NOV 10, 2016

Modeling and Control of Wind Energy Systems

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ABSTRACT:

Wind technology is a major player in utility-scale renewable energy for the production of electricity around the globe. The power harnessed from the wind is a sustainable, low-pollution and low-water use resource for electricity production. Many countries share the strategic goal of increasing the penetration of wind energy into the electric grids. In the U.S. alone the goal is to increase from 61 gigawatts of wind power, supplying 4.5% of the electricity demand in 2013, to 220 gigawatts of wind power contributing 20% electricity by 2030. Attaining this goal would require a continued decrease of the cost of wind power. Arguably, advanced physics-based modeling and simulation, flow monitoring and advanced controls are key to reducing the cost of wind energy. This talk will provide an overview of the work done at the University of Texas at Dallas in these areas. It will be shown how the convergence of high-fidelity simulations, reduced-order models, field measurements (blending LiDAR technology with SCADA and met tower data), and advanced controls may yield increases in annual energy production and reliability of wind turbines and wind farms, which are important factors in reducing the cost of wind energy.

BIOGRAPHY:

Mario Rotea is the holder of the Erik Jonsson Chair in Engineering and Computer Science at the University of Texas at Dallas, where he is also the department head of mechanical engineering. Rotea spent 17 years at Purdue University as a professor of aeronautics and astronautics, developing and teaching methods for the analysis and design of control systems. He also worked for the United Technologies Research Center as senior research engineer on advanced control systems for helicopters, gas turbines, and machine tools. Rotea was the head of the Mechanical and Industrial Engineering Department at the University of Massachusetts Amherst, where he expanded the department in the area of wind energy and applications of industrial engineering to the health care sector. His career includes terms as director of the Control Systems Program and division director of Engineering Education and Centers at the National Science Foundation. Rotea is cofounder of WindSTAR, an NSF Industry University Cooperative Research Center aimed at bringing together academia and industry to advance wind energy through industry-relevant research and education. Rotea joined UT Dallas in 2009 to serve as professor and inaugural head of the then newly-created mechanical engineering department. He directed the department's rapid growth, increasing student enrollment from 10 students to more than 900 in 2015. Rotea is a Fellow of the IEEE for contributions to robust and optimal control of multivariable systems. Rotea graduated with a degree in electronic engineering from the University of Rosario. He received a master's degree in electrical engineering and his Ph.D. in control science and dynamical systems from the University of Minnesota.