# Current-Based Online Nonintrusive Condition Monitoring and Fault Diagnosis for Wind Turbines

Wei Qiao

Department of Electrical Engineering, University of Nebraska–Lincoln, NE 68588-0511

**Abstract**

Condition monitoring is an effective means to improve wind turbine reliability and performance and reduce wind turbine operating and maintenance (O&M) costs. Most existing technologies for wind turbine condition monitoring require additional sensors and data acquisition devices to implement. Most of these sensors are mounted on the surface or are buried in the body of wind turbine components, which are difficult to access during wind turbine operation. The use of additional sensors and devices increases the cost, size, and hardware wiring complexity of wind turbine systems. Moreover, the sensors and devices are inevitably subject to failure, which could cause additional problems with system reliability as well as additional O&M costs. Therefore, it is desirable to develop nonintrusive, lower-cost, reliable technologies to fully exploit the benefits of condition monitoring for wind turbines.

This seminar will present current-based technologies for online nonintrusive wind turbine condition monitoring and fault diagnosis. The proposed technologies only use phase current signals measured from generator terminals for condition monitoring and fault diagnosis of wind turbines. These current measurements have been used by existing wind turbine control and protection systems; no additional sensors or data acquisition devices are required. The proposed technologies are able to effectively extract the signatures of faults in wind turbines from the current measurements and can be easily integrated into existing wind turbine control, protection and monitoring systems. The proposed technologies will be demonstrated for condition monitoring of small direct-drive wind turbines with various rotor imbalance, blade and bearing faults as well as wind turbine gearbox faults. The proposed technologies will offer an effective means to achieve condition-based, smart maintenance for wind turbines.

**Biography**

Professor Wei Qiao received the B.Eng. and M.Eng. degrees in electrical engineering from Zhejiang University, Hangzhou, China, in 1997 and 2002, respectively, the M.S. degree in high performance computation for engineered systems from Singapore-MIT Alliance (SMA), Singapore in 2003, and the Ph.D. degree in electrical engineering from Georgia Institute of Technology, USA in 2008. He joined the University of Nebraska–Lincoln (UNL) as an Assistant Professor of electrical engineering in August 2008, was the UNL Harold and Esther Edgerton Assistant Professor from March 2011 to August 2013, and has been a tenured Associate Professor since August 2013. His research interests include renewable energy systems, smart grids, microgrids, condition monitoring and fault diagnosis, energy



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storage systems, power electronics, electric machines and drives, and computational intelligence. His research has been sponsored by the U.S. National Science Foundation, Department of Energy, Department of Transportation, state funding agencies and industry. He has published 2 book chapters and more than 130 papers in refereed journals and conference proceedings, and holds 7 pending international/U.S. patents. Professor Qiao is the Corresponding Guest Editor of a Special Section on Wind Energy Conversion Systems of the *IEEE Transactions on Industrial Electronics* in 2014, has been an Associate Editor of the *IET Power Electronics* since 2014, an Associate Editor of the *IEEE Journal of Emerging and Selected Topics in Power Electronics* since 2013, and the Chair of the Sustainable Energy Sources Technical Thrust of the IEEE Power Electronics Society since 2009. He was an Associate Editor of the *IEEE Transactions on Industry Applications* in 2010-2013 and a founding chair of the *IEEE Symposium on Power Electronics and Machines in Wind Applications (PEMWA)*. Professor Qiao was the recipient of a 2010 U.S. National Science Foundation CAREER Award, the 2010 IEEE Industry Applications Society Andrew W. Smith Outstanding Young Member Award, the 2012 UNL College of Engineering Faculty Research & Creative Activity Award, the 2011 UNL Harold and Esther Edgerton Junior Faculty Award, and the 2011 UNL College of Engineering Edgerton Innovation Award. He has received four best paper awards from the IEEE Power & Energy Society, Industry Applications Society, and Power Electronics Society.