Electrical Engineering
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Reliability Engineering for Electrical Energy Systems 2020: Smart Grid Applications and Beyond

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Abstract
Reliability engineering for future electrical energy systems is the central theme of this talk. Electrical energy systems worldwide are undergoing a radical transformations in structure and functionality driven by a quest to increase efficiency and reliability. Such transformations are enabled by the introduction of new technologies such as advanced communication and control applications, integration of new generation sources, e.g., wind, photovoltaics (PV), new loads, such as plug-in hybrid electric vehicles (PHEV), and advanced power electronics devices for power-flow control, such as flexible AC transmission systems (FACTS). However, added functionality provided by the integration of new technologies comes with side effects—increasing system complexity and the introduction of new sources of uncertainty at all levels in systems that are already inherently complex.

Current reliability engineering tools, although effective for today's electrical energy systems, are inadequate to engineer future electrical energy systems, as they cannot capture the impacts of integrating the aforementioned technologies. Without adequate tools to address the impact of new technology integration, ad-hoc designs will likely result, leading to the deployment of poorly understood, unreliable and unsafe systems, which could have catastrophic consequences. In this context, it is key to ensure that the transition to a smarter electricity infrastructure does not jeopardize the reliability of our electricity supply twenty years down the road.

In this talk, I will describe several research projects that attempt to address the above problems. In particular, I will discuss my group's research efforts on developing: i) tools for quantifying the impact on grid reliability of deep penetration of renewable resources; ii) component fault detection and isolation (FDI) algorithms for efficient health diagnosis in electrical energy systems; and iii) distributed control and algorithms for enabling the utilization of distributed energy resources, e.g., PV systems and PHEVs to provide voltage control for increased reliability of electric distribution networks.

Biography
Alejandro 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, with special emphasis on applications to electric power systems and power electronics.

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. Dr. Domínguez-García received the NSF CAREER Award in 2010. He is an editor of the IEEE Transactions on Power Systems. He is also a Grainger Associate since 2011.

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