CREW Seminar Series: Fall 2012

Wind Energy Integration – Applications of Energy Storage Systems and Wind Power Fluctuation Smoothing Control

Abstract

An introduction of wind power generation will be presented with the technical challenges of high penetration of wind energy integration. Among the challenges are low voltage ride-through, real power and reactive power control, and mitigation of wind power fluctuation. With the smart grid deployment, synchrophasor based wide-area monitoring system (WAMS) will facilitate large-scale wind integration by precise control and management to prevent grid instability and blackout.

Recognizing wind energy is an area needing interdisciplinary research, Dr. Gao will focus on the electrical grid integration aspect and more specifically, on how to use energy storage systems to facilitate wind integration. To accommodate the wind power fluctuation, a hybrid energy storage system (HESS) consisting of batteries and super-capacitors is proposed. A probability-based approach is used for Power Capacity Specification of Wind Energy Storage Systems. Through optimization of a benefit function the optimal dispatched wind power level is determined. The proposed approach has been verified using real wind data from an existing wind power plant. An intelligent control strategy that regulates the output power and also substantially increases the battery life in HESS will also be discussed.

In addition, wind power fluctuation causes grid frequency deviation. Thus, better control methodology needs to be developed to smooth the fluctuation without excessive spillage. Based on an actual industrial power system, a smoothing controller is developed to suppress the power fluctuation from DFIG (Doubly Fed Induction Generator) based wind farm. This controller consists of three main functionality components: frequency deviation risk assessment model, wind turbine rotor speed optimizer, and rotor speed upper limiter. With an optimal down-regulated power curve, the wind power fluctuation is smoothed and a trade-off between fluctuation smoothing and energy loss is achieved.

By **David Wenzhong Gao** from **University of Denver**

On **Friday, November 9, 2012, at 11:00am**

In **Bechtel Collaboratory (room 1B50), Discovery Learning Center**
University of Colorado at Boulder

Refreshments will be available at 10:50am

To attend the live broadcast (using Adobe Connect):
https://meeting.colorado.edu/seminarseries-2012fall-davidgao/

Dr. David Wenzhong Gao is an Associate Prof. of Electrical and Computer Engineering and Director of Renewable Energy and Power Electronics Laboratory at the University of Denver, CO. Dr. Gao holds a BS degree from Northwestern Polytechnical University, Xi'an, China, an MS degree from Northeastern University, Shenyang, China, and a Ph.D. degree in Electric Power Engineering from Georgia Institute of Technology, Atlanta, USA.

Dr. Gao has conducted extensive research in areas of power and energy systems including renewable energies, distributed generation, smart grid, power delivery, power electronics application, power system protection, power system restructuring, and hybrid electric vehicles. In addition to more than 120 technical papers published, he also co-authored a book entitled "Modern Hybrid Electric Vehicles" published by John Wiley & Sons, U.K. His research was funded by many funding agencies, e.g., US-NSF, US-DOE, NREL, Argonne National Laboratory, Oak Ridge National Laboratory, US Army Research Office, US Office of Naval Research, Tennessee Valley Authority, US Electric Power Research Institute. In 2009, he won US NSF CAREER award for wind power research. He received the Best Paper Award in the Complex Systems Track at the 2002 Hawaii Conf. on System Sciences. Since June 2003, Dr. Gao has been a Senior Member of the IEEE.

Dr. Gao currently serves as an Editor for IEEE Transactions on Sustainable Energy and he has been an active reviewer of leading journals and conferences such as IEEE Transactions on Power Systems, IEEE Transactions on Power Electronics, IEEE Transactions on Smart Grid, IEEE Transactions on Energy Conversion, IET Renewable Power Generation, IEEE Transactions on Power Delivery; IEEE Vehicular Power and Propulsion Conference, IEEE Power and Energy Society General Meeting. He is also a Technical Co-chair in the Organizing Committee of 2013 IEEE GreenTech Conference, Denver, in April 2013. Dr. Gao has been invited to serve on the grant review panel for many funding agencies, e.g., NSF, DOE, and the Natural Sciences & Engineering Research Council of Canada.

How to get to the CU-Boulder Discovery Learning Center

From 28th Street (Hwy 36), go west on Colorado Ave., which leads into the University. Take the next left (going south) onto Regent Drive. The Discovery Learning Center (DLC; highlighted in green below) is located on the west side of Regent Drive. Parking is available at visitor parking lots and nearby meters.

The seminar takes place in the Bechtel Collaboratory room (1B50), which is located in the 1st basement (ground level), on the east side of the building (right side of the building when you come in through the south entrance).