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Enhancing the Efficiency of Wind Turbines

New Intelligent Systems and Grooved Designs Described by Scientists in New York and Minnesota at Fluid Dynamics Meeting Today in Long Beach, CA

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WASHINGTON, D.C., November 21, 2010 -- A milestone in the history of renewable energy occurred in the year 2008 when more new wind-turbine power generation capacity was added in the U.S. than new coal-fired power generation. The costs of producing power with wind turbines continues to drop, but many engineers feel that the overall design of turbines is still far from optimal.

New ideas for enhancing the efficiency of wind turbines are being presented this week at the American Physical Society Division of Fluid Dynamics meeting in Long Beach, CA.

One issue confronting the efficiency of wind energy is the wind itself -- specifically, its changeability. The aerodynamic performance of a wind turbine is best under steady wind flow, and the efficiency of the blades degrades when exposed to conditions such as wind gusts, turbulent flow, upstream turbine wakes, and wind shear.

Now a new type of air-flow technology may soon increase the efficiency of large wind turbines under many different wind conditions.

Syracuse University researchers Guannan Wang, Basman El Hadidi, Jakub Walczak, Mark Glauser and Hiroshi Higuchi are testing new intelligent-systems-based active flow control methods with support from the U.S. Department of Energy through the University of Minnesota Wind Energy Consortium. The approach estimates the flow conditions over the blade surfaces from surface measurements and then feeds this information to an intelligent controller to implement real-time actuation on the blades to control the airflow and increase the overall efficiency of the wind turbine system. The work may also reduce excessive noise and vibration due to flow separation.

Initial simulation results suggest that flow control applied on the outboard side of the blade beyond the half radius could significantly enlarge the overall operational range of the wind turbine with the same rated power output or considerably increase the rated output power for the same level of operational range. The team is also investigating a characteristic airfoil in a new anechoic wind tunnel facility at Syracuse University to determine the airfoil lift and drag characteristics with appropriate flow control while exposed to large-scale flow unsteadiness. In addition, the effects of flow control on the noise spectrum of the wind turbine will be also assessed and measured in the anechoic chamber.

Another problem with wind energy is drag, the resistance felt by the turbine blades as they beat the air. Scientists at the University of Minnesota have been looking at the drag-reduction effect of placing tiny grooves on turbine blades. The grooves are in the form of triangular riblets scored into a coating on the blade surface. They are so shallow (between 40 and 225 microns) that they can't be seen by the human eye -- leaving the blades looking perfectly smooth.

Using wind-tunnel tests of 2.5 megawatt turbine airfoil surfaces (becoming one of the popular industry standards) and computer simulations, they are looking at the efficacies of various groove geometries and angles of attack (how the blades are positioned relative to the air stream).

Riblets like these have been used before, in the sails on sailboats taking part in the last America's Cup regatta and on the Airbus airliner, where they produced a drag reduction of about 6 percent. The design of wind turbine blades was, at first, closely analogous to that of airplane wings. But owing to different engineering concerns, such as turbine blades having a much thicker cross section close to the hub and wind turbines having to cope with peculiar turbulence near the ground, drag reduction won't be quite the same for wind turbines.

University of Minnesota researchers Roger Arndt, Leonardo P. Chamorro and Fotis Sotiropoulos believe that riblets will increase wind turbine efficiency by about 3 percent.

The Presentation, Benefits of Active Flow Control for Wind Turbine Blades" is at 2:44 p.m. on Sunday, November 21, 2010 in the Long Beach Convention Center Room: 201A. ABSTRACT: http://meetings.aps.org/Meeting/DFD10/Event/132489

The presentation, "On the skin friction drag reduction in large wind turbines using sharp V-grooved riblets. Application to a 2.5 MW Clipper wind turbine section" is at 2:57 p.m. on Sunday, November 21, 2010 in the Hyatt Regency Long Beach Room: Regency D. ABSTRACT: http://meetings.aps.org/Meeting/DFD10/Event/132632

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MORE MEETING INFORMATION

The 63rd Annual DFD Meeting is hosted this year by the University of Southern California, California State University Long Beach, California Institute of Technology, and the University of California, Los Angeles.

It will be held at the Long Beach Convention Center, located in downtown Long Beach, California. All meeting information, including directions to the Convention Center is at: http://www.dfd2010.caltech.edu/

USEFUL LINKS
Main meeting Web site: http://www.dfd2010.caltech.edu/
Search Abstracts: http://meetings.aps.org/Meeting/DFD10/SearchAbstract
Directions to Convention Center: http://www.longbeachcc.com/

PRESS REGISTRATION
Credentialed full-time journalist and professional freelance journalists working on assignment for major publications or media outlets are invited to attend the conference free of charge. If you are a reporter and would like to attend, please contact Jason Bardi (jbardi@aip.org, 301-209-3091).

ONSITE WORKSPACE FOR REPORTERS
A reserved workspace with wireless internet connections will be available for use by reporters in the Promenade Ballroom of the Long Beach Convention Center on Sunday, Nov. 21 and Monday, Nov. 22 from 8:00 a.m. to 5:00 p.m. and on Tuesday, Nov. 23 from 8:00 a.m. to noon. Press announcements and other news will be available in the Virtual Press Room (see below).

VIRTUAL PRESS ROOM
The APS Division of Fluid Dynamics Virtual Press Room will be launched in mid-November and will contain dozens of story tips on some of the most interesting results at the meeting as well as stunning graphics and videos. The Virtual Press Room will serve as starting points for journalists who are interested in covering the meeting but cannot attend in person. See: http://www.aps.org/units/dfd/pressroom/index.cfm

GALLERY OF FLUID MOTION
Every year, the APS Division of Fluid Dynamics hosts posters and videos that show stunning images and graphics from either computational or experimental studies of flow phenomena. The outstanding entries, selected by a panel of referees for artistic content, originality and ability to convey information, will be honored during the meeting, placed on display at the Annual APS Meeting in March of 2011, and will appear in the annual Gallery of Fluid Motion article in the September 2011 issue of the American Institute of Physics' journal, Physics of Fluids.

This year, selected entries from the 28th Annual Gallery of Fluid Motion will be hosted as part of the Fluid Dynamics Virtual Press Room. In mid-November, when the Virtual Press Room is launched, another announcement will be sent out.

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ABOUT THE APS DIVISION OF FLUID DYNAMICS

The Division of Fluid Dynamics of the American Physical Society (APS) exists for the advancement and diffusion of knowledge of the physics of fluids with special emphasis on the dynamical theories of the liquid, plastic and gaseous states of matter under all conditions of temperature and pressure. See: http://www.aps.org/units/dfd/

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