Holcombe Department of Electrical and Computer Engineering
Seminar Series

Energy Internet: Concept and Critical Technology Development

Dr. Alex Huang
Progress Energy Distinguished Professor of Electrical & Computer Engineering
North Carolina State University

Abstract

Dr. Huang proposed the vision of the Energy Internet in 2007 and the concept was inspired by the ever-growing electronic commerce (E-commerce) industry (e.g., ebay, Amazon) that provides consumer-to-consumer and business-to-consumer sales services via “Information Internet”. In a similar paradigm shift, the highly distributed and scalable electricity consumers/prosumers have to play a more active role that the centralized bulk power plants are currently serving. If the “Information Internet” was the engine that powered the economic growth in the last 20 years, then a similar and even more powerful “Energy Internet” will accomplish even more in the next several decades. The Energy Internet innovations will radically change the way people generate, distribute, and consume electricity every day.

The Energy Internet is a complex physical-cyber-social-business system involving cyber-systems (e.g., information networks), physical-systems (e.g., electric grid), and social-systems (e.g., business model, policy, human behavior). There are many critical technologies that must be developed. One of the first step is to transform the electric grid infrastructure into a reliable and resilient smart grid with plug-and-play capability. The FREEDM grid concept was proposed by Dr. Huang as part of the Energy Internet vision to be the resilient grid architecture to support the plug-and-play of high penetration of distributed generation and storage solutions. At the center of the FREEDM grid infrastructure is the migration of the grid from a passive one to an actively controlled and managed one, utilizing Solid State Transformer (SST) as a key enabling technology. This talk will discuss the FREEDM grid architecture, the SST technology, and the need to replace 60Hz transformer by SST technology, and to make an SST into a smart transformer, and eventually into an “Energy Router”.

Biography of Speaker

Dr. Alex Huang received his B.Sc. degree from Zhejiang University, China in 1983 and his M.Sc. degree from Chengdu Institute of Radio Engineering, China in 1986, both in electrical engineering. He received his Ph.D. from Cambridge University, UK in 1992. From 1994 to 2004, he was a founding member and a professor of Center for Power Electronics System (an NSF ERC) at Virginia Tech. Since 2004, he has been a professor of electrical engineering at North Carolina State University and he is currently the Progress Energy Distinguished Professor of Electrical and Computer Engineering. He established the NSF FREEDM Systems ERC in 2008. As part of the FREEDM System concept, he developed the original concept of Energy Internet with the Solid State Transformer serving as an Energy Router. Today, FREEDM Systems ERC is one of the most successful ERCs in the USA with support from many companies. Dr. Huang is also the lead PI and visionary leader behind NCSU’s recent success in establishing the next generation Wide bandgap power electronics manufacturing innovation institute. Dr. Huang’s research areas are power semiconductor devices, power management integrated circuits, power electronics and its emerging applications such as those in future electric power delivery and management systems. A very active and productive research leader, Dr. Huang has mentored and graduated more than 70 Ph.D. and master students and has generated more than $200m external R&D fundings in the last 20 years. Dr. Huang has published more than 400 papers in journals and conference proceedings, and holds 20 US patents. Dr. Huang is the inventor and developer of the ETO thyristor technology. Dr. Huang is a fellow of IEEE and the recipient of the prestigious 2003 R&D 100 award and 2011 MIT Technology Magazine awards.