Hybrid AC and DC Networked Microgrids Towards Grid Modernization: Control, Optimal Design, and Implementation

Abstract:

A resilient, stable, and secure distribution system is urgently needed to modernize electric grids and ensure operational continuity. As effective entities of integrating DERs and local loads, single as well as networked microgrids have been widely deployed in modern distribution grids. In this tutorial, a cross-layer and resilient control framework of networked and dynamic microgrids with stability guarantees will be discussed. Meanwhile, a system-level optimization algorithm will be introduced to determine the dynamic formation of networked microgrids 'on-the-fly' considering the real-time operating conditions. Focusing on the actual implementation, typical applications of hybrid AC and DC networked microgrids will be explored, including solar energy integration, coastal community resiliency enhancement, distribution grids black start, among others. This tutorial will be organized with a joint effort from national lab, academia, and industry practitioners.

Instructor Bio:

Feng Qiu received the B.E. degree from Huazhong University of Science and Technology, China and the Ph.D. degree from the School of Industrial and Systems Engineering at the Georgia Institute of Technology in 2013. He is a Principal Computational Scientist with the Energy Systems Division at Argonne National Laboratory, Argonne, IL, USA. The current research interests of Dr. Qiu and his research group include optimal operation in modern power systems, power grid resiliency enhancemenet, and networked microgrids. Dr. Feng is the Editor of IEEE Transactions on Power Systems, and IEEE Power Engineering Letters. His work on power grid operation and control is funded by multiple offices across the U.S. Department of Energy (DOE).

Jianzhe Liu received the B.E. degree in electrical engineering from Huazhong University of Science and Technology, China, in 2012, and the Ph.D. degree in electrical and computer engineering from The Ohio State University, US, in 2017. Dr. Liu was a visiting scholar at Aalborg University, Denmark, in 2017. He is currently an Energy Systems Scientist at Argonne National Laboratory. His research interests include robust control and optimization for electric power systems.

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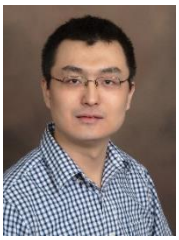

Xiaonan Lu received his B.E. and Ph.D. degrees in electrical engineering from Tsinghua University, Beijing, China, in 2008 and 2013, respectively. From September 2010 to August 2011, he was a guest Ph.D. student at the Department of Energy Technology, Aalborg University, Denmark. From October 2013 to December 2014, he was a Postdoc Research Associate at the Department of Electrical Engineering and Computer Science, University of Tennessee, Knoxville. From January 2015 to July 2018, he was with Argonne National Laboratory, first as a Postdoc Appointee and then an Energy Systems Scientist. In July 2018, he joined the College of Engineering at Temple University as an Assistant Professor. His research interests include modeling and control of power electronic inverters, hybrid AC and DC microgrids, power electronics dominated power grids, and real-time hardware-in-the-loop simulation. Dr. Lu is the Associate Editor of IEEE Transactions on Industrial Electronics, the Associate Editor of IEEE Transactions on Industry Applications, the Editor of IEEE Transactions on Smart Grid, and the Editor of Power Engineering Letters. He serves as the Vice Chair of the Industrial Power Converters Committee (IPCC) in IEEE Industry Applications Society (IAS) and the Secretary of the Joint Power Electronics (PELS) and IAS Chapter in Princeton/Central Jersey/Philadelphia. Dr. Lu received the IEEE Philadelphia Section Delaware Valley Young Electrical Engineer of the Year in 2020.

Xuan Wu received the M.S. degree in EE from Arizona State University, Tempe, AZ, in 2013, and the Ph.D. degree from The Ohio State University, Columbus, OH, in 2018. Currently, he is a Principal Engineer at American Electric Power (AEP). His research interests include power system operation, planning, security & resilience, transmission engineering and equipment. Xuan received AEP Key Contributor Award, IEEE PES Columbus Chapter Outstanding Engineer Award, and IEEE Transactions on Power Systems Best Paper Award. He is currently an Editor of International Transactions on Electrical Energy Systems. Dr. Wu is the Representative of IEEE PES Region 2, an IEEE Senior Member, and a Registered Professional Engineer licensed in Ohio.