Northeastern

Department of Civil and Environmental Engineering Distinguished Seminar Series

Fluid-Structure Interactions (FSI) of Built Structures in Violent Wind Storms

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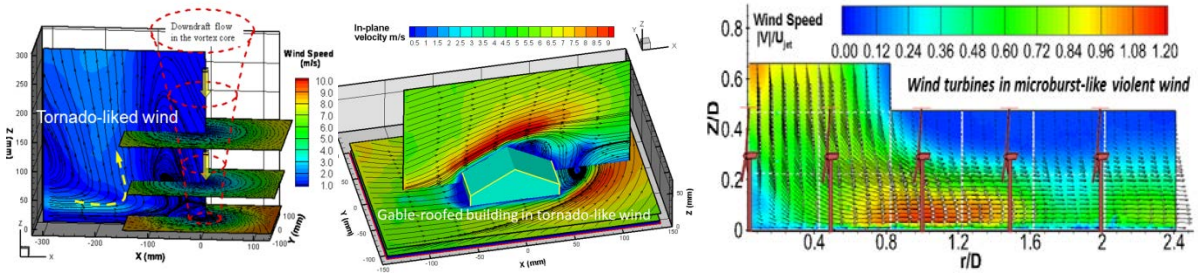
Director, Advanced Flow Diagnostics and Experimental Aerodynamics Laboratory
Iowa State University

Friday, October 6, 2017 12:00 pm-1:00pm
101 Churchill Hall

Abstract

The recent research efforts in the speaker's research group to characterize fluid-structure interactions (FSI) of built structures with violent wind storms (i.e., tornadoes, downbursts and snow storms) will be introduced. By leveraging the large-scale tornado/microburst simulators available at Iowa State University, a series of experimental studies were conducted to quantify the flow characteristics of violent tornado-like/microburst-like surface wind and to assess the resultant wind loads acting on built structures (i.e., low-rise gable-roofed buildings, high-rise buildings and large-scale wind turbines) induced by violent tornado-like/microburst-like winds, in comparison with those sited in conventional straight-line atmospheric boundary layer (ABL) winds. In addition to measuring the surface pressure distributions to determine the resultant wind loads acting on the test models, a digital particle image velocimetry (PIV) system was also used to conduct detailed flow field measurements to quantify the wake vortex and turbulent flow structures around the test models. The flow field measurements were correlated with the measured surface pressure distributions and the resultant wind loads acting on the building models to elucidate the underlying physics of flow-structure interactions between the violent wind storms and the built structures in order to provide more accurate prediction of the damage potentials of the violent wind storms. Icing represents the most significant threat to the integrity of wind turbines in cold weather. Comprehensive experimental investigations were performed by using the unique Icing Research Tunnel available at PI's laboratory to quantify the transient behavior of wind-driven surface water film/rivulet flows and dynamic ice accreting process over the surfaces of wind turbine blade models at different icing conditions. The findings derived from the icing physics studies can be for more accurate prediction of ice formation and accretion on wind turbine blades and to develop effective anti-/de-icing strategies for safer and more efficient operation of wind turbines in cold weather.



Biographical Sketch

Dr. Hui Hu is the Martin C. Jischke Professor and Assoc. Dept. Chair of Aerospace Engineering at Iowa State University. Dr. Hu's recent research interests include laser-based flow diagnostics, wind turbine aerodynamics and rotorcraft aeromechanics; aircraft icing physics and anti-icing/de-icing technology; film cooling and thermal management of gas turbines; low-speed aerodynamics and vortex flow controls; bio-inspired aerodynamics of unmanned-aerial-vehicles (UAVs); micro-flows and micro-scale heat transfer in microfluidics or "Lab-on-a-Chip" devices; wind engineering and Fluid-Structure Interactions (FSI) of built structures in violent wind storms (i.e., tornadoes, downbursts and snow storms). Dr. Hu received several prestigious awards in recent years, including *2006 NSF-CAREER Award, 2007 Best Paper in Fluid Mechanics Award (Measurement Science and Technology, IOP Publishing), 2009 AIAA Best Paper Award in Applied Aerodynamics, 2012 Mid-Career Achievement in Research Award* of Iowa State University, *2013 AIAA Best Paper Award in Ground Testing Technology, and 2014 Renewable Energy Impact Award of Iowa Energy Center*. Further information about Dr. Hu's technical background and recent research activities is available at: http://www.aere.iastate.edu/~huhui/

Hui Hu, Ph.D.

Martin C. Jischke Professor of Aerospace Engineering

Department of Aerospace Engineering

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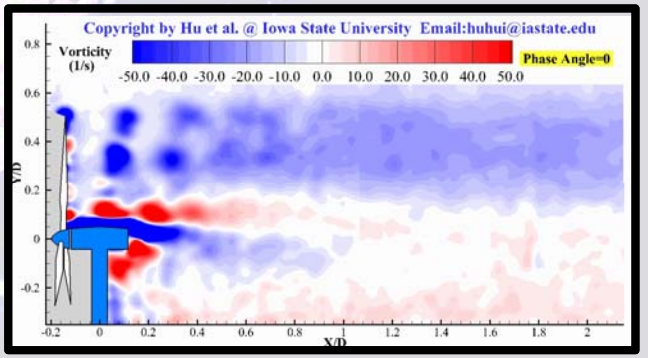

IOWA STATE UNIVERSITY

Education

- **PhD Mechanical Engineering, *UNIVERSITY OF TOKYO***
- **PhD Aerospace Engineering, *BEIJING UNIVERSITY OF AERONAUTICS & ASTRONAUTICS***
- **MS Aerospace Engineering, *BEIJING UNIVERSITY OF AERONAUTICS & ASTRONAUTICS***
- **BS Aerospace Engineering, *BEIJING UNIVERSITY OF AERONAUTICS & ASTRONAUTICS***

Research Interests

- **Flow diagnostics**
- **Wind turbine & engineering**
- **Aircraft icing physics & technology**
- **Vortex flow controls**
- **Bio-inspired UVAs**
- **Wind engineering**

Selected Service and Awards

- **Director, Advanced Flow Diagnostics and Experimental Aerodynamics Laboratory**
- **Director, Aircraft Icing Physics and Anti-/De-icing Technology Laboratory**
- **Associate Department Chair for Graduate Education**
- **NSF CAREER Award 2006**