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Nov 29 - Dec 2, 2021

Panel Discussion

Big Data Analytics for Smart Energy Systems

Time: Nov. 30th 13:00–15:20 (GMT+1)

The comprehensive digitization, informatization, and intelligence of the energy system have made the amount of relevant data increase exponentially, and it has the remarkable characteristics of massive, multi-source, heterogeneous, and so on. By combining massive data with collected information from different links of the energy system, various entities, such as power utilities, customers, energy investment, society, etc., can use big data analytics technology to deepen the understanding of the energy system and its relevant links and create new value. This panel will discuss big data analytics application in the smart energy systems.

Moderator

Dr. Yanli Liu
Tianjin University

Short Bio

She is the associate professor of the school of electrical and information engineering, head of the department of electrical engineering and executive deputy director of integrated energy power system intellectual center in Tianjin University.

Her research area includes power system stability and security, cyber physical power system, and data-driven method applications in Smart Grid. She is now the “Smart Grid and Energy Internet” Subject Associate Editor of the journal Engineering (published by Chinese Academy of Engineering) and Associate Editor of the journal International Journal of Electrical Power & Energy Systems. She is vice-chair of the IEEE Task Force " Application of Big Data Analytic on Transmission System Dynamic Security Assessment" and secretary of the IEEE Task Force “Cyber-Physical Interdependence for Power System Operation and Control”.

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AppliedEnergy Editor in Chief: J. Yan

Speakers

Prof. Nikos Hatziargyriou
National Technical University of Athens
GMT+1 13:00-13:20

Topic: The role of data in intelligent distribution grids

Abstract

The role of Intelligent Distribution Networks, as the backbone of future integrated energy systems, will be first discussed. In order to operate efficiently the complex future integrated systems wide application of ICT technologies is required. For this reason, large investments are planned by distribution system operators in grids digitalization. In distribution system operation and planning in particular, the benefits provided by the organization and exploitation of the large amount of data, available by the wide deployment of smart meters, sensors, smart substations, intelligent devices, etc. are very significant. The key functionalities that can strongly benefit from the proper use of data and the way they can lead to a more secure and efficient operation of the system will be described. Indicative results of data applications in distribution systems and other power system areas will be briefly reported.

Short Bio

Nikos D. Hatziargyriou is professor in Power Systems at the National Technical University of Athens. He has over 10 years industrial experience as Chairman and CEO of the Hellenic Distribution Network Operator and as executive Vice-Chair of the Public Power Corporation. He was chair and vice-chair of the EU Technology and Innovation Platform on Smart Networks for Energy Transition (ETIP-SNET). He is honorary member of CIGRE and Life Fellow of IEEE, currently Editor in Chief of the IEEE Trans on Power Systems. He is the 2017 recipient of the IEEE/PES Prabha S. Kundur Power System Dynamics and Control Award. He is author and of more than 250 journal and 500 conference papers and he is included in the 2016, 2017 and 2019 Thomson Reuters lists of top 1% most cited researchers. He is Globe Energy Prize laureate 2020.

Prof. Vladimir Terzija
Humboldt Fellow
IEEE Fellow
GMT+1 13:20-13:40

Topic: On infrastructure and methods for model-free monitoring of voltage-instability in modern power systems

Abstract

As a result of high penetration of Converter Interfaced Generation (CIG), also called nonsynchronous generation, converter connected demand and mixed ac-dc transmission and even distribution networks, the nature of operation of modern electrical power systems became a challenge. The nature of the entire system became more complex, expressed in quite a new dynamic, requesting new approaches for monitoring, protection and control. On the other hand, availability of modern sensor and ICT technology opened new paradigms for coping with previously described challenges. The presentation is aiming at addressing new approaches of monitoring of future electrical power systems, focused on voltage instability detection and monitoring. In this context, a novel model-free and data driven approach based on Maximum Lyapunov Exponent calculation, will be discussed and presented. Experience gathered from 3 flagship and large-scale projects funded by Ofgem (UK) Network Innovation Competition, VISOR, EFCC and FITNESS projects, will be summarized and also discussed from the perspective of their extension to another level: integration of different energy systems and approaches for their operation, fostering flexibility and resilience of a particular integrated energy system. Approaches used in the AMPaC Megagrant project (https://ampac.skoltech.ru/), will be discussed, too.

Short Bio

Vladimir Terzija was born in Donji Baraci (former Yugoslavia). He received the Dipl-Ing., M.Sc., and Ph.D. degrees in electrical engineering from the University of Belgrade, Belgrade, Serbia, in 1988, 1993, and 1997, respectively. He is a Full Professor at Skoltech, Moscow, Russian Federation. He is also a Distinguished Professor at the Shandong University, Jinan, China, where he has been since 2013. From 1997 to 1999, he was an Assistant Professor at the University of Belgrade, Belgrade, Serbia. From 2000 to 2006, he was a senior specialist for switchgear and distribution automation with ABB, Ratingen, Germany. From 2006 to 2020 he was the EPSRC Chair Professor in Power System Engineering with the School of Electrical and Electronic Engineering, The University of Manchester, Manchester, U.K. His current research interests include smart grid applications; wide-area monitoring, protection, and control; multi-energy systems; switchgear and transient processes; ICT, data analytics and digital signal processing applications in power systems. Prof. Terzija is Editor in Chief of the International Journal of Electrical Power and Energy Systems, Alexander von Humboldt Fellow, Fellow of IEEE, as well as a DAAD and Taishan Scholar. He is the recipient of the National Friendship Award, China (2019).

Prof. Z.Y. Dong
University of NSW

GMT+1 13:40-14:00

Topic: Data driven electric vehicle and charging infrastructure modelling and optimization

Abstract

Shared monility business is a key driving force for the diffusion of electric vehicles aiming at better social, environmental and mobility benefits in the city. Optimal mobility planning requires a wholistic approach to consider siting and sizing of charging facilities in power distribution networks while trying to maintain system stability and reliability with high EV penetrations. In this talk a framework for EV infrastructure planning considering economic benefit together with maximizing mobility demands will be presented with case studies. Modelling of the uncertainties associated with EVs is included in this framework. The planning problem is formatted as a multi-objective optimization problem which can be solved effectively with mixed integer nonlinear programming optimization and stochastic dynamic discrete simulations.

Short Bio

Professor Z.Y. Dong obtained Ph.D. from the University of Sydney, Australia. He is a SHARP Professor of Energy Systems at the University of NSW, Sydney, Australia. He is also serving as Director of the University of NSW's Digital Grid Futures Institute; and Director of Australian Research Council Research Hub for Integrated Energy Storage Solutions. His immediate role is Professor and Head of the School of Electrical and Information Engineering, The University of Sydney. He was Ausgrid Chair and Director of the Ausgrid Centre for Intelligent Electricity Networks (CIEN) providing R&D support for the Smart Grid, Smart City national demonstration project of Australia. He also worked as manager of a state transmission network service provider in Australia responsible for transmission system planning. His research interest includes smart grid and smart cities, power system planning, power system dynamics and stability, load modeling, renewable energy systems, and electricity market. He has also been working as editor/associate editor for a number of IEEE transactions and IET journals. He is Fellow of IEEE and a Web of Science Highly Cited Researcher.

Prof. Le Xie
Texas A&M University
GMT+1 14:00-14:20

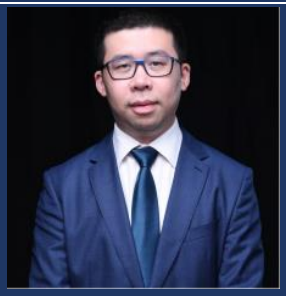
Topic: An open-access cross-domain approach to analyzing the impact of extreme events on the electricity sector: what we learned from COVID-19 and 2021 Texas winter outage

Abstract

Extreme events such as COVID-19 and the 2021 Texas power outage are placing increasing amount of operational challenges to the resiliency of the electricity sector. We illustrate an open-access and cross-domain approach to analyzing the short-run impact and corrective measures of these extreme events on the electricity sector. We release a first-of-its-kind cross-domain open-access data hub, integrating data from across all existing U.S. wholesale electricity markets with COVID-19 case, weather, mobile device location, and satellite imaging data. Leveraging cross-domain insights from public health and mobility data, we rigorously uncover a significant reduction in electricity consumption that is strongly correlated with the number of COVID-19 cases, degree of social distancing, and level of commercial activity. For the 2021 Texas power outage, we collaboratively release an open-source extendable model that is synthetic but nevertheless provides a realistic representation of the actual energy grid, accompanied by open-source cross-domain data sets. This simplified synthetic model is calibrated to the best of our knowledge based on published data resources. Building upon this open-source synthetic grid model, researchers could quantitatively assess the impact of various policies on mitigating the impact of such extreme events. This approach and methodology are generalizable for other regions experiencing significant energy portfolio transitions.

Short Bio

Dr. Le Xie is a Professor, Chancellor EDGES Fellow, and Presidential Impact Fellow in the Department of Electrical and Computer Engineering at Texas A&M University, and the Assistant Director-Energy Digitization at Texas A&M Energy Institute. He received B.E. in Electrical Engineering from Tsinghua University in 2004, S.M. in Engineering Sciences from Harvard in 2005, and Ph.D. in Electrical and Computer Engineering from Carnegie Mellon in 2009. His industry experience includes ISO-New England and Edison Mission Energy Marketing and Trading. His research interest includes modeling and control in data-rich large-scale systems, grid integration of clean energy resources, and electricity markets. Dr. Xie received the U.S. National Science Foundation CAREER Award, and DOE Oak Ridge Ralph E. Powe Junior Faculty Enhancement Award. He was awarded the 2021 IEEE Technical Committee on Cyber-Physical Systems Mid-career Award, and 2017 IEEE PES Outstanding Young Engineer Award. He is a Fellow of the IEEE (Class 2022). He was recipient of Texas A&M Dean of Engineering Excellence Award, ECE Outstanding Professor Award, and TEES Select Young Fellow. He serves or have served on the Editorial Board of IEEE Transactions on Smart Grid, IET Transaction on Smart Grid, and Foundations and Trends in Electric Energy Systems. He is the founding chair of IEEE PES Subcommittee on Big Data & Analytics for Grid Operations. His team received the Best Paper awards at North American Power Symposium 2012, IEEE SmartGridComm 2013, HICSS 2019 and 2021, IEEE Sustainable Power & Energy Conference 2019, and IEEE PES General Meeting 2020.



Prof. Junhua Zhao
The Chinese University of Hong Kong, Shenzhen
Director of Energy Markets and Finance Lab
GMT+1 14:20-14:40

Topic: Cyber physical social system for supporting low carbon energy transition

Abstract

In the context of the "dual carbon" strategy, China's power system will undergo a low-carbon transition from thermal power to new energy in the next 30-40 years. The low-carbon power system can theoretically be represented as a complex network system containing the triple elements of information-physics-society. This lecture discusses how to utilize AI and big data analytics to build a low-carbon power system model from three levels: micro modeling (user behavior), meso modeling (corporate behavior), and macro modeling (policy formulation), and introduces several practical applications.

Short Bio

Professor Zhao is a National Youth Expert at the Chinese University of Hong Kong, Shenzhen. The director of the Energy Market and Finance Lab, the Shenzhen Finance Institute, and an invited energy industry expert at China Merchants Bank. He has long been engaged in research on smart grid, energy economy, low-carbon transition, and artificial intelligence. In 2020, he was named "Top 2% Scientists in the World" by Stanford University and Mendeley Data. In 2017, he was awarded the Young Scientist of the Future by the ADC Forum in Australia. In 2017, he won the "China's 100 Most Influential Chinese Sci-tech Journal Papers" award from the Ministry of Science and Technology. He won the Hunan Science and Technology Progress Award twice, and the Zhejiang Natural Science Award once. His research have had important impacts in the industry. Has participated in the rule design for multiple domestic power markets. A number of software products he developed have been applied to large energy companies such as New York Edison, Hongkong Electric, Guangdong Energy Group, CNOOC, and Datang Power Generation.

Dr. Yan Xu
Associate Professor and Cluster Director at Energy Research Institute
Nanyang Technological University (NTU), Singapore
GMT+1 14:40-15:00

Topic: Data-driven frequency control of stochastic power systems

Abstract

Load frequency control (LFC) of a power system aims to restore system frequency and eliminate unscheduled tie-line power interchange among different control areas. Intermittent renewable energy sources (RES) such as wind and solar power have introduced significant challenges for LFC due to more complex cross-area power balancing between generation and demand. This seminar will present a series of deep reinforcement learning (DRL) based data-driven methods for more effective LFC of the stochastic power systems with large-scale RES. The principle of DRL will be explained at first. Then, a value-based DRL model will be introduced for single-area LFC, followed by a multi-agent DRL model for coordinated LFC of multi-area power systems. After that, a data-driven controller for energy storage system is introduced to provide LFC support to the power grid.

Short Bio

Dr Yan Xu obtained his B.E. and M.E. degrees from South China University of Technology, Guangzhou, China, and PhD degree from University of Newcastle, Australia. He did postdoctoral research with University of Sydney Postdoctoral Fellowship and then joined Nanyang Technological University (NTU) with the Nanyang Assistant Professorship. He is now an Associate Professor at School of EEE and a Cluster Director at Energy Research Institute @ NTU (ERI@N).

Dr Xu is now leading the SODA (Stability, Optimization & Data-Analytics) research group which consists of 14 PhD students and 6 Post-doctoral Fellows, focusing on power system stability, microgrid, and smart grid data-analytics. His research is funded by Singapore National Research Foundation (NRF), Ministry of Education (MOE), Energy Market Authority (EMA), Housing & Development Board (HDB), Rolls-Royce, Singtel, Infineon, Singapore Power (SP) Group, Lite-On, and technology start-up companies. Many of his research outcomes have been practically applied/licensed to the industry.

As the first/corresponding author, Dr Xu has published 1 book, 93 IEEE Transactions papers and 30 IET journal papers. He has 13 "Web-of-Science highly cited papers" and received 11 IEEE/IET paper contest and conference best paper awards. Dr Xu is serving as an Editor for IEEE Transactions (TSG and TPWRS), IET journals (GTD and ECE), and China's international power engineering journals (CSEE JPES and MPCE). He is also serving as the Chairman for IEEE Power & Energy Society (PES) Singapore Chapter.

Discussion

GMT+1 15:00-15:20