Topics and Challenges in Utility Interactive Systems

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Abstract

Utility interactive systems are becoming increasingly prevalent due to growth in renewable energy, energy storage, and electric vehicles. This talk will start with a brief review of reference frame theory with a particular focus on multiple reference frames. Though reference frame theory has a long history, some effects that have commonly been neglected are becoming increasingly important. Next, a few innovative control methods will be reviewed, followed by a look at systems of converters. Recent advances in stability and stochastic analysis will be discussed.

With these analysis and control methods established, the unique challenges of two applications will be explored. Aircraft ground support equipment must provide clean, harmonic-free, balanced, three-phase 400 Hz power. The primary challenge is that the harmonics of interest approach the Nyquist rate associated with typical PWM frequencies. Extreme fast charging of electric vehicles is an emerging problem that calls for sophisticated system-level power and energy management. An XFC station can experience load steps in the 400 kW range, which must be managed to maintain power quality on the distribution network. These two applications together drive new control and analysis methods for three-phase inverters and rectifiers.

Biography

Jonathan W. Kimball received the B.S. degree in electrical and computer engineering from Carnegie Mellon University, Pittsburgh, PA, in 1994, the M.S. degree in electrical engineering from the University of Illinois at Urbana-Champaign (Illinois) in 1996, and the Ph.D. degree in electrical and computer engineering from Illinois in 2007. He worked in industry at Motorola and Baldor, and subsequently co-founded SmartSpark Energy Systems. He joined the faculty at Missouri University of Science and Technology in 2008 where he is currently a professor.