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In this issue:

Power performance and wakes of wind turbines under yawed flow

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Wind turbine wakes are recognized as a key issue causing underperformance of existing wind farms. To improve the performance and reduce the cost of wind power, one approach is to develop innovative methods to improve the net capacity factor by reducing wake losses. "Smart Wind Farms" employing active wake management strategies can help in reducing the wake impacts, thus improving the overall power performance of the array of wind turbines. In this research, the output power of a utility scale wind turbine under yawed flow and the characteristics of the wake measured by TTU Ka-band radars are studied to explore the possibility of steering the wake of a yawed upstream turbine so that it does not reduce the power performance of a downstream turbine.

In theory, power production in yawed flow is a function of mass flow rate through the rotor and the induced velocity. Also, a yawed turbine is able to deflect its wake due to a non-uniform pattern of the induced velocity as shown in Figure 1.

Preliminary field observations show that the power coefficient of a turbine does not degrade significantly under yaw conditions up to approximately 15 degrees as shown in Figure 2.

Figure 3 shows wind speeds at hub height for two cases: Case 1 with 4.6° yaw and Case 2 with 2.5° yaw. The dashed line represents average inflow wind direction. From these figures, it can be observed that the wakes do not necessarily follow the inflow wind direction. A yawed wind turbine may be able to deflect its wake in the near-wake region, changing the wake trajectory downwind, with the progression of the far-wake being dependent on several atmospheric factors such as wind streaks.

(Continued on page 2)

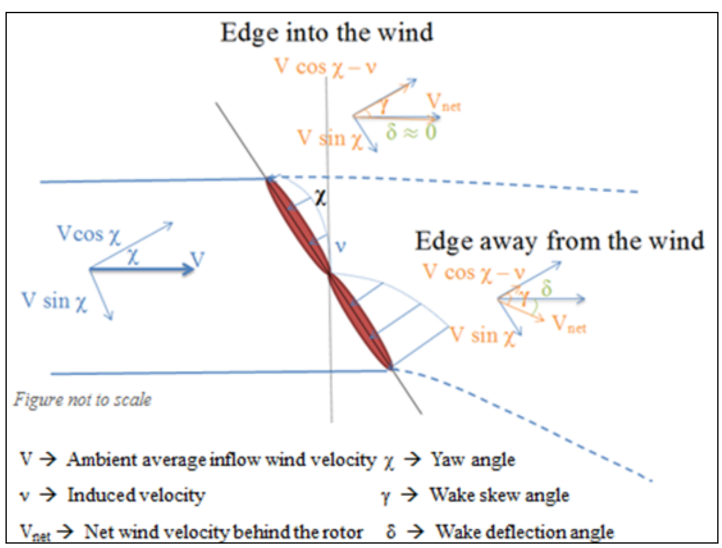


Figure 1: Induced velocity and wake deflection for yawed flow.

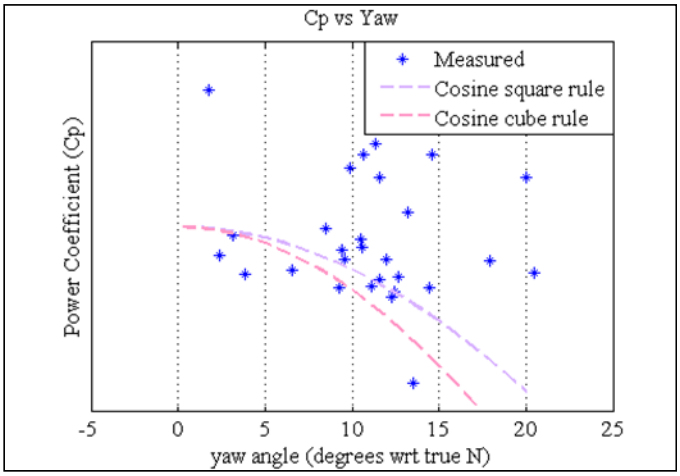


Figure 2: Power coefficient for yawed flow for wind speeds between 10 and 11 m/s - filtered out pitch angles greater than 0°.

The wind speed observations from the radars were used to study the wake recovery as shown in Figure 4. The observed induced velocity measurements compared well with the estimations from momentum theory.

It has now been established that wake effects are not being accurately accounted for in the industry standard wake models used today and can cause underperformance in wind farms. Wind turbine wakes have been observed to persist for very long distances downstream. Hence, it is very important to explore wake management strategies for reducing the negative impacts of the wakes on the performance of downstream turbines in a wind farm. Innovation in wake management can result in substantial economic benefits for wind projects. The broad impact of this research is to reduce the losses in wind farms and make wind projects economically competitive with other sources of energy. This research was focused mainly on the power performance improvement and future work would involve the study of rotor cyclic loading to improve the overall performance as well as the reliability of wind farms.

The merger of remotely sensed wind fields with operational turbine data provides tremendous potential to develop further innovation in the next generation of wind farm control strategies.

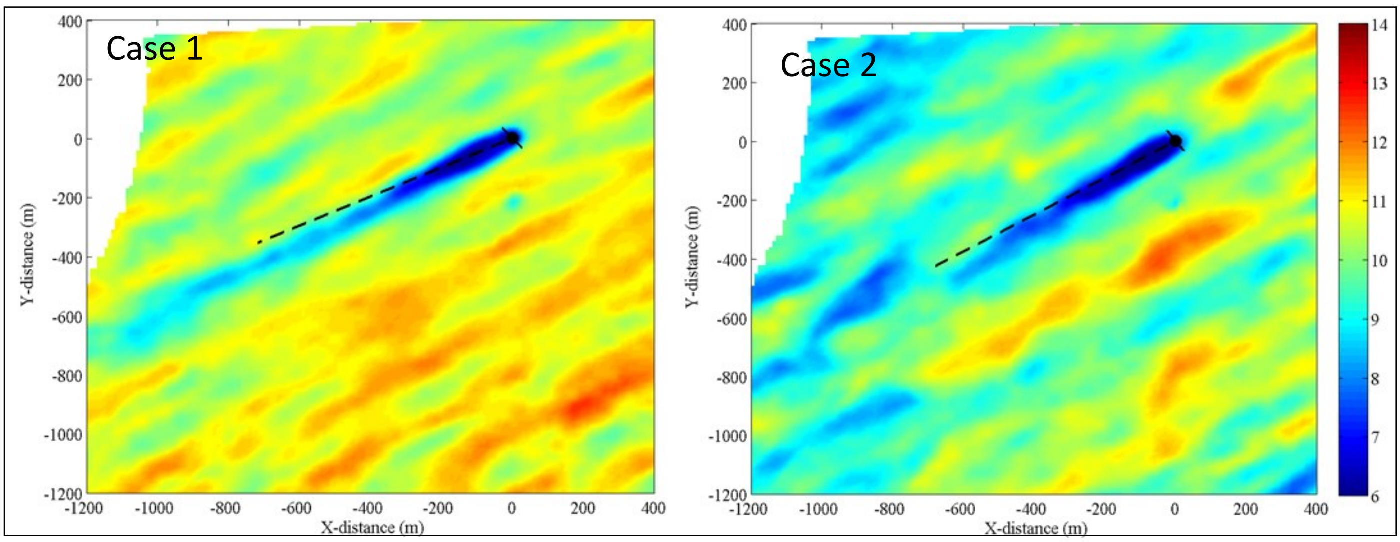


Figure 3: Hub height horizontal section of wind speeds (m/s). Dashed line represents average inflow wind direction.

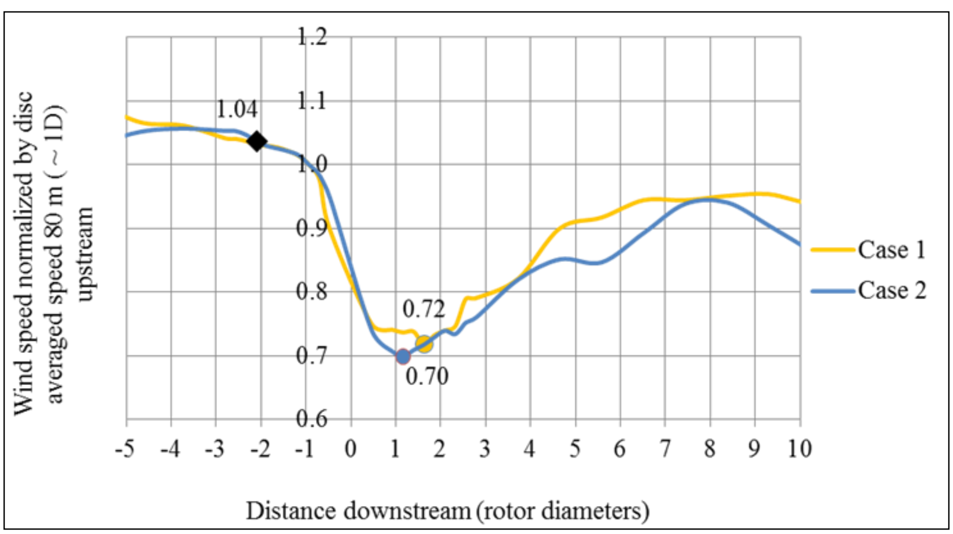
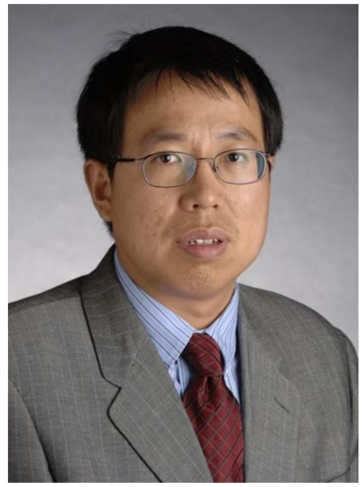


Figure 4: Disc-averaged wind speed in the wake region normalized by disc-averaged inflow wind speed for Case1 and Case 2.

TTU's National Wind Institute Announces Leadership Change

Texas Tech University recently announced a change in leadership for the university's renowned National Wind Institute. Dr. Daan Liang, Associate Professor in the Departments of Civil and Environmental Engineering at TTU, will now take the helm of the institute as Interim Director effective September 01. Former NWI Director, Dr. John L. Schroeder, has elected to focus on wind-related research and technology development projects after holding that position for the past 5 years.



Dr. Daan Liang

Dr. Liang has served previously as the Coordinator of the doctoral program in Wind Science and Engineering since 2013, and as a faculty affiliate with the Institute since 2004. He will continue in his role as a faculty affiliate for TTU's Center for Multidisciplinary Research in Transportation.

Dr. Liang earned his Ph.D. and his Master's degree at the University of Buffalo in New York, and his academic career has focused on the effects of severe wind events, and how they impact a community and the surrounding region. Recent academic publications include the American Journal of Preventive Medicine, the American Journal of Economics & Society, Wind and Structures among others.

Dr. Liang is Principal Investigator (PI) and co-PI on research projects funded by the National Science Foundation, the U.S. Department of Energy, Texas Department of Transportation, and industry partners on windstorm damage assessment, community resiliency to natural disasters, innovation in risk management, and wind energy.

NWI supports a broad array of observational, experimental, and testing facilities, and TTU has had an ongoing wind-related research program since 1970. More than 40 faculty members conduct wind-related research through NWI. They, along with approximately 25 graduate students, provide critical support to pursue innovative research and application. Current projects relate to wind energy, wind hazards, wind science, remote sensing technology and others.

AAWE Awards

Several great nominations for Best Paper were received for papers published in 2013. The AAWE awards committee deliberations resulted in a tie between the following two papers, which are both outstanding and contribute to the wind engineering community in vastly different ways. Authors of both papers will be presented with plaques at the next AAWE conference or event. In the meantime, the primary author of each winning paper will receive a $250 cash prize.

Thanks are extended to the AAWE members who nominated fabulous candidates for all of the awards. Thanks are also extended to the AAWE awards committee: Luca Caracoglia, Leighton Cochran, Anne Cope, and Fred Haan. Congratulations to the following award recipients:

- Teng Wu and Ahsan Kareem in recognition of their contributions to wind engineering for the paper titled "Bridge aerodynamics and aeroelasticity: A comparison of modeling schemes" published in the Journal of Fluids and Structures
- Eri Gavanksi, Bahareh Kordi, Greg Kopp and Peter Vickery in recognition of their contributions to wind engineering for the paper titled "Wind loads on roof sheathing of houses" published in the Journal of Wind Engineering and Industrial Aerodynamics.

Please start thinking about papers published in 2014 for possible submission for the next opportunity to present this award. Nominations for the next Best Paper Award are due before January 31, 2015. Please send all nominations to AAWE Awards Committee Chair Anne Cope at acope@ibhs.org.

The International Association for Wind Engineering awards process is also an annual process, with nominations due on or before March 31 each year. Information is available on the IAWE web site. Please consider nominating fellow AAWE members for these two prestigious IAWE awards:

- IAWE Senior Award (Davenport Medal), which is presented for a record of outstanding achievement, normally within the previous ten-year period, in at least two out of: i) significant and original contribution to wind engineering research; ii) applications to wind engineering practice; iii) educational contributions in the field of wind engineering; iv) international community involvement.
- IAWE Junior Award, which is presented for a record of outstanding achievement, within the previous five-year period, in at least one of: i) significant and original contribution to wind engineering research; ii) applications to wind engineering practice; iii) educational contributions in the field of wind engineering. Nominees should be under the age of forty years on January 1st of the year.

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