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IEEE BDA Tutorial Series: Big Data & Analytics for Power Systems

Machine Learning Methods for Power System Digital Twin Development
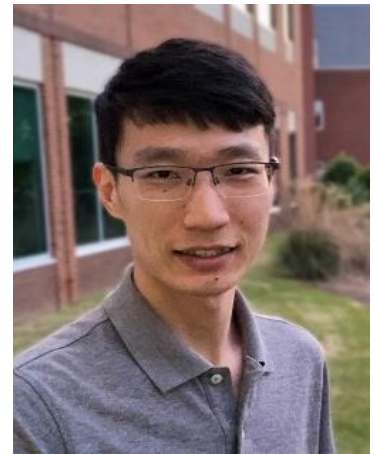
Ning Lu
North Carolina State University

Yiyan Li
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Lidong Song
North Carolina State University

9:00 am-11:00 am, Tuesday, Oct.18, 2022, Pacific Time
(6:00 pm - 8:00 pm, Tuesday, Oct.18, 2022, Central European Summer Time)

Link: https://asu.zoom.us/j/5513218843

Abstract: Many countries have set a goal to achieve 100% clean energy by 2035. This will spur integration of a large amount of renewable systems and operation of microgrid at all levels. To cope with the operational variability and uncertainty in those systems, new control technologies and energy management systems for maintaining system frequency and voltage are required. However, the development of those technologies requires the modeling of a wide variety of new topologies and unseen operating conditions in realistic simulated environments. In the past, only a limited number of IEEE test systems or typical feeder models are available. The data sets are often times snapshots in a small range of operation conditions. This will not be sufficient for meeting the increasing need for the development of high-fidelity power distribution grid digital-twins that can replay actual system operations and mimic its evolution when different control strategies are applied. In the past few years, we have been focusing on developing machine learning–based methods to automate and expedite the development of power system digital twins. In this tutorial, we are going to introduce the technical details of a few ML-based algorithms developed for such purposes: GAN-

based synthetic network topology and load profile generation, meta-learning based load forecasting, and GAN-based super-resolution tool for producing high-resolution data sets. The challenges and opportunities emerging in this research area will also be discussed.

Bio: Dr. Ning Lu is a Professor in the ECE Department of North Carolina State University. Dr. Lu is an IEEE Fellow and has over 25 years of experience in electric power engineering. She received her Ph.D. degree from Rensselaer Polytechnic Institute in 2002. From 2003 to 2012, Dr. Ning Lu was a senior research engineer with Pacific Northwest National Laboratory. Dr. Lu's research interests include load modeling and control, energy management systems, renewable integration, microgrid modeling and control, real-time and faster-than-real-time large-scale co-simulation systems, and meter data analysis. She has authored more than 150 publications.

Dr. Yiyan Li is currently a postdoc researcher at FREEDM Systems Center, NC State University supervised by Dr. Ning Lu, and will join Shanghai Jiao Tong University as an Assistant Professor by the end of this year. He received the B.S. and Ph.D. in 2014 and 2019 respectively, both in Electrical Engineering, Shanghai Jiao Tong University. His research mainly focuses on big data analytics and machine learning applications in power distribution systems, including forecasting technologies, synthetic data generation, etc.

Lidong Song received the B.S. degree in electrical engineering from the China University of Mining and Technology, Beijing, in 2016, and the M.S. degree in electrical engineering from Xi'an Jiaotong University, in 2019. He is currently pursuing the Ph.D. degree in electrical engineering with North Carolina State University, Raleigh, USA. His research interests include deep learning application and data-driven model development in distribution systems, such as load profile super-resolution, non-intrusive load monitoring, and baseline load estimation.