisticated offshore VAWT .

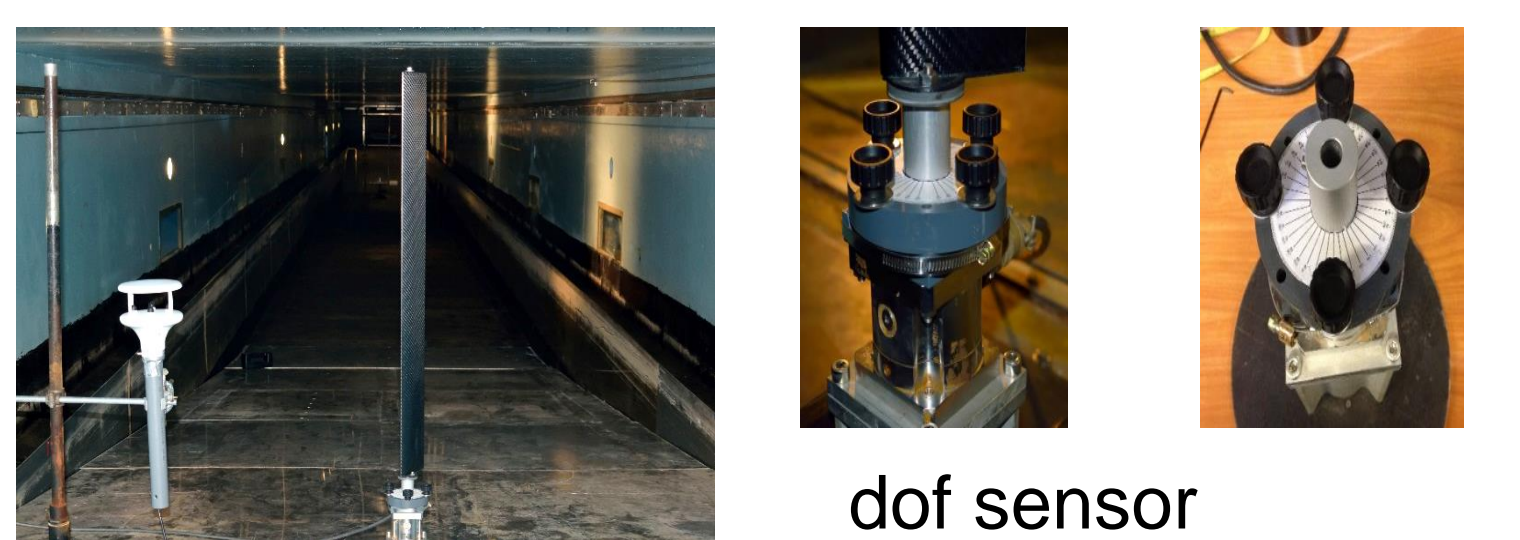
In this context through the AEROPITCH project, we have developed and tested VAWT models through analytical, numerical and experimental approach.

Context and Objectives

- ✓ Exploring the possibility of VAWT for offshore wind turbine applications with Pitch Control
- ✓ Wind tunnel experiments of VAWT with pitch control
 - Design of a vertical axis wind turbine
 - Development of pitch control law
 - Testing of vertical axis wind turbine with and without pitch control

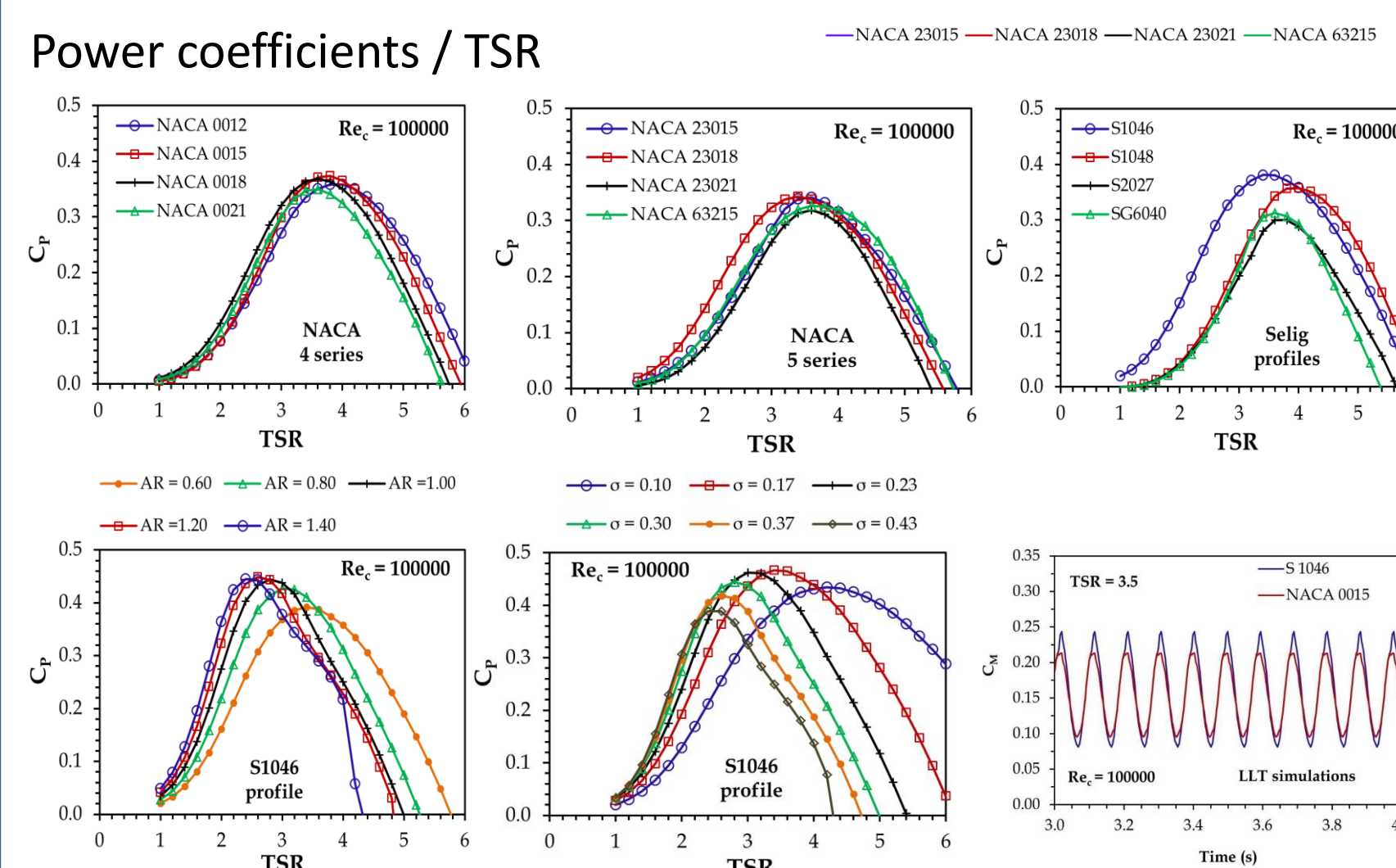
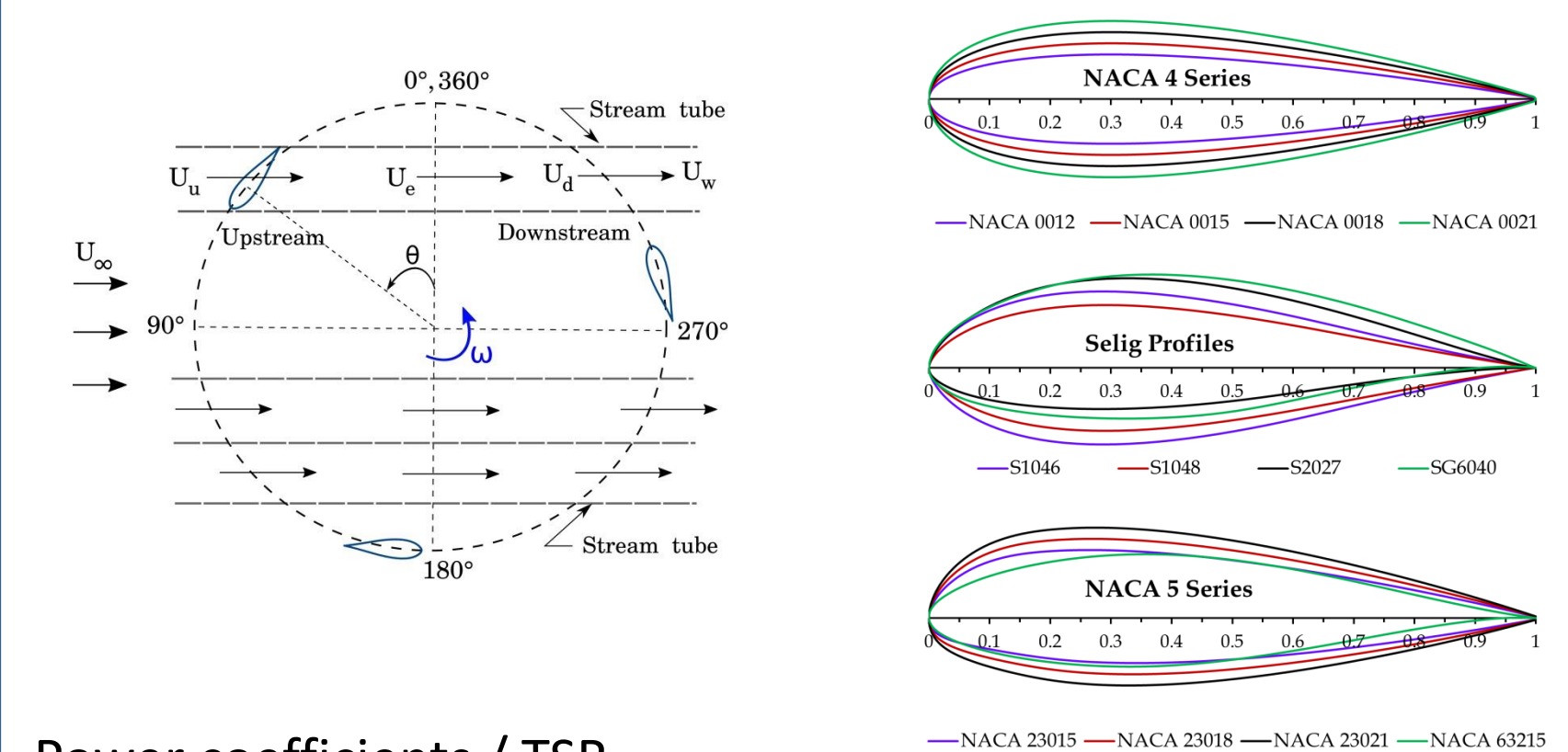
Methods and Materials

- ✓ Simulations through unsteady CFD, unsteady LLT, steady state DMST
- ✓ Wind Tunnel Experiments, forces and momentum sensors, Hot wire velocimetry, PIV

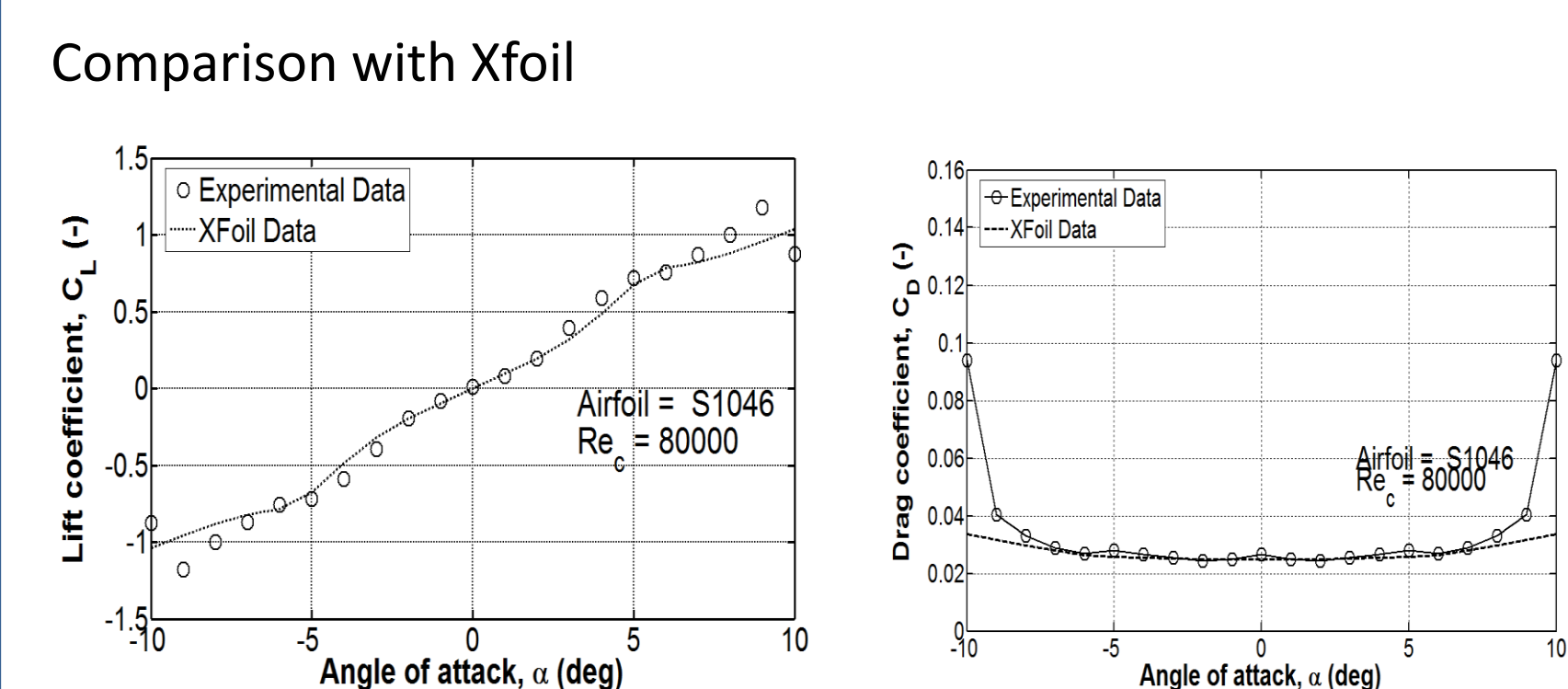
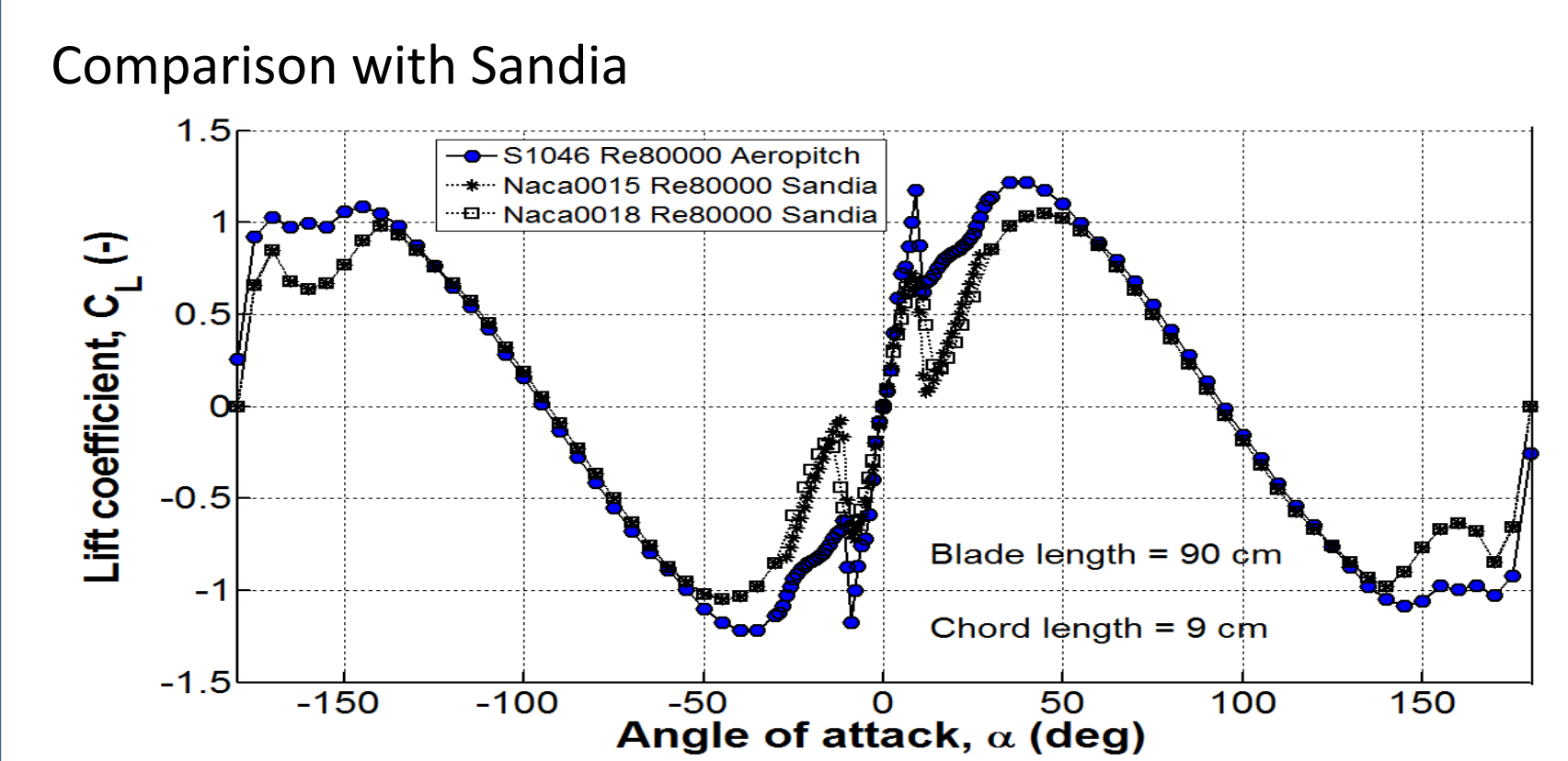
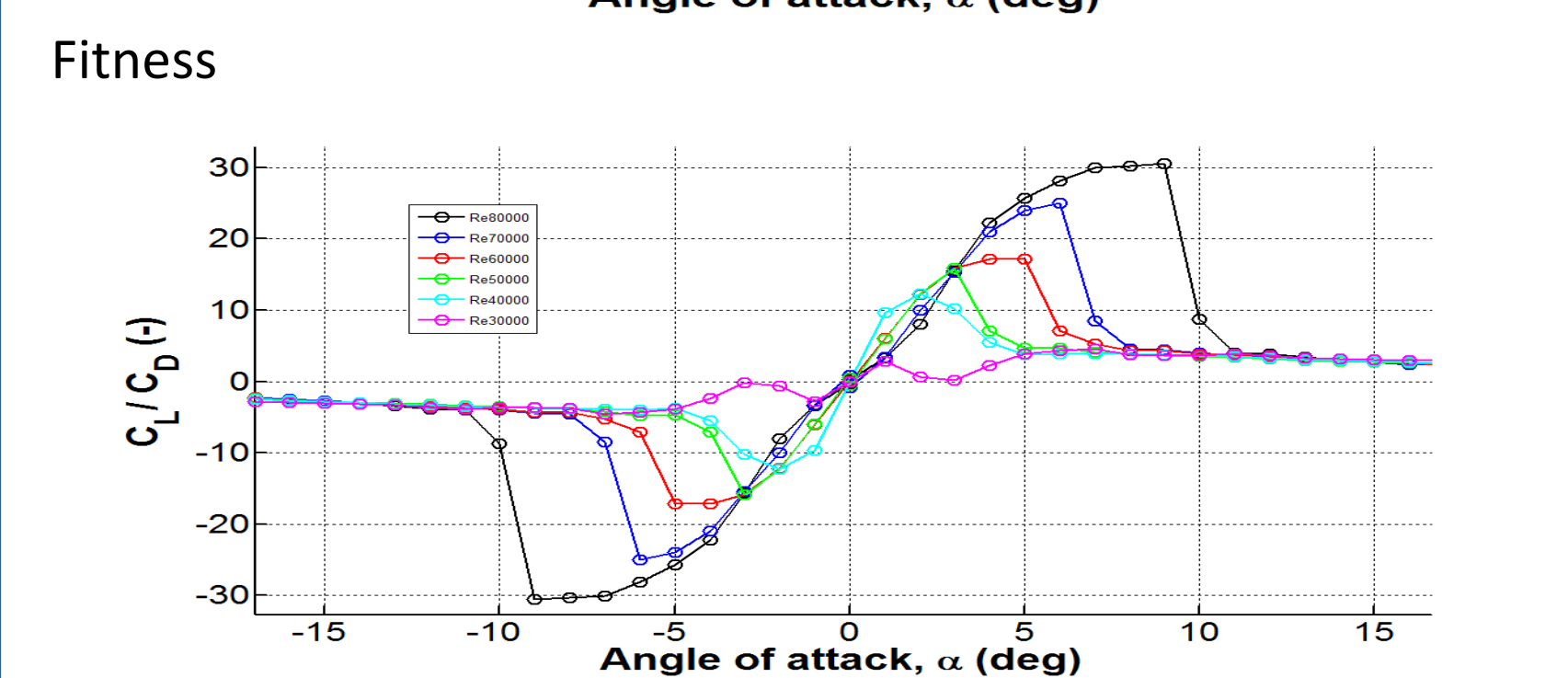
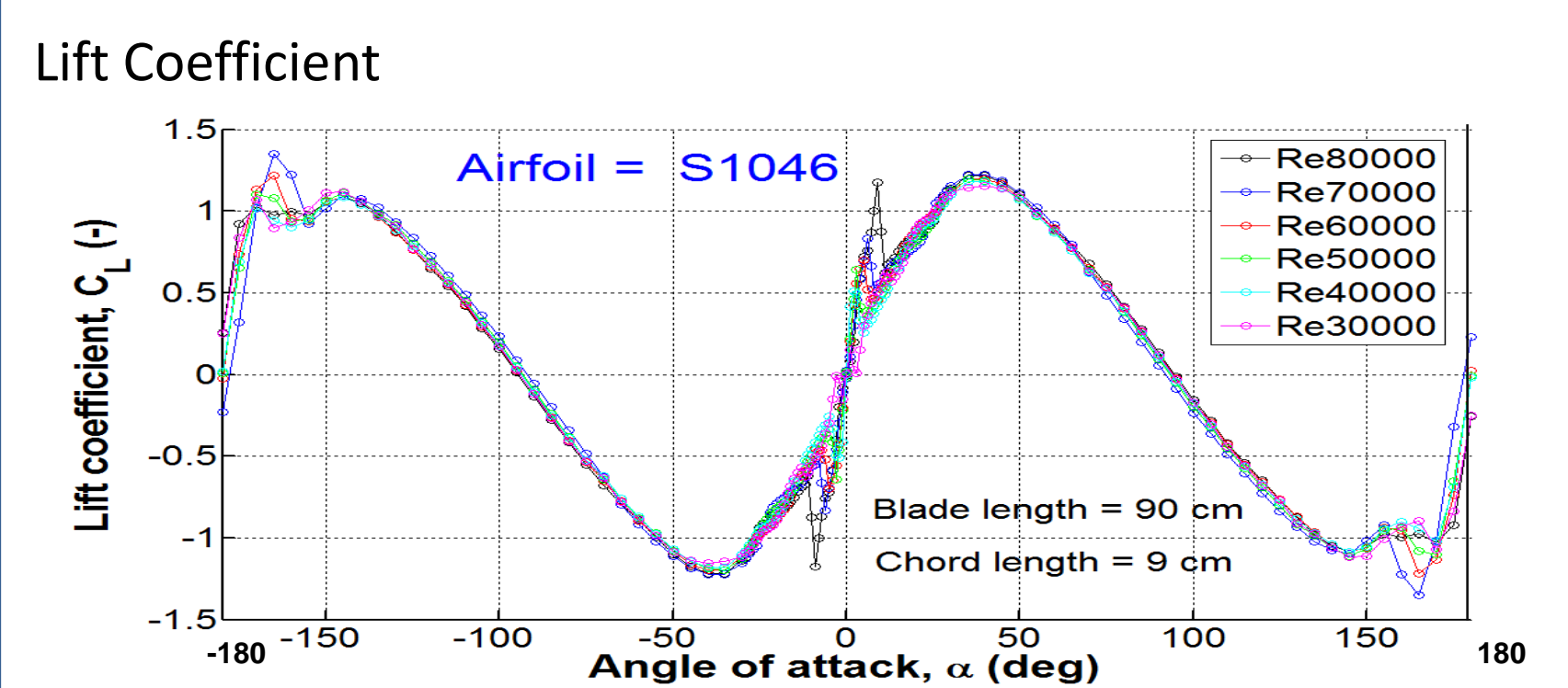
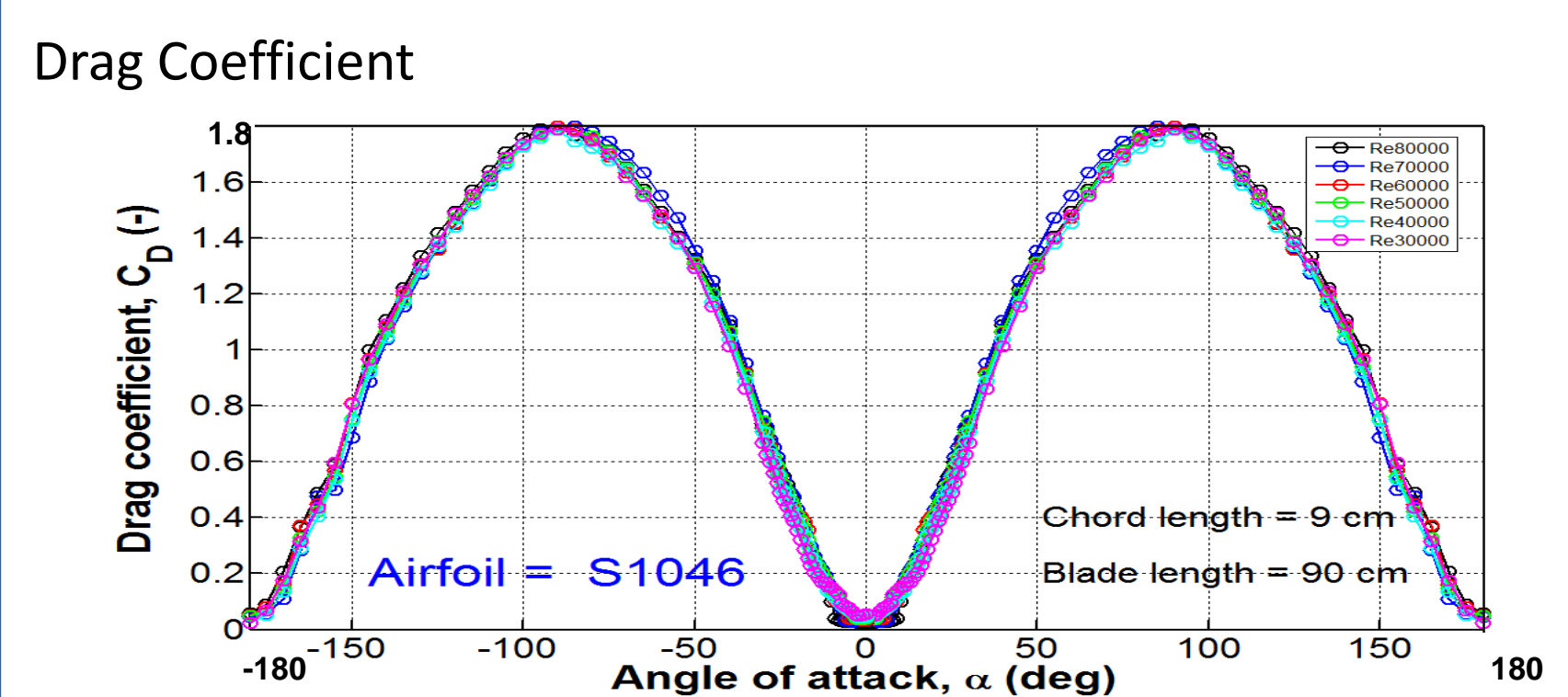


Results

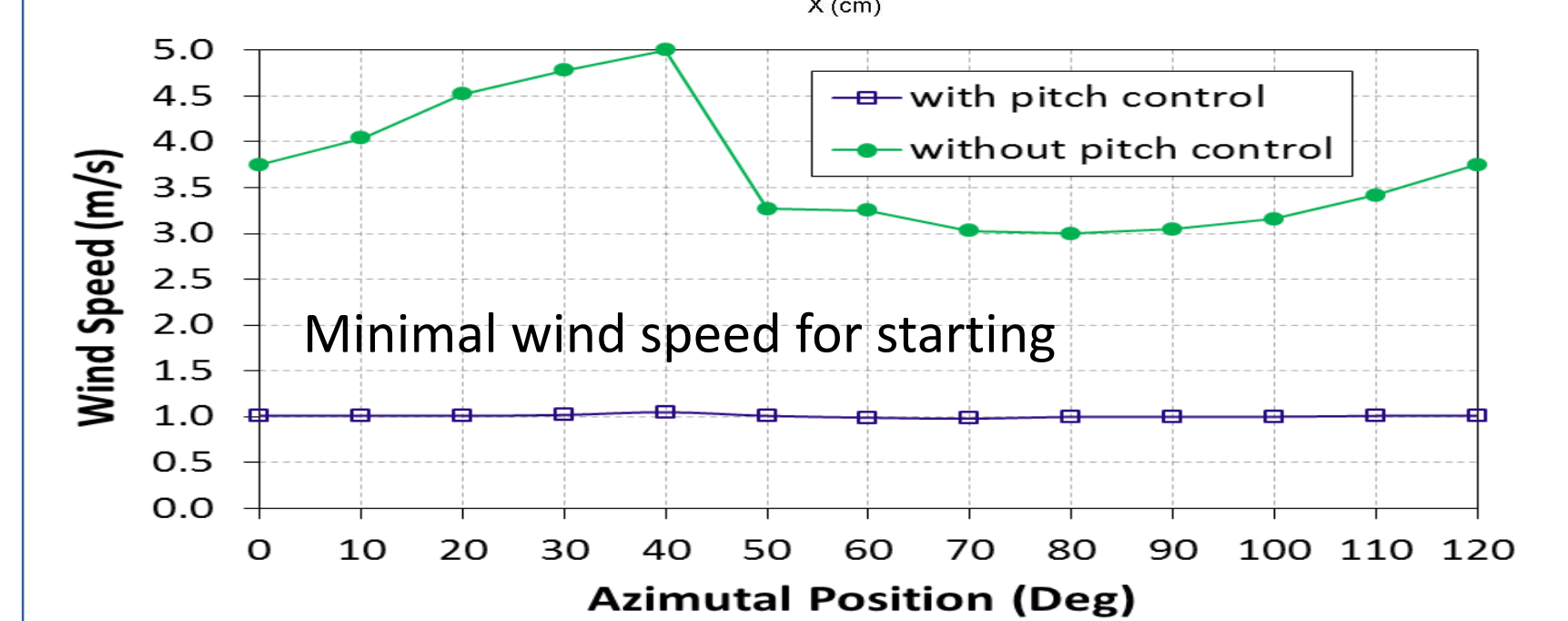
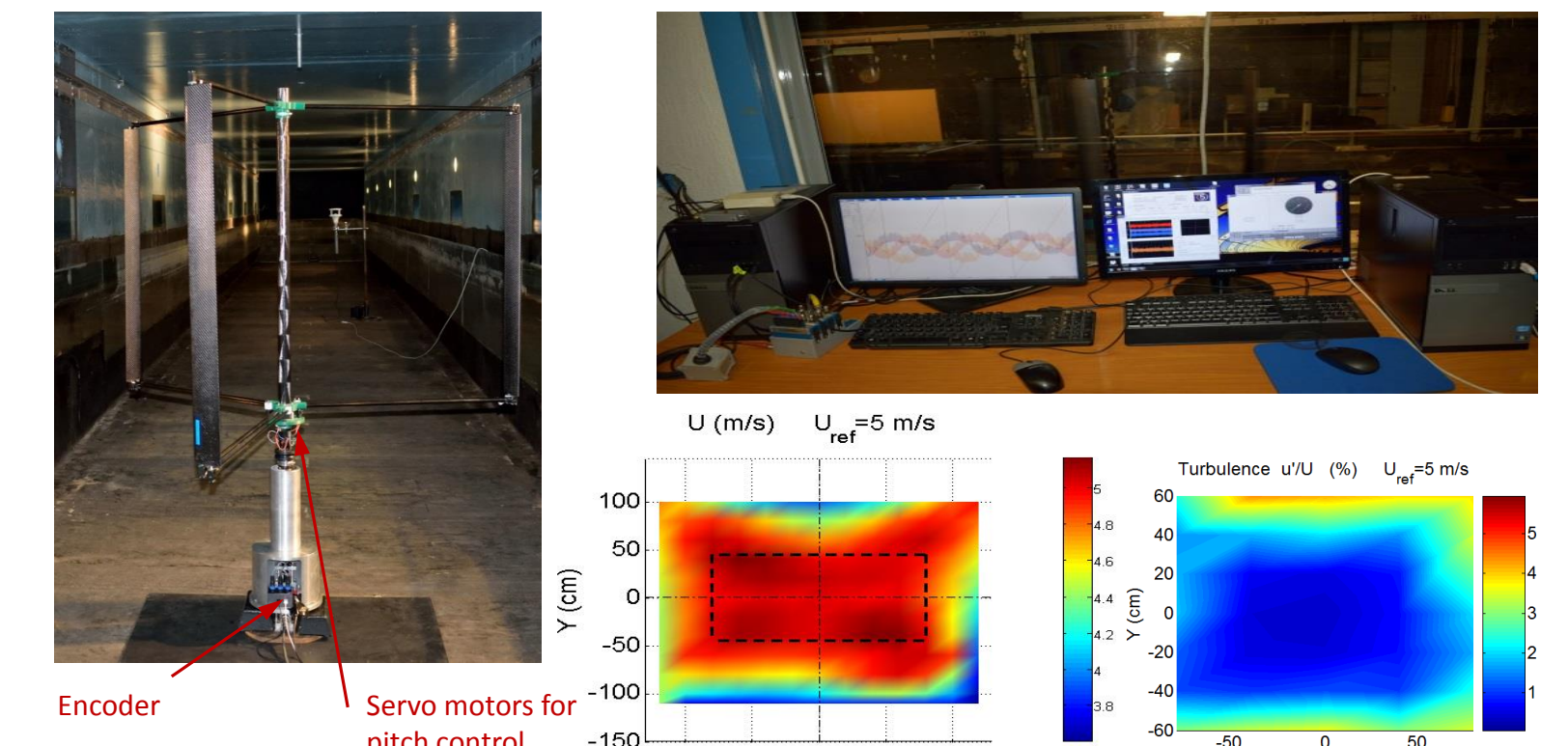
• Selection of Blade Profiles



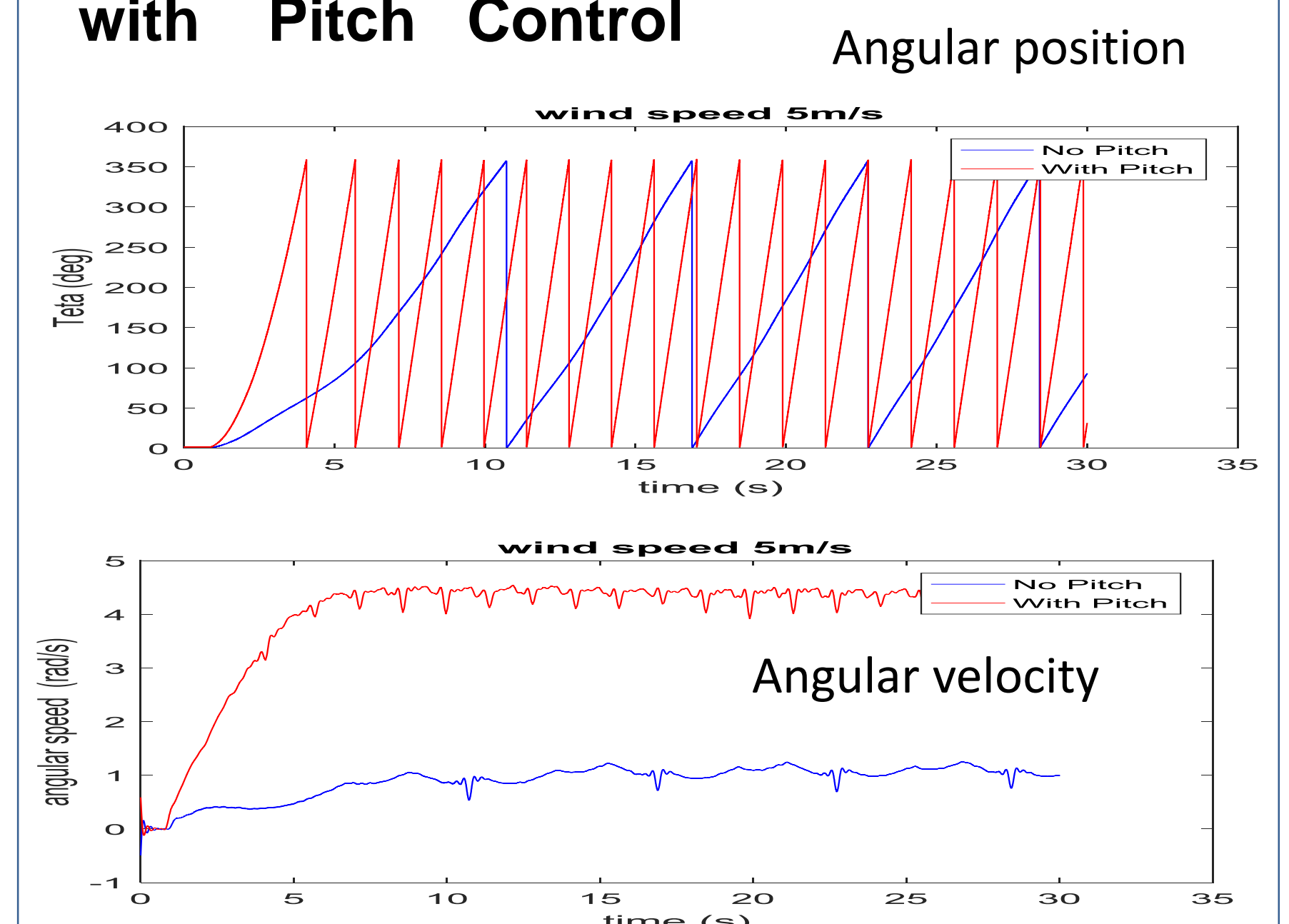
• Aerodynamic force calculation on S1046



• Starting Characteristics Study with Pitch Control



• Dynamic Characteristics Study with Pitch Control



To be continued...

Conclusion

- ✓ Numerical and experimental study on a VAWT model with Pitched Blades
- ✓ DMST is a very fast processing tool for a comparative analysis among large number designs and conditions with lower order accuracy
- ✓ Selig profile S1046 has the best characteristics for the wind tunnel experiments at target chord Reynolds numbers in the range of 60 000 to 140 000
- ✓ Experimental results using our VAWT model with S1046 blades are in accordance with Xfoil numerical results and Sandia experiments with Naca 0015 blades
- ✓ The pitch control divides the start speed by a factor 4 !
- ✓ The pitch control multiplies the performance of the wind turbine by a factor 4

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