

## Smart Grids & Smart Cities: Emerging Frontiers of Control

**Dr Anuradha Annaswamy**

**Senior Research Scientist**

**Department of Mechanical Eng., MIT, Cambridge, MA 02139 USA**

**Email: aanna@mit.edu**

**Abstract:** As we move deeper into the 21st century, critical infrastructures related to energy and transportation are becoming *smart* – monitor themselves, communicate, and most importantly self-govern. Various drivers have enabled this transition, including sustainability concerns, scarcity in resources, economic considerations, and rapid growth in enabling technologies of sensor networks, and computational and communication systems. Two ideal illustrations of such infrastructures include smart grids and smart cities.

The smart grid infrastructure has come into sharp focus with the arrival of renewable resources such as wind and solar energy, global concerns of sustainability and greenhouse gas emissions, and dwindling resources of fossil fuels. The idea behind a Smart Grid is the creation of a dynamic, cyber-physical infrastructure that meets the challenges of intermittency and distributed availability of renewables, and realizes the advantages of reduced operational costs and emissions, via a flexible, intelligent, and networked grid that plans, controls, and balances supply and demand over an entire region. The concept of Smart City is gaining popular attention driven by goals of sustainability and efficiency, the needs of enhancing quality of life and affordability, and the explosion of technological advances in communication and computation. Given that 50% of the world's population lives in urban regions, critical infrastructures such as transportation, energy, and healthcare, as well as their growing interdependencies have to be collectively analyzed and designed to realize the Smart City concept.

In this talk, foundations of critical infrastructures will be presented, with particular emphasis on smart grids and smart cities. The role of decision and control in these applications, the associated research challenges, and recent successes will be discussed.



**Bio sketch of the speaker:** **Dr. Anuradha Annaswamy** received the Ph.D. degree in Electrical Engineering from Yale University in 1985. She has been a member of the faculty at Yale, Boston University, and MIT where currently she is the director of the Active-Adaptive Control Laboratory and a Senior Research Scientist in the Department of Mechanical Engineering. Her research interests pertain to adaptive control theory and applications to aerospace, automotive, and propulsion systems, cyber physical systems science, and CPS applications to Smart Grid, Smart Cities, and Smart Infrastructure. She is the author of a graduate textbook, over a hundred journal publications, and numerous conference publications. She is the co-editor of the IEEE CSS report on *Impact of Control Technology: Overview, Success Stories, and Research Challenges, 2014* (2<sup>nd</sup> edition), and the co-editor of the IEEE publication "IEEE Vision for Smart Grid Control: 2030 and Beyond," 2013.

Dr. Annaswamy has received several awards including the George Axelby and IEEE CSM best paper award, the Presidential Young Investigator award from the NSF, the Hans Fisher Senior Fellowship from the Institute for Advanced Study at the Technische Universität München (TUM) in 2008, and the Donald Groen Julius Prize for 2008 from the Institute of Mechanical Engineers. Dr. Annaswamy is a Fellow of the IEEE and a member of AIAA. She is currently the Vice President for Conference Activities in the Executive Committee of the IEEE Control Systems Society.