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UMASS AMHERST ENGINEERS DEVELOPING MULTI-LINE ANCHOR SYSTEM FOR FLOATING OFFSHORE WIND TURBINES

A team of researchers that includes two engineers from the University of Massachusetts (UMass) Amherst is developing a new mooring system for floating offshore wind turbines that uses an integrated network of anchors and lines to hold dozens or even hundreds of turbines in place in the ocean in industrial-scale, offshore wind farms.

Civil and environmental engineers Sanjay R. Arwade and Don J. DeGroot from UMass Amherst, along with Charles P. Aubeny from Texas A&M University and Melissa Landon of the University of Maine, are conducting the research with a three-year, $497,341 grant from the National Science Foundation (NSF). The funding comes jointly from the NSF's Grant Opportunities for Academic Liaison with Industry (GOALI) and geotechnical engineering programs.

The research team is working with Vryhof Anchors, an international industrial partner that is a world leader in producing offshore anchoring systems, including the one used by the world's first floating offshore wind turbine in Norway.

The University of Maine–led New England Aqua Ventus I is one example of an operational offshore floating wind project.

This industrial collaboration is particularly important to the success of the project since Vryhof can assist Arwade and DeGroot with assessments of the complex installation, staging, and cost-estimating aspects of the project. Vryhof will also help guide the research in directions that will be directly applicable to the needs of the wind industry.

The principal goal of the research is to develop offshore floating wind farms where the individual floating wind turbines are moored using a networked series of anchors and cables that hold the entire wind farm in place. Currently, each floating wind turbine has its own individual anchoring system. The proposed networked system would save money and require fewer anchors and geotechnical site investigations, according to the researchers.

ALSO IN THIS SECTION

In order to accomplish this goal, the researchers will have to evaluate the feasibility and design implications of highly variable soil conditions on the ocean floor for securing the anchors, the layout of the wind farms, and the complicated dynamics that cause loads on the anchors. The scientists will also develop wind and wave models for the best placement and orientation of the wind farms.

"This project is an exciting opportunity to bring together structural dynamics and geotechnical engineering in new ways to support national renewable energy goals by potentially lowering capital costs associated with offshore wind development," Arwade said.

The team is also looking at the best designs for the mooring lines and the connections between the floating wind turbine and the anchors, according to Arwade. They will also develop three-dimensional models for measuring the behavior of the anchors on the seafloor and the best designs for the multiple cables attached to each anchor.

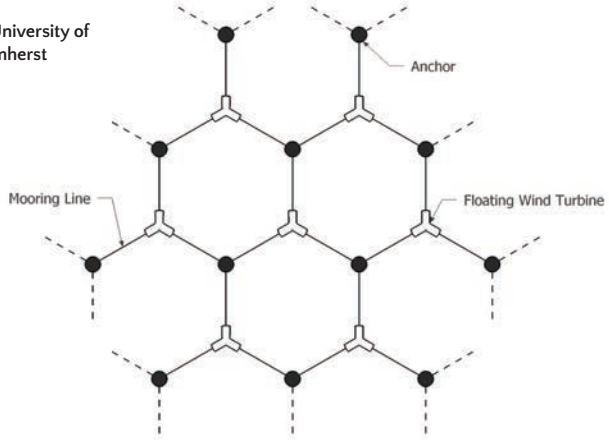
"At each level — at the floating structure and at the anchor — there are challenging, nonlinear, dynamic issues that force this research to work at the cutting edge of geotechnical engineering and offshore structural engineering," Arwade said. "For that reason, it also provides a perfect opportunity to educate the next generation of researchers in the area of offshore wind energy and supports a doctoral student toward that end."

It is expected that this project may hasten progress toward the goal of generating 20 percent of U.S. energy needs from wind power by potentially reducing the cost of building offshore wind farms by a significant margin.

— Source: University of Massachusetts Amherst

For more information, go to www.umass.edu.

Casey Fontana / University of Massachusetts Amherst



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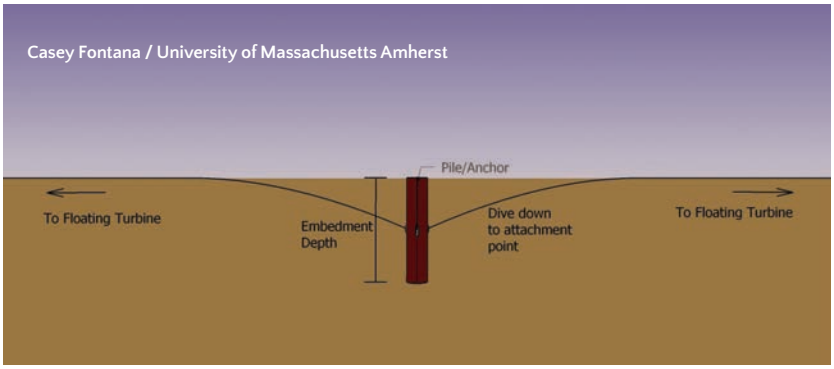

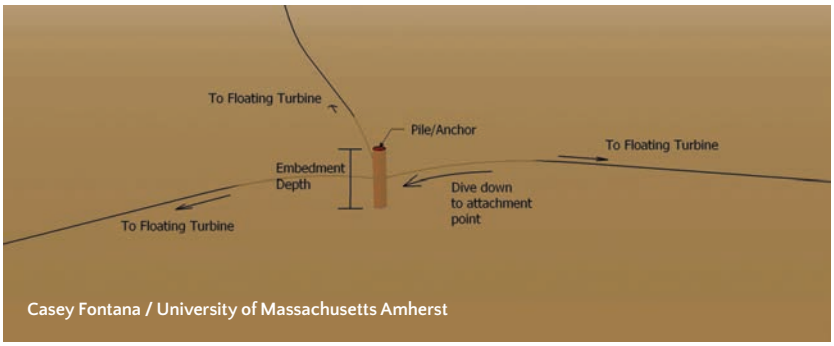

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SENTIENT SCIENCE CHOSEN FOR COMPUTATIONAL GEARBOX TESTING OF 8-MW OFFSHORE WIND TURBINE

Sentient Science recently announced that it has signed an agreement with Adwen, a leading offshore wind turbine manufacturer, to validate the drivetrain for its next generation turbine of 8-MW-rated power, which has the largest annual energy production (AEP) on the market with the highest nominal torque drivetrain and largest rotor.

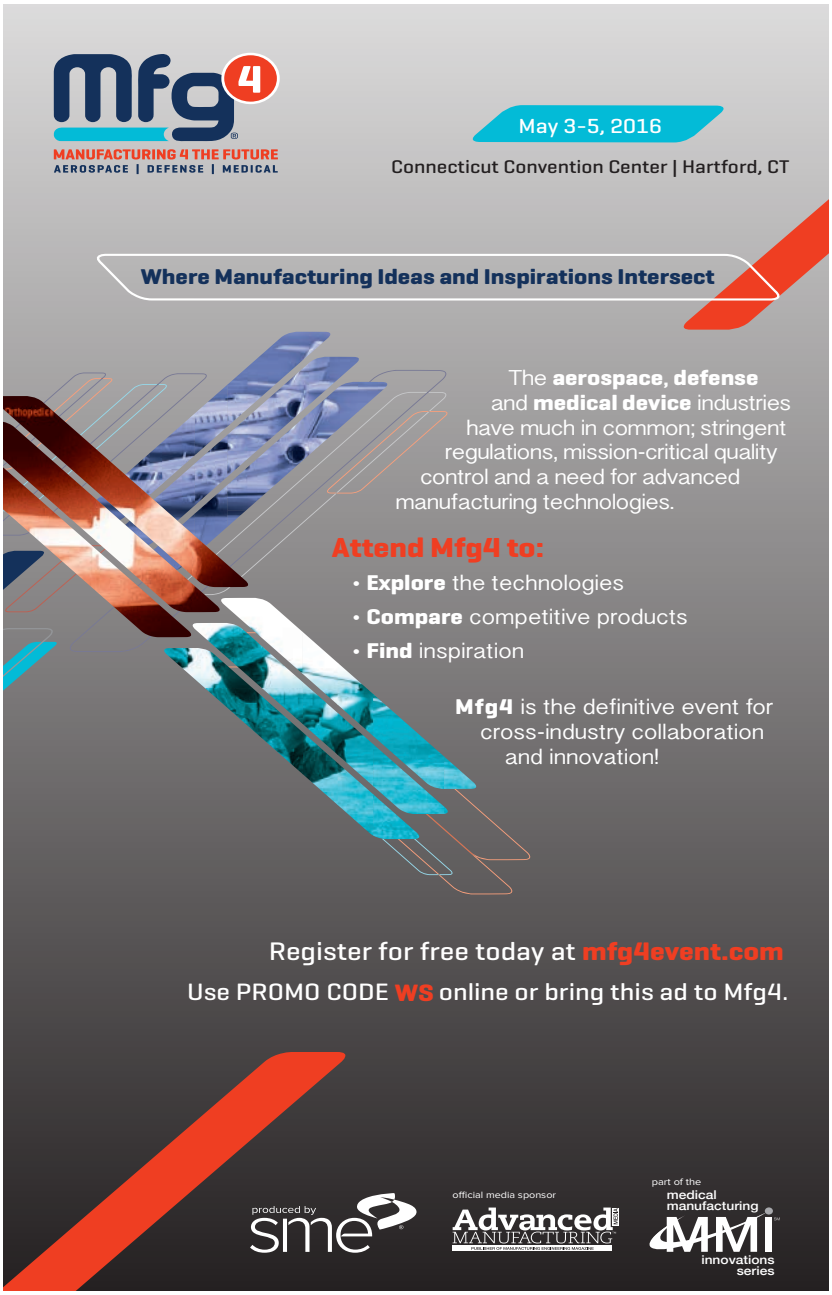
Under the terms of the agreement, Sentient Science's DigitalClone computational testing software will be used to further validate the Adwen 8-MW platform's drivetrain design and standards.

"Confidence in 20- to 30-year rotating equipment life is our crucial objective," said Ward Thomas, CEO and president of Sentient Science. "The world's largest equipment operators, gearbox and bearing manufacturers, and lubrication suppliers are turning to Sentient to confirm that their products will lower the cost of energy by 1 cent per kWh on land and 5 cents per kWh offshore. Sentient is proud to help confirm and validate the system under design and to make sure that Adwen has the world's most tested drivetrain before our friends at Fraunhofer begin their physical testing."

DigitalClone is designed to provide an exhaustive and comprehensive validation strategy in which thousands of gearbox validation test points are computationally created within weeks for a fraction of the cost of physical testing. This allows massive amounts of testing points and insights to be evaluated before physical testing begins.

"A front-end to our physical testing process with the newest computational test technology matches with our rigorous test and validation process, always with the final aim of increasing the reliability of the turbine," said Maite Basurto, CTO of Adwen. "Using Sentient's DigitalClone is a first step in our extensive validation program. It will contribute to having a faster certification process and, finally, a more reliable turbine available in serial production in 2018."

The United States National Renewable Energy Lab (NREL) and Department of Energy (DoE) has invested more than $25 million in DigitalClone to make it as accurate




Sentient Science

as physical testing. Today, one in every 10 land-based wind turbines are contracted to use DigitalClone for life prediction and life extension and 30-year risk and failure analysis.

— Source: Sentient Science

For more information,
go to www.sentientscience.com.

LEVENMOUTH TURBINE OFFERS UNRIVALLED OPPORTUNITY FOR RENEWABLE ENERGY R&D

Offshore Renewable Energy (ORE) Catapult recently unveiled its 7-MW demonstration offshore wind turbine in Levenmouth, Scotland, underlining the vital role that the United Kingdom plays in research, technology, and skills development at the heart of the global renewable energy industry.

The Levenmouth Demonstration Turbine was acquired by ORE Catapult from Samsung Heavy Industries in December 2015 and is the world's most advanced open-access offshore wind turbine dedicated to research. It offers complementary opportunities for economic growth, training, and the development of skills that


ORE Catapult / Matthew Kelly

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are vital for the future of the offshore wind industry.

The turbine offers an unrivalled opportunity to develop a deeper understanding of a wide range of technologies as well as the operations and maintenance aspects of offshore wind turbines with the ultimate goal of reducing the cost of energy. ORE Catapult is working closely with key academic and industry stakeholders to align the research program of the Levenmouth Demonstration Turbine with industry priorities to drive down the costs associated with offshore wind energy development.

ORE Catapult is also working with local partners, including Fife Council, Fife College, Levenmouth Academy, Skills Development Scotland, and the Energy Skills Partnership, to develop and deliver educational and training programs that will both support local young adults to move on to higher education and develop a unique curriculum to ensure that training programs deliver employment-focused, in-demand skills to local people.

"Scotland's research and development in renewables is unrivalled and the Levenmouth Demonstration Turbine adds to Scotland's extensive portfolio of test facilities," said Fergus Ewing, the Scottish government minister for business, energy, and tourism. "ORE Catapult will work with the offshore wind sector, Skills Development Scotland, and the Energy Skills Partnership to ensure the knowledge is transferred to the industry to help it develop our offshore wind resources."

Fergus Ewing MSP accessing an offshore wind turbine through next-generation virtual reality technology developed by Heriot Watt University in association with Energy Skills Partnership.

"The Levenmouth Demonstration Turbine will play a major part in the development of future technologies to lower the cost of offshore wind," said Andrew Jamieson, chief executive of ORE Catapult. "It offers opportunities for the U.K. supply chain and technology developments, and it is vital that the turbine also plays a role in locally developing and supporting the next generation of Scottish engineers, who will ensure that Fife enjoys a bright future thanks to renewable energy."

According to William Leithead, the chair of the EPSRC Supergen Wind Hub and director of the EPSRC Doctoral Training Centre for Wind and Marine Energy Systems, the Levenmouth turbine is a game-changer for the U.K. academic community.

"Until now, we've lagged behind other European nations in not having open access to a full-scale turbine that can be used to back up new research outputs and technologies," Leithead said. "Access to the Levenmouth Demonstration Turbine will make it possible to position the Scottish and a wider U.K. academic research community right at the heart of European wind research, funding opportunities, and technology development."

— Source: ORE Catapult

For more information, go to ore.catapult.org.uk.

ADWEN'S AD 5-135 FIRST TURBINE TO OBTAIN DNV GL TYPE CERTIFICATE

Adwen's AD 5-135 turbine has obtained the first type certificate based on the "Guideline for the Certification of Offshore Wind Turbines, Edition 2012" issued by DNV GL. This new guideline updates the previous version from 2005 to fully comply with the GL's "Guideline for Onshore Wind Turbines, Edition 2010" and to cover IEC 61400, parts 1 and 3.

The new guideline contains a type certification process specifically developed for offshore wind turbines. It takes into account the important increase on the average size

of turbines experienced from 2005 as well as the use of advanced, intelligent control systems to mitigate loads. Furthermore, the machinery and electrical design requirements are improved to be state-of-the-art.

The AD 5-135 is an evolution of the AD 5-116 that was first certified in March 2015 according to this guideline and has been updated to cope with the specific configuration required for Wikinger offshore wind farm, Iberdrola's 350-MW project in the Baltic Sea. Among the new features are the 25-year operating lifetime and the grid loss system — a new system that allows energy production for self-consumption in case of temporary loss of grid connection.

"We are pleased to issue the first type certificate according to GL 2012 to Adwen for their AD 5-135 turbine," said Mike Wöbbeking, head of the certification body at DNV GL-Energy. "As the development of modern offshore wind turbines is rapidly progressing, the guideline GL 2012 is taking all the latest safety and reliability requirements into account, including updated qualifications for load, mechanical engineering, and safety engineering."

— Source: Adwen

For more information, go to www.adwenoffshore.com.


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WoWE Lunch and Q&A with Andrea Jung
Just before WINDPOWER 2015 WoWE partnered with GE to host a special lunch with Andrea Jung, CEO of Grameen America, former CEO of Avon, and member of the GE Board of Directors

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