Stanford University

TomKat Center for Sustainable Energy
Precourt Institute for Energy
Energy and Environment Affiliates Program
Civil and Environmental Engineering
Department of Electrical Engineering

Stanford SmartGrid Seminar

Smart Grids: End-to-End Cyber Physical Electric Energy Systems

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Abstract: This talk concerns modeling, analysis and design challenges and opportunities in cyber physical electric energy systems. We first summarize our vision using control engineering and systems theory as a unifying theme for modeling energy systems as complex dynamic systems encompassing technical, economic, policy and information processes. We highlight the key role of sensors and actuators, which are currently being deployed as part of smart grid efforts. In order for these sensors and actuators to be deployed at value, it is essential to characterize the architecture of the physical grid and the characteristics/preferences of its users. We illustrate several qualitatively different physical architectures (bulk power systems; hybrid grids; fully distributed grids for developed world; and, grids for developing world). We summarize the state-of-the-art cyber in these physical grids, identify the key problems that require improvements and propose possible cyber architectures to support these improvements. The principles of CPS design are based on the same end-to-end CPS framework referred to as Dynamic Monitoring and Decision Systems (DYMONDS). We finally illustrate this framework using the real-world data from two Azores Islands featured in our recently published book entitled ``Engineering IT-Enabled Sustainable Electricity Services: The Case of Low-Cost Green Azores Islands".

Bio: Marija Ilic received her Doctor of Science Degree in Systems Science and Mathematics at Washington University in St. Louis, MO in 1980, and all other degrees in Electrical Engineering at the University of Belgrade, Serbia. She is currently a Professor at Carnegie Mellon University, Pittsburgh, PA, with a joint appointment in the Electrical and Computer Engineering and Engineering and Public Policy Departments. She is the Director of the Electric Energy Systems Group (EESG) at CMU. She is also the Honorary Chaired Professor for Control of Future Electricity Network Operations at Delft University of Technology in Delft, The Netherlands. She was an Assistant Professor at Cornell University, Ithaca, NY, and tenured Associate Professor at the University of Illinois at Urbana-Champaign. She was then a Senior Research Scientist in Department of Electrical Engineering and Computer Science, Massachusetts Institute of Technology, Cambridge, from 1987 to 2002. Her main interest is in the systems aspects of operations, planning, and economics of the electric power industry. She has co-authored several books in her field of interest. Prof. Ilic is an IEEE Fellow.