

1. Tutorial Title

Data Center Power System Stability

2. Instructor Team

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3. Abstract

Data center power system design has traditionally emphasized efficiency and reliability. With the rapid growth in both scale and number of data centers, stability is becoming an important concern for power systems inside data centers as well as the grid they connect to. With virtually every watt of electricity processed by power converters at least 2-3 times, data centers have a very high concentration of power electronics, creating the potential for new types of instability that have challenged the development of renewable energy and power grids in recent years. An instability event may shut down an entire data center or parts of it due to protective actions or damage to power supplies and other components. Interactions with nearby power plants, especially onsite power generators, may also lead to excitation of generator torsional modes, causing generators to shut down and threatening the stability of the power grid.

This seminar introduces the concept of data center power system stability, reviews possible behavior and consequences of instability, including the effects on the power grid, and presents practical methods to analyze and mitigate the problem. Impedance-based frequency-domain models are developed for power supplies and overall data center power systems and used to study system stability. Practical methods to solve typical instability problems and to guarantee stability through the design of power supplies and other components are also presented. The seminar concludes with an overview of applications to other large load centers such as hydrogen production facilities, as well as a framework to study their impact on grid system stability. The topics are treated in-depth for an intermediate/advanced audience.

4. Instructor Biography

Dr. Jian Sun joined the faculty at Rensselaer Polytechnic Institute (RPI) in 2002, where he is currently a Professor in the Department of Electrical, Computer and Systems Engineering. He is also the Director of the Center for Future Energy Systems (CFES) funded by New York State. His research interests are in the general area of power electronics and energy conversion.

Dr. Sun received his doctorate from University of Paderborn, Germany. Prior to joining RPI, he spent five years at Rockwell Collins working on power electronics for aerospace power systems and was a Post-Doc Fellow at Georgia Tech from 1996 to 1997. As Director of CFES, he is responsible for the strategic directions and development of the Center's research, industry collaboration, education, and outreach programs. His professional activities in the power electronics community included serving as Editor-in-Chief of IEEE Power Electronics Letters from 2008 to 2014, Treasurer of IEEE Power Electronics Society (PELS) from 2013 to 2020, and as PELS Vice President of Conferences from January 2021 to December 2024.

Dr. Sun received the IEEE PELS Modeling and Control Technical Achievements Award in 2013 and the R. David Middlebrook Outstanding Achievement Award in 2017. He is a Fellow of IEEE.