Impact of Wind Variability on Power System Small-Signal Reachability

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ABSTRACT

The push toward energy independence and a cleaner environment entails increased penetration of renewable resources in the power grid. It has long been acknowledged that the integration of these resources presents major challenges in operations and planning of today's power systems. For example, the highly variable nature of wind speeds not only makes the wind resource highly intermittent but presents major difficulties in accurate forecasting. Therefore, the integration of wind presents an additional source of uncertainty in the management of these non-dispatchable units. This uncertainty affects operations planning—power system operators, faced with the lack of control of these units, must compensate by bringing additional insurance for their system through the increase in the level of reserves. Deep levels of wind penetration in the system also have an impact on system dynamic performance, i.e., small-signal and transient stability. In this regard, it has been acknowledged that, as the presence of wind in the power grid increases, new tools are necessary to assess the impact of wind on the security of supply and load balancing in near real time.

This talk focuses on this last problem—the impact of wind penetration on system dynamic performance. In particular, *we address how system variables may deviate from prescribed values imposed by operational requirements due to the uncontrolled variability of the wind resource*. In this regard, we introuce an analytically tractable method, amenable for computer implementation, to assess whether certain variables of interest, such as system frequency and bus voltages, remain within acceptable ranges while the system is subjected to uncontrolled disturbances caused by the variability of the wind resource. We envision this method to be used in planning studies as well as operations. It provides operators with a metric of how close the time-evolved system may be from violating certain performance requirements given the amount of available wind-based generation and its expected variability.

SPEAKER'S BIO

Dr. Domínguez-García is an Assistant Professor in the Electrical and Computer Engineering Department at the University of Illinois, Urbana, where he is affiliated with the Power and Energy Systems area. His research interests lie at the interface of system reliability theory and control theory, with special emphasis on applications to electric power systems, power electronics, and safety-critical/fault-tolerant aircraft, aerospace and automotive systems.

Dr. Domínguez-García received the Ph.D. degree in Electrical Engineering and Computer Science from the Massachusetts Institute of Technology, Cambridge, MA, in 2007 and the degree of Electrical Engineer from the University of Oviedo (Spain) in 2001.

After finishing the Ph.D., he spent some time as a post-doctoral research associate at the Laboratory for Electromagnetic and Electronic Systems of the Massachusetts Institute of Technology. Prior to joining MIT as a graduate student, Dr. Domínguez-García was with the Department of Electrical Engineering of the University of Oviedo where he held the position of Assistant Professor. He received the NSF CAREER Award in 2010.