

## Plenary Session Title

### “Electronic Energy Routing for Future Electrical Power Systems”

#### Abstract

Today, only ~20% of the total human energy consumption is from electricity. Since almost all sustainable energy is first converted to electricity, we may need to build 4-10 additional electrical power systems in the next 30 years if we are to achieve a *sustainable energy abundance*! But, constant-frequency synchronous (50/60 Hz) electromechanical grid cannot balance constantly varying distributed renewable generation with variable consumption instantaneously, and anyway, why would we build additional new power systems using the 150-year old technology?

The presentation will outline possible power electronics solutions for transporting electrical energy from renewable electricity generation through a global network of undersea and underground electrical HVDC and MVDC lines connected by electronic energy routers (“solid-state substations”). Several innovative approaches for implementing high-power-density converters for routing electrical energy packets, utilizing wide bandgap semiconductor devices operating at high-frequencies, will be described. Examples of design, implementation and testing of experimental MV and LV modules will be illustrated. This will include descriptions of intelligent gate drivers, current and voltage sensors, planar and coaxial power interconnects, auxiliary power system components, integrated passives, and electro-thermo-mechanical layout for partial-discharge-free operation. A novel concept of implementing real-time distributed control algorithms in modular multi-core hardware and multi-thread software will be discussed as well.

The new electronic power system, will be able to collect energy from wherever the sun is shining and wind is blowing and deliver it instantly, at the speed of light, to customers anywhere around the world.

#### Keynote Biography

Prof. Dushan Boroyevich  
*University Distinguished Professor*  
*Virginia Polytechnic Institute and State University*

Dushan Boroyevich received his Dipl. Ing. degree from the University of Belgrade in 1976 and his M.S. degree from the University of Novi Sad in 1982, in what then used to be Yugoslavia. He received his Ph.D. degree in 1986 from Virginia Tech, Blacksburg, USA. From 1986 to 1990, he was an assistant professor and director of the Power and Industrial Electronics Research Program at the University of Novi Sad. He then joined the Bradley Department of Electrical and Computer Engineering at Virginia Tech as associate professor. He is now University Distinguished Professor and Associate Vice President for Research and Innovation in Energy Systems at Virginia Tech. He was the president of IEEE Power Electronics Society for 2011-12.

Prof. Boroyevich is a member of the US National Academy of Engineering and is recipient of 4 honorary professorships in China and Taiwan, as well as numerous other awards, including the IEEE William E. Newell Power Electronics Technical Field Award and the European Power Electronics Association Outstanding Achievement Award. His research interests include electronic power distribution systems, multi-phase power conversion, power electronics systems modeling and control, and integrated design of power converters. Dushan advised almost 50 Ph.D. and 50 M.S. students.