Rotor/ABL Aerodynamics, TASK-1 plus more

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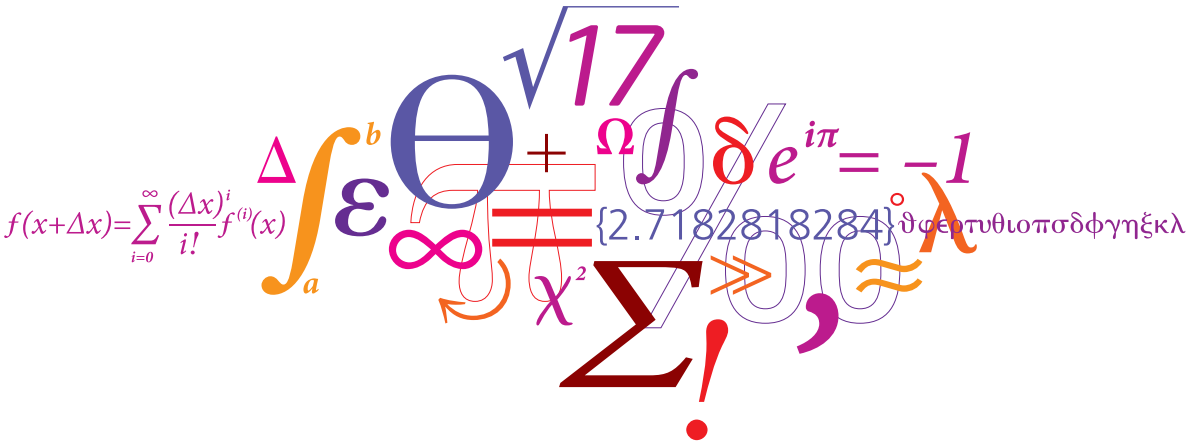
DTU Wind Energy, 11-04-2012



Outline

1. Description of Task-1
2. Milestones
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Description of Task-1

Task-1

Focus on CFD computations using the resolved geometry of the rotor, with large scale effects in the form of turbulent inflow and yaw, and blade scale laminar/turbulent transition.

The original plan was to base the work on the DAN-AERO and Siemens Boulder exp.

Expected results:

Comparison of state of the art turbulence models with multi-scale aerodynamic data. Development of phenomenological 'engineering' models describing dynamic stall and yaw.

Partners (Risø-DTU, LM-Glasfiber, Mek-DTU, Siemens, Vestas)

Milestones

Task-1

The following milestones were defined within the present package, or are related to the work

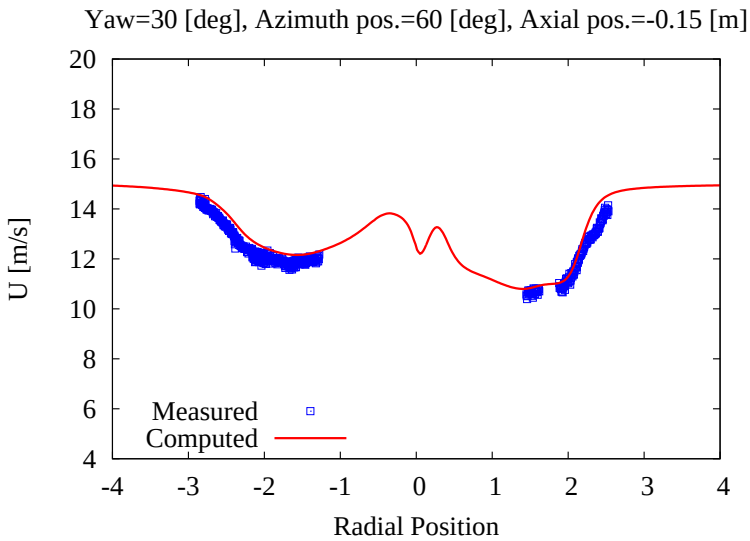
- M1: Parametric study of two modern turbines in atmospheric shear. **Month 12**
- M2: Evaluation of the importance of cross flow instabilities for modern wind turbine rotors. **Month 24**
- M3: Parametric study of two modern turbines in yaw. **Month 24**
- M4: Development of refined 'engineering' yaw model. **Month 36**
- M5: Evaluation of dynamic stall models and airfoil characteristics with respect to dynamic inflow and inflow turbulence. **Month 48**
- M6: Simulation of various unsteady inflow conditions for the NM80. **Month 36**
- M12: Parametric study of wake/wake interaction between two or more turbines. **Month 36**

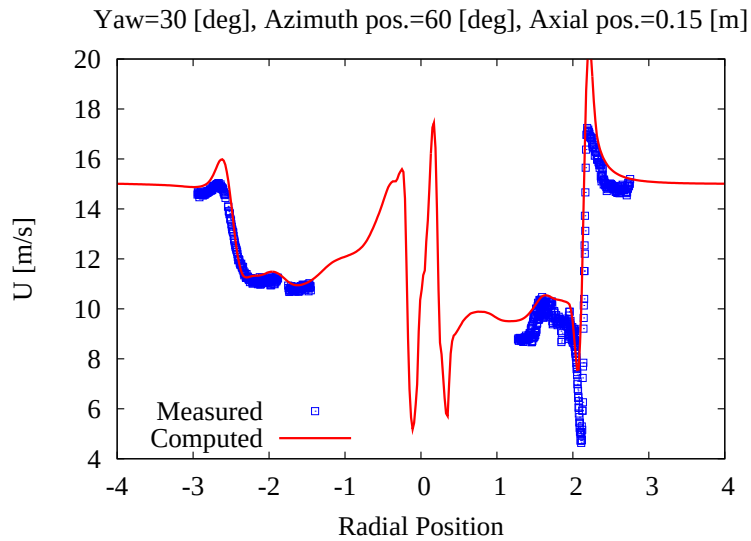
Actual activities, 2009-2011

- Mexico axial flow cases, investigating differences with measurements
- Mexico yaw cases
- NREL Phase-VI dynamic stall computations during standstill
- Rotors in partial wake and in shear
- Identifying and extracting data sets from the DAN-AERO exp.
- Comparison of AD, AL and CFD with RG
- Computation of CFD of RG using turbulent inflow
- Grid generation for rotors

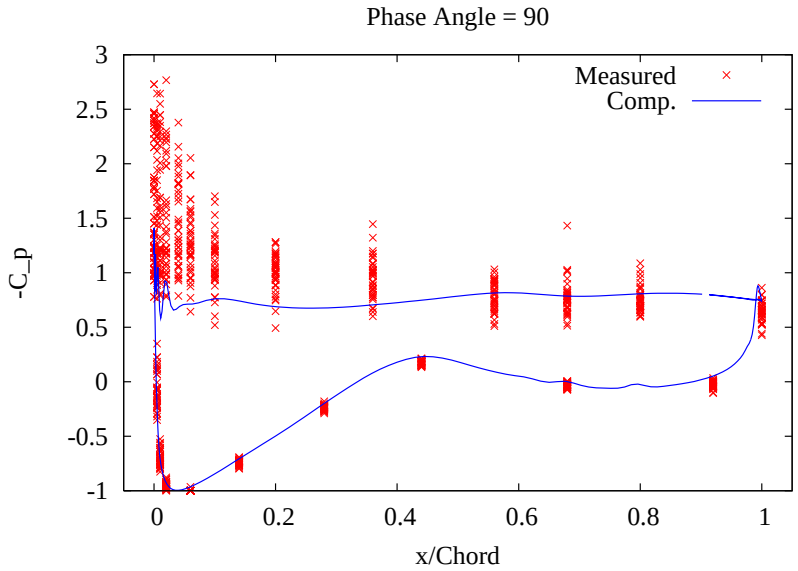
MEXICO, yaw angle 30 degrees, 15 m/s

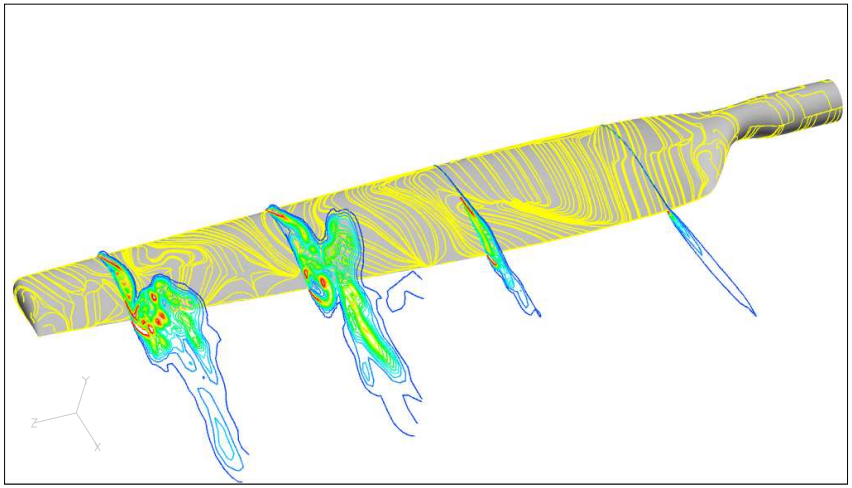
Up and downstream radial traverses in the horizontal plane
Rotor azimuth position=60 deg.

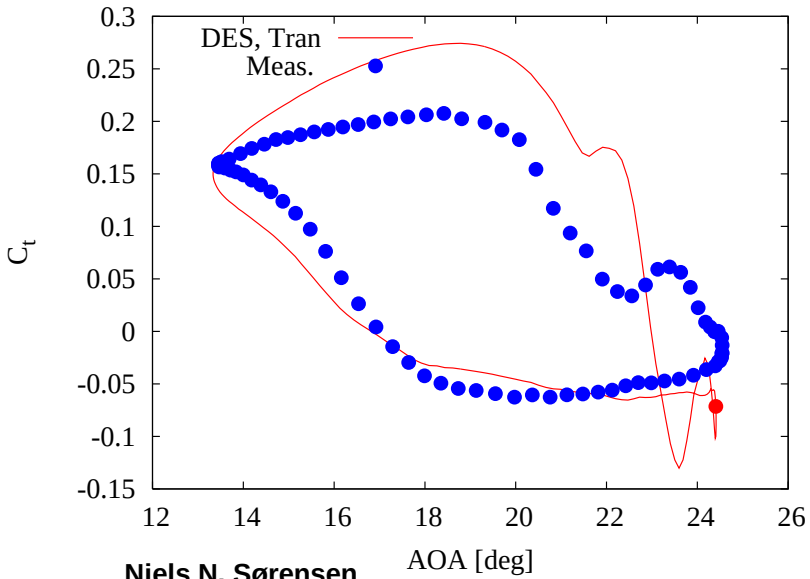


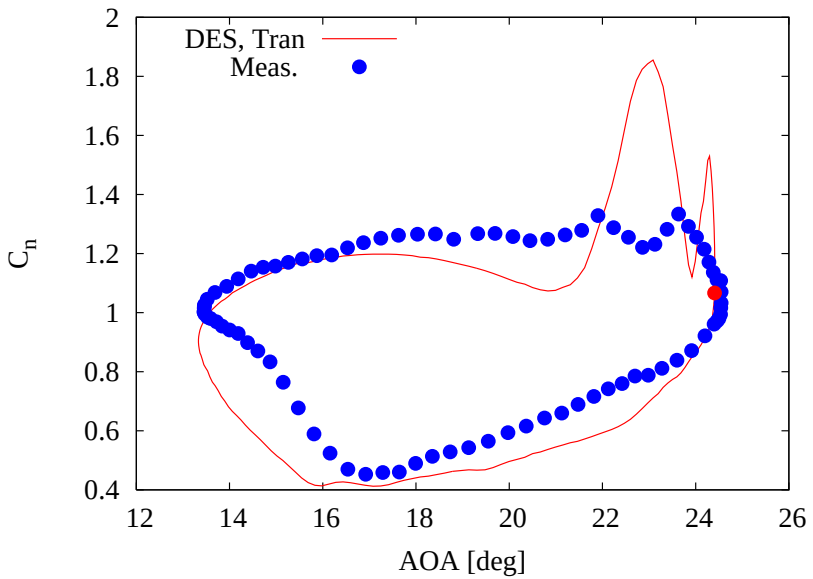


Dynamic Stall, NREL Phase-VI Standstill, r/R=0.80



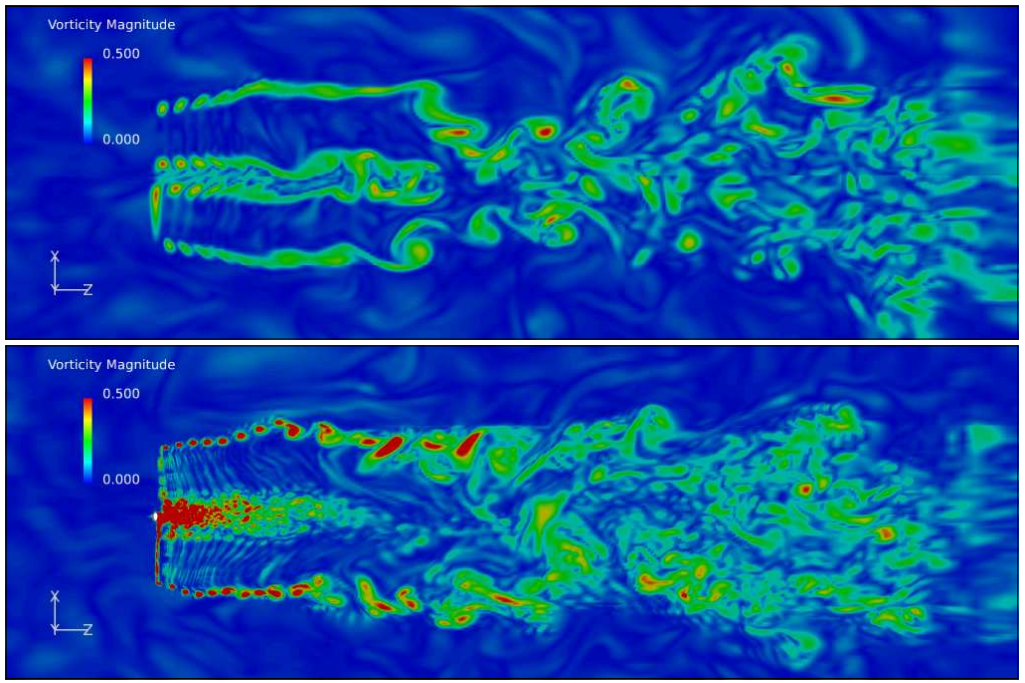






Comparison of GR, AD and AL technique

Comparison of AL and GR rotor computations in turbulent inflow.
AL top, GR bottom.



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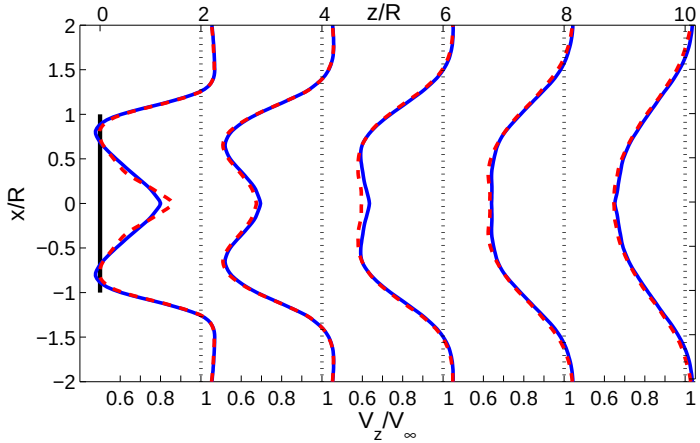
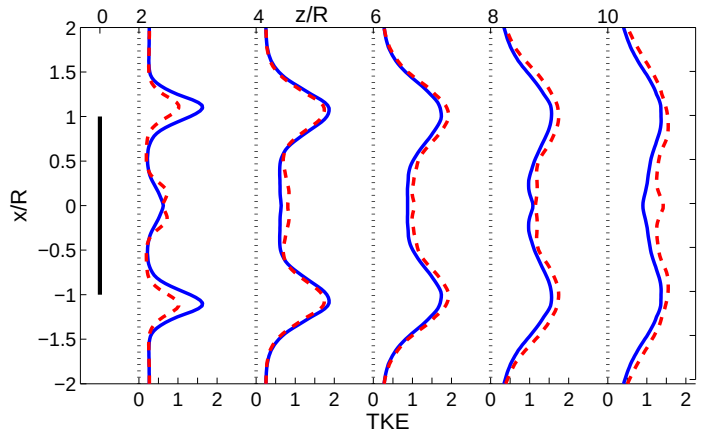
Comparison of GR, AD and AL technique

Comparison of AL and GR rotor computations in turbulent inflow.
AL in blue, GR in red.





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Planned activities 2012

The focus will be on catching up on the delayed milestones for CFD simulations with resolved geometry, M1, M2 and M3.

- Mesh generation for the NM80 and Siemens rotor, March-April.
- Parametric computations of rotors in atmospheric shear for the milestone M1, April-May.
- Study of the influence of transition, milestone M2, May-June.
- Simulation of the NM80 in unsteady inflow, M4, Sep-Dec.
- Yaw studies of two modern turbine, milestone M3, July-Sep.

Status on Ph.D. Enrolment

- Analysis of Wind Turbine Aerodynamics and Aeroelasticity Using Vortex Based Methods, April-May 2012.
- Multiple Wind turbine Wakes, 01-11 2011.
- Flow of air over complex forested terrain, 01-11 2011.
- Development of Efficient Turbulence Models for CFD Wake Simulations, 15-12 2011.

International Dimension

- Close collaboration with NREL, regarding dynamic stall and static stall.
- Large effort to explorer the unique MEXICO data set, in close collaboration with ECN.
- Participation in the Wake Bench project.
- Participation in the MexNext II project.
- Plans for participation in the new INNWIND European project.

Other Business

- Activities have been delayed due to confidentiality issues.
- We have settled the business with Vestas regarding the terrain/forrest modelling, but implementation at Vestas is still pending.
- There is a strong synergy between the activities in the flow center and the activities in the Wasp-CFD project.