THE SMART GRID: OVERVIEW, ISSUES, AND CHALLENGES

S. Massoud Amin, D.Sc.
Director, Technological Leadership Institute (TLI)
Honeywell/H.W. Sweatt Chair in Technological Leadership
Professor, Department of Electrical & Computer Engineering
University of Minnesota

Abstract: Recent policies combined with potential for technological innovations and business opportunities, have attracted a high level of interest in smart grids. The potential for a highly distributed system with a high penetration of intermittent sources poses opportunities and challenges.

From a broader view, global trends toward interconnectedness, privatization, deregulation, economic development, accessibility of information, and the continued technical trend of rapidly advancing information and telecommunication technologies all suggest that the complexity, interactivity, and interdependence of infrastructure networks will continue to grow. A major challenge is posed by the lack of a unified mathematical framework with robust tools for modeling, simulation, control and optimization of time-critical operations in complex multicomponent and multiscaled networks. Mathematical models of such complex systems are typically vague (or may not even exist); moreover, existing and classical methods of solution are either not available, or are not sufficiently powerful.

From a strategic R&D viewpoint, the agility and robustness/survivability of large-scale dynamic networks that face new and unanticipated operating conditions is being addressed. Virtually every crucial economic and social function depends on the secure, reliable operation of energy, telecommunication, transportation, financial, and other infrastructures. How to retrofit and engineer a stable, secure, resilient grid with large numbers of such unpredictable power sources? What roles will assets optimization, increased efficiency, energy storage, advanced power electronics, power quality, electrification of transportation, novel control algorithms, communications, cyber and infrastructure security play in the grid of the future? What are the emerging technologies to enable new products, services, and markets? This presentation briefly provides an overview of smart grids, and focuses on addressing challenges and opportunities ahead.

Wednesday, February 23, 2011
1:30 p.m.
Bryan Hall, Room 305
(A short reception will follow.)

Host: Arye Nehorai

Short Bio: Professor Massoud Amin, who coined the term "smart grid", is leading extensive R&D efforts into its development, and is considered its father. At Minnesota, he leads a team of 5 endowed chairs and 47 senior faculty members and industry executives, who develop local and global leaders for technology enterprises. He teaches/researches in complex dynamical systems, smart grids, pivotal and emerging technologies, S&T policy, and critical infrastructure security. Before becoming a professor of Electrical and Computer Engineering, at the University of Minnesota, he directed all Infrastructure Security, Grid Operations/Planning, and Energy Markets at the Electric Power Research Institute (EPRI) after 9/11. Prior to that he led mathematics and information sciences at EPRI, worked on self-repairing energy infrastructures, and led the development of over 24 technologies transferred to industry. Dr. Amin received his D.Sc. from Washington University, the Department of Systems Science and Mathematics (SSM) in May, 1990.