Abstract:

Next-generation power systems are expected to be sustainable in composition, distributed in operation, and resilient to extenuating weather conditions. A compelling framework to seek these goals is provided by low-inertia microgrids. These are a heterogenous collection of renewable-energy resources and energy-storage devices that are interfaced to an AC electrical distribution system through power-electronic inverters. In this talk, we focus on islanded microgrids that are controlled and operated independently from the bulk power system.

We introduce a control method called Virtual Oscillator Control for synchronizing and regulating a collection of islanded power-electronic inverters without communication. The premise of virtual oscillator control is to program power-electronic inverters to emulate the dynamics of Lienard-type nonlinear oscillators. A system with virtual oscillator control is self-organizing in that the inverters synchronize their AC outputs, share the load, and collectively maintain voltage and frequency within regulatory limits without any supervisory control. A stable power system emerges innately by design, and the only form of communication is that provided by the physical electrical network that couples the inverters (oscillators). The proposed technique is developed using concepts from nonlinear control theory and experimental results are presented to validate the concept. The system-theoretic methods that will be outlined in this talk are relevant to the broad domain of synchronization phenomena in complex networks of coupled nonlinear oscillator circuits; a pervasive research topic in various scientific disciplines including neuroscience, physics, systems biology, social networks, and engineering.

Bio:

Sairaj Dhople received the B.S., M.S., and Ph.D. degrees in electrical engineering, in 2007, 2009, and 2012, respectively, from the University of Illinois, Urbana-Champaign. His research interests include modeling, analysis, and control of power electronics and power systems with a focus on renewable integration.

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