ECE 590 I
POWER & ENERGY SYSTEMS SEMINAR

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Smart Grid Cyber-Physical Security: Challenges in Real-Time System Monitoring

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Abstract:
The next-generation power grid, the so-called smart grid, has drawn considerable attention from academia, industry, and government in light of its wide-ranging impacts on society, economics and the environment. Such smart grids integrate control, communication and computation aiming to ensure stability, efficiency and robustness of electricity supply and delivery to the end users. While much research has been performed to date, the state of the art in the cyber-physical security of smart grids is still in its early stages. Typically, the legacy power grid is protected by isolated and uncoordinated devices, which constitute the implementations of the ad-hoc solutions for various protection problems, that ignore the inherent interdependencies among them as grid-connected elements. The absence of communication and collaboration among these devices exposes them to possible, intricate attacks that leverage their insular condition and lack of situational awareness. This presentation discusses the key thrusts of a new research project with the aims to overcome such vulnerabilities through the development of a cross-layer cyber-physical security framework for the smart grid. We highlight some of the salient aspects of the proposed framework, including the incorporation of a distributed nonlinear controller for transient stability enhancement. The new control layer design aims to guarantee robustness to uncertainties in modelling and operating conditions with the capability to compensate input time-delays due to uncertain conditions in actual operations. The framework will integrate innovative bad data analytics based on distributed software-defined network cross-layered information. The bad data analytics will consider the inherent interdependencies in the grid components and the monitored on-going physical processes to dispatch the appropriate countermeasures. The development of an adaptive distributed robust machine learning approach for security applications is an important component of the proposed framework. Such a tool is needed in light of the fact that the attackers continually deploy newly formulated threats that cannot be detected by approaches that rely solely on prior training data. The distributed machine intelligence method to be developed has a key focus on rapid adaptivity to the detection and identification of new threats even with only one incident of a previously unobserved threat.

Bio:
Arturo Suman Bretas is Professor in the Department of Electrical and Computer Engineering at the University of Florida. He is also the director of the Power Systems Laboratory. His research interests include power system operations, protection, and control. After he received the B.Sc. and M.Sc. degrees in 1995 and 1998, respectively, from the University of Sao Paulo in Brazil, he obtained his Ph.D. degree from Virginia Tech in 2001. In 2002, he joined the Federal University of Rio Grande do Sul, Brazil, as an assistant professor. Prof. Bretas was invited to the Grenoble Institute of Technology, France, to be a CNRS research scholar during 2003 and 2004. In 2005, he returned to UFRGS as an associate professor. He joined the University of Florida in 2015. Since 2002, he has been involved in more than 17 industry and government sponsored projects with total funding above $ 23 million. These projects cover activities in cyber-physical system security, new technologies to enhance power system control and real-time monitoring, distribution systems reliability optimization and planning under electricity restructuring. Professor Bretas has published more than 296 scientific papers in international journals and conferences.