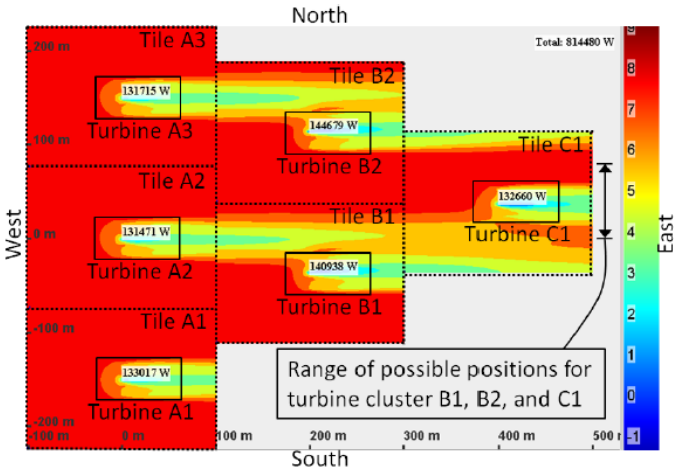
January 2013

MODEL REDUCTION TECHNIQUES FOR FAST AND ACCURATE WIND FARM MODELING

Scientists at Christian Michelsen Research are developing tools for fast and accurate wind farm modeling through reduced solving of CFD models. The model reduction technique (MRT) offers the speed of simplified wake models, but avoids the over-simplified assumptions these models are based on. MRT utilizes the governing equations used in CFD models and access their solution. The in-house code CMR-Wind is used for generating the CFD snapshots MRT requires to set up the reduced model space. Within tenths of a second the MRT solution can be achieved, and the MRT tool computes the three-dimensional flow field for both wind speed and turbulent kinetic energy in addition to the power output from each turbine.

Access to the turbulence level in the wind farm is of great importance in order to decide the placement of the turbines and to plan for efficient control during operation. Short calculation time opens for evaluation of different turbine configurations, and hence the tool is useful for optimizing the wind farm layout.



Read more about this project at www.norcowe.no

DATABASE FOR NORCOWE MEASUREMENT DATA

NORCOWE's Database for measurement data – Metawind – is now open for use and several different datasets are already stored in the database. The purpose of the database is primarily a central storage of data sets from measurements by NORCOWE equipment. Metawind is based on Met.no's METAMOD web application and a separate conversion tool called NORDC (NORCOWE Data Conversion) developed by CMR Computing. The converted data format, NetCDF, is an open and extremely flexible file format for arbitrary numerical data in related series.

NetCDF files are self-describing in two levels:

1) General metadata such as description of context, purpose, origin, and application of the data collected in the file.

2) Specific metadata for each data series; tags with names and units.

Currently the following raw data types are supported by the NORDC release: LIDAR text format data (STA format), LIDAR binary format data (RTD format), MAST data, Buoy data and SCAT (RSS QuikSCAT).

Support for more raw data types will be provided by NORDC when corresponding conversion routines are developed. Access to Metawind can be provided for all NORCOWE members. Please send an email to post@norcowe.no for more information.

UPCOMING EVENTS:

April 17: Science Meets Industry Stavanger. Key topics are *Green Battery, Deeper Waters* and *Innovation*. Full program and registration at www.norcowe.no
May 21-22: NORCOWE Work Package meetings.
May 28: Workshop "CFD for Wind Energy", Bergen.

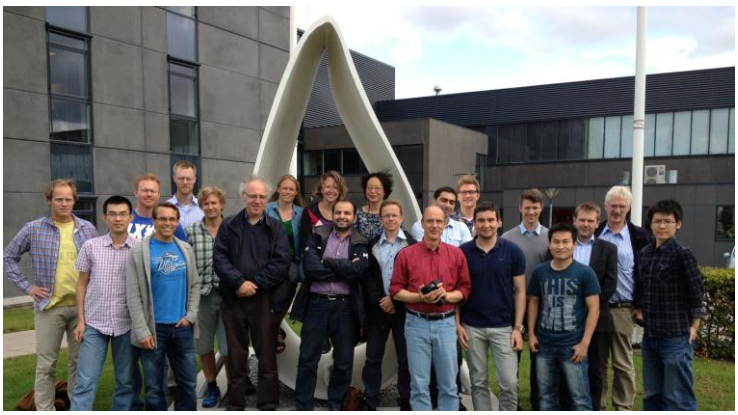
WIND TURBINE ALGORITHM FOR WRF BY UNI

Uni Research has developed and implemented a wind turbine algorithm for the Weather Research and Forecasting Model (WRF). WRF is an open source numerical mesoscale model, and this algorithm is now included in the current release of WRF. The algorithm is flexible with respect to turbine size (MW), rotor diameter, hub height and size/density of the wind farm. Documentation of the implementation is described in the paper *"Local and mesoscale Impact of Wind Farms as Parameterized in a mesoscale NWP model"* published in Monthly Weather Review, Vol.140, No. 9, 3017-3038.

NORCOWE SUMMER SCHOOL 2013

Who: *PhD students, second year master students and others with equivalent education/experience.*
Where: *Preikestolen Turisthytte, Stavanger*
When: *August 26-30 2013. Registration at www.norcowe.no.*
Organizing Committee: *Finn Gunnar Nielsen (Statoil, UoB), Jasna B. Jakobsen (UoS) and Birgitte Furevik (met.no).*

NORCOWE's summer school opens with an introduction to offshore wind energy, addressing key challenges related to meteorology, oceanography, design, maintenance and operation. The main part will address various aspects of geophysical and structural data. Data analyses methods will be presented and the use of observations to validate and verify models will be discussed. The topics will be addressed by lectures and teamwork.



Summer School 2012 visiting Siemens Blade Factory in Aalborg

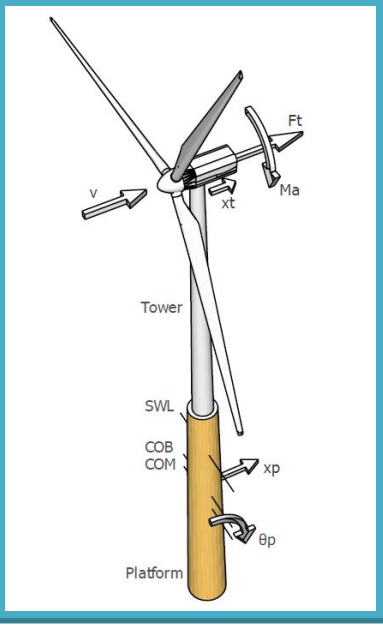
COMPLETED PHD THESIS

Søren Christiansen at Aalborg University has completed his PhD thesis, entitled *Model–Based Control of a Ballast–Stabilized Floating Wind Turbine Exposed to Wind and Waves.* Tentative date for the defense is March 6, 2013, and he is the third NORCOWE PhD student to complete his PhD.

Søren's work addresses the control of a floating spar buoy wind turbine with focus on the impact of the additional platform dynamics. In contrast to the bottom fixed wind turbine, a floating wind turbine is subject to not only aerodynamics and wind induced loads, but also to hydrodynamics and wave induced loads. The wave motions cause the platform to pitch forward, which results in an increase of the relative wind speed. With a conventional pitch control system, the blades will pitch to feather and damp the load, and decrease the rotor thrust. The result is an exacerbation of the platform motion. In control terms, conventional pitch control introduces a negative damping term resulting in large motion and loads.

To address the problem of negative damped fore-aft tower motion, additional control loops are suggested which stabilize the response of the onshore controller and reduce impact of the wave induced loads. The work is extended to model predictive control to address the wave disturbance further. In the context of control engineering, the dynamics and disturbances of a floating wind turbine have been identified. Objectives of maximized electrical power and minimized fatigue have been reached using advanced methods of estimation and control.

Illustration: *Forces and moments acting on a floating wind turbine.*



NORCOWE (Norwegian Centre for Offshore Wind Energy) is one of several Norwegian centers for environment-friendly energy research, funded by the Norwegian Research Council and industrial partners. For more info and contact address: *www.norcowe.no*.
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