NOWITECH Norwegian Research Centre for Offshore Wind Technology

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NEWSLETTER
September 2013

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EERA DeepWind'2014, Deep Sea Offshore Wind R&D Conference, 22-24 January, Trondheim, Norway

The conference has been developing every year since 2004, and is established as an important venue on deep sea offshore wind R&D. News for 2014 are that the conference is organized in association with the European Energy Research Alliance (EERA) sub-program on offshore wind energy, and being a three day event giving more time for presentations and networking.

The conference includes a mix of plenary presentations with broad appeal and presentations in parallel sessions on specific technical themes. Ample time is planned for oral and poster presentations, discussions and networking.

Boost your professional profile and recognition by submitting a paper abstract addressing any of the topics in the program. First authors of abstracts selected for presentation (oral or poster) are granted reduced fee for participation. More information available at Deepwind_2014. **Deadline for abstract submission is 1th November 2013.**

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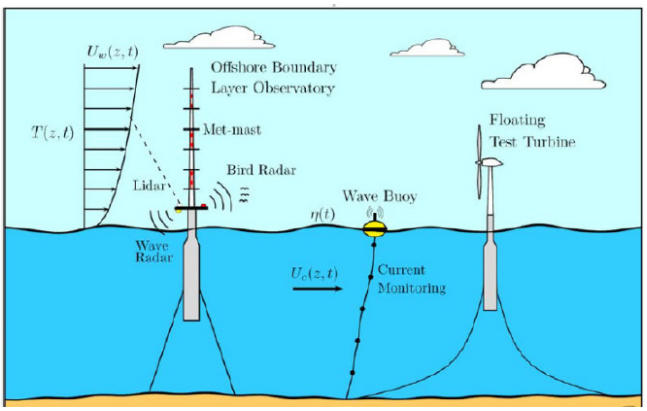
Industry meets Science: NOWERI progress

In the seminar series "Industry meets Science" progress of NOWERI was presented 6 June 2013.

The research partners of NOWITECH and NORCOWE cooperates on the realization of NOWERI. The Research Council of Norway (RCN) has a contract with NTNU on the wind turbine (42 MNOK) and with the University of Bergen on offshore met-ocean measurements (21 MNOK).



The funding from the Research Council of Norway for the investment in the lab is greatly appreciated.

Presentations from this and previous seminars in the series are available at http://www.sintef.no/Projectweb/Industry-meets-science/.

The next seminar is planned for 30 October 2013, Trondheim. Details will follow on NOWITECH web.

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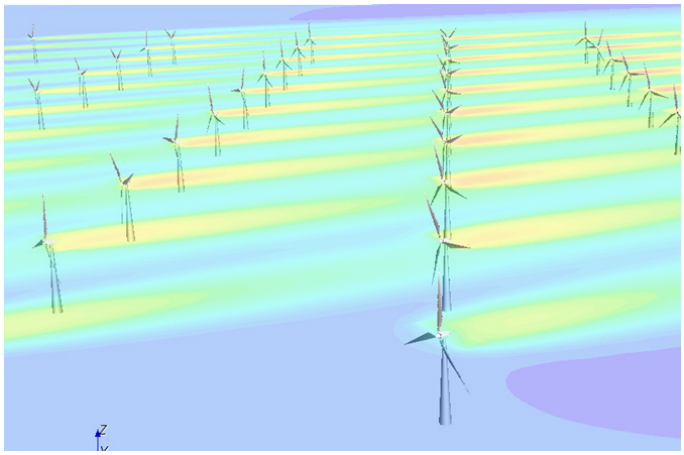
CD-adapco new partner in NOWITECH

Computational Dynamics Ltd – located in the UK - along with Analysis & Design Application Co. Ltd – located in the US – is a new partner in NOWITECH.

Together they are trading under the name CD-adapco. CD-adapco is the world's largest independent CFD-focused (Computational Fluid Dynamics) provider. Their software – STAR-CCM+ provides a comprehensive engineering physics simulation for solving problems within flow, heat transfer and stress.

CD-adapco will be hosting a complimentary training course on their STAR-CCM+ software for CFD for NOWITECH members in Trondheim 21-22 October 2013. The purpose is to learn how to use CFD software to simulate flows associated with offshore wind turbines. Examples include hydrodynamics including floating bodies, wave effects, and moorings as well as aerodynamics such as wake effects from multiple turbines. Space is limited - register here today and logging in to your CD-adapco account; if you don't yet have an account, it is easy to create one at no cost.



Simulation result of wind farm by CD-adapco

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Hans Christian Bolstad new Centre Manager in NOWITECH

Hans Christian Bolstad started as new Centre Manager in NOWITECH 5th August 2013.

Hans Christian Bolstad comes from a position as Head of Development in Q-Free ASA. He has previously been working with Optoplan and Optomed as Head of Product Development, and with SINTEF Electronics and Cybernetics as Research Director. Hans Christian has long experience in management of research and development from different sectors, including telecom, medicine, oil and gas, and projects with private and public funding, including the Research Council of Norway and the European Commission. He holds a MSc (1987) and a PhD (1994) from NTNU. Hans Christian takes over the position after Nils Arild Ringheim that started with Statnett 1 April 2013.

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Jens Kjær Jørgensen new work package manager for WP2 – Energy conversion system

Jens Kjær Jørgensen (38) has replaced Bernd Schmid as leader of NOWITECH WP2.

Jens has worked 8 years as researcher in SINTEF Materials and Chemistry in the field of application and performance of polymer and composite materials. From before he has a Ph.D. in polymer materials science. The focus of WP2 is wind turbine blades and gearless generators. Jens has participated in the work of WP2 related to blades and composites materials the last three years, and in addition represents SINTEF in EERA Wind subprogram Structures and Materials. He looks forwards to define and participate in the work in WP2 for the remaining years of NOWITECH, and to corporate with the management.

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Successful PhDs within wind energy from NTNU 2013

Seven PhD dissertations on wind energy aspects have been defended successfully at NTNU in 2013. Among topics are environmental and system aspects, converter, HVDC transmission, pitch control and gearbox modeling. The brief descriptions below are excerpts of their dissertation that can be found through the NTNU search portal DiVA.

The Scientific Committee of NOWITECH coordinates the PhD students within wind energy at NTNU. The seven PhDs listed below are associated to NOWITECH, but funded by other sources.

Contact persons in NOWITECH: Trond Kvamsdal, Chair Scientific Committee (Trond.Kvamsdal@math.ntnu.no)

Successful PhDs within wind energy from NTNU 2013

Aigner, Tobias: System Impacts from Large Scale Wind Power
Department of Electric Power Engineering

The objective of the European Union to increase the share of renewable energy sources and Wind Power Production in particular, will be a severe challenge for the power system. Unscheduled production changes and remaining forecast deviations will require more control actions and a tighter interconnection between areas. To benefit from distributed generation and geographical smoothing, grid reinforcements and the commissioning of new cross-border interconnections will be necessary. Furthermore, a regulatory framework to exchange energy across country borders has to be established. This thesis studies the impacts of Wind Power Production on the European power system and proposes measures for its efficient and secure integration. These measures include a cost-optimal grid expansion in the European transmission system and the integration of intra-day and regulating power markets in Northern Europe and the Nordic area.

Arvesen, Anders: Understanding the Environmental Implications of Energy Transitions. A Case Study for Wind Power
Department of Energy and Process Engineering

A fundamental change in the ways in which we provide energy to run our economies, an energy transition, is needed to mitigate climate change. Wind power is an important part of future global energy supply in most energy scenarios. This thesis aims to contribute to a better understanding of the environmental implications of energy transitions, primarily by examining the case of wind power. This involves new investigations of both potential negative impacts of wind power and the positive role of the technology in emission reduction, as well as a critical review of past research. Three papers on wind power are presented: a comprehensive literature review of life cycle assessments (LCA) of wind power, a scenario-based LCA of large-scale adoption of wind power, and an LCA of an offshore wind farm. A hybrid LCA methodology is employed in the scenario-based LCA and LCA of an offshore wind farm. Another paper is presented which is not concerned with wind power in particular, but takes the form of an evaluation of limitations of climate change mitigation literature. It helps to achieve the aim stated above by bringing together knowledge of indirect effects of mitigation measures, and by elucidating how these effects may influence the viability of proposed mitigation strategies.

Jafar, Muhammad: Transformer-Less Series Compensation of Line-Commutated Converters for Integration of Offshore Wind Power
Department of Electric Power Engineering (current affiliation: DNV GL)

Wind energy is gradually becoming a major contributor to the overall energy production, especially in the developed world. This is because of the ever- increasing concerns about long-term availability of conventional fuels, global warming, and energy security. Wind power production is gradually moving offshore because of scarcity of onshore sites (particularly in Europe), environmentalists' concerns over noise and visual pollution, and better wind conditions out in the open sea. Offshore wind farms are generally located close to the shore currently in shallow waters. However, more power demand from wind will eventually put more and more wind farms farther out in the deep sea. This would require floating turbine and grid-integration platforms.

Successful PhDs within wind energy from NTNU 2013

Iguin, Raymundo E. Torres: Grid Integration of Offshore Wind Farms using Hybrid HVDC Transmission: Control and Operational Characteristics
Department of Electric Power Engineering (current affiliation: SINTEF)

The transmission of offshore wind energy is one of the most relevant challenges since the best wind conditions are located far from shore. High-voltage DC (HVDC) is the most feasible option for the grid integration of offshore wind farms if the distance to shore is relatively long. Currently, there are two different HVDC technologies: current source converter (CSC)-based HVDC and voltage source converter (VSC)-based HVDC. Among CSCs, the line-commutated converter (LCC)-based HVDC is a well established technology around the world. Few studies have been focused on the application of CSC to integrate offshore wind farms to the main grid. In particular for offshore applications, LCCs have some limitations, namely: the relatively large footprint, and the external commutation voltage required for proper operation. Nevertheless, LCC HVDC transmission has attractive features as well such as higher power capability, lower power losses, and lower costs compared with the other HVDC options.

Reiso, Marit: The Tower Shadow Effect in Downwind Wind Turbines
Department of Civil and Transport Engineering (current affiliation: Reinertsen)

Scarcity of land sites applicable for wind turbines is pushing the technology offshore. By going offshore the expenses of nearly all components increases, which has triggered extensive research with the aim of decreasing component costs, and increasing reliability, as also maintenance costs increase as going offshore.

The focus of this thesis is to look at ways to reduce aerodynamic loads which can contribute in lowering structural fatigue loads and thereby component costs for offshore wind turbines. The loading is mainly reported as blade root flapwise bending moment on wind turbines intentionally made for bottom fixed offshore sites. The load reduction is investigated using a different wind turbine configuration with a downwind mounted rotor and further compared with the conventional upwind mounted rotor on a monopile tower. Blades on downwind mounted rotors are exposed to the fluctuating wake behind the towers, known as the tower shadow. The influence from the tower shadow on blade fatigue loads is investigated using three different types of towers; a full height truss type tower, a faring (airfoil shaped) tower and a monopile tower.

Sandquist, Lars Fredrik: Individual Pitch Control for Large Scale Wind Turbines
Department of Civil and Transport Engineering

In this thesis a number of advanced control algorithms are developed and applied for use with large scale onshore and offshore wind turbines. Individual pitch control for wind turbines is a relatively recent development, and controllers need to be carefully designed. Algorithms are developed for both optimizing power productions and load mitigation, using various techniques and approaches. Individual pitch control methods for controlling the generator speed and blade flap motions are analysed in publications 1-3. The control methods evaluated are LQG control, diagonal control, gain scheduling and $H\infty$ loop shaping. Individual pitch control methods for controlling the tower motions together with the generator speed and blade flap motions for offshore wind turbines has been evaluated and compared in publication 4. The most important novelty of the work is the development and evaluation of the robust $H\infty$ loop shaping method, which to the author's knowledge has not been used for wind turbine control before. This method works very well in reducing both fatigue damage of the blades as well as in the support structure, resulting in a robust and efficient controller.

Successful PhDs within wind energy from NTNU 2013

Xing, Yihan: Modeling and analysis of the gearbox in a floating spar-type wind turbine
Department of Marine Technology (current affiliation IKM Ocean Design)

This thesis seeks to reveal and investigate important drivetrain dynamics in relation to offshore wind turbines. Emphasis is placed on drivetrains of the spar-type floating wind turbines (FWTs). FWTs are proposed to be used for offshore wind power extraction at the deeper-water sites where fixed foundations are economically infeasible. The FWT is a complex machine that is subjected to tough offshore environmental conditions and access for maintenance, repair and overhaul is limited and expensive. It is therefore important to understand the FWT drivetrain because gearbox failures have consistently plagued the wind energy industry and have not been able to reach the 20 year design life. Moreover, gearbox failures often result in massive downtime. Some industry players have even labeled the gearbox as the 'missing link'. There is a need for new insight into the understanding of drivetrain dynamics from an offshore perspective in order to improve its design and better predict its life. The findings in this thesis contribute to the de-risking process of offshore wind.

ETEST: Mobile lab for grid compliance testing of offshore wind turbines arrived to Trondheim.

The mobile test laboratory is for creating a controlled voltage-dip at the terminals of the generator under test, and by this the grid compliance of the generator can be tested. The grid code sets requirements to the ability of generators to ride-through certain voltage dips, though this influence wind turbine stability, structural loads and lifetime. The mobile test laboratory is a key facility to enable research addressing these critical issues. A first trial of the lab and training of personnel will be carried during the fall. Thereafter **the lab will be available for continued research and testing of grid compliance of generators.** The lab conforms to the test requirements specified in IEC 61400-21 and for generators **rated up to 8 MVA and 36 kV**. The funding from the Research Council of Norway for the investment in the lab is greatly appreciated.

An enthusiastic scientific staff from SINTEF Energy Research and NTNU in front of the mobile test lab. The lead for procurement and operation of the lab, research scientist Helge Seljeseth is number one from left.

Photos by Helge Seljeseth

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