EPE'25 – Call for Tutorials

POWER QUALITY AND OPERABILITY OF DISTRIBUTED POWER GENERATION SYSTEMS: ADVANCED AND INTELLIGENT CONTROL

Names and Affiliations of the Lecturers:

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Tutorial Objectives:

In this paragraph, please describe the tutorial objectives of the tutorial that you propose. Please make sure the objectives are clearly described.

Power electronics play a crucial role in enabling green and sustainable energy generation, distribution and utilization across various electric systems (e.g., AC, DC, hybrid, grid-tied, standalone etc.). Their applications extend to residential, industrial and commercial systems, as well as to distributed power generation systems (DPGS). Thanks to advancements in power electronics and intelligent control, DPGS are increasingly driving the adoption of renewables, accelerating transportation electrification, promoting Smart Grid development, and facilitating Zero Energy Buildings. However, they face challenges in ensuring uninterruptible, high-quality power supply, adhering to international standards. Hence, the development of advanced control systems, capable of maintaining power quality and smart management in dynamic environments is imperative. In this light, this tutorial addresses technological challenges associated with the mass adoption of power electronics-based DPGS. It offers a step-by-step guide to designing key power electronic systems that meet stringent regulatory standards. The primary objective is to provide practical insights into enhancing power quality, operational efficiency, and compliance with grid regulations. Additionally, the tutorial explores the integration of advanced control technologies, including AI, to develop sustainable, grid-friendly, and cost-effective DPGS. By the end of the session, participants will gain a comprehensive understanding of how power electronics can improve DPGS sustainability, enhance decision-making capabilities, and contribute to the broader target of reducing energy costs while meeting regulatory demands.

Target Audience:

In this paragraph, please describe the target audience of the tutorial that you propose. Please make sure the target audience is clearly described.

The tutorial targets intermediate and advanced engineers and researchers in power electronics, who look for advanced DPGS solutions, as well as higher-grade undergraduates and postgraduates. In parallel, anyone who seeks fundamental knowledge for power electronics technology and DPGS systems integration is mostly welcome.

Topical Outline:

Part 1 – *Power Electronics and Control of DPGS* (Estimated time: 55 minutes)

- General Requirements on DPGS *(10 minutes)*
  - Motivation and background
  - Renewable and distributed systems development
- Power Electronics and Control of PV Systems *(45 minutes)*
  - Power electronics and general control of DPGS
  - High-precision current control and design
  - Advanced and intelligent control for DPGS

Break and Transition (5 minutes)

Part 2 – *Advanced Compensators and Their Control in DPGS* (Estimated time: 55 minutes)

- Power Quality Issues in DPGS *(10 minutes)*
  - Motivation and background
  - Impacts and standards for PQ issues
- Advanced PQ Compensators and Their Control *(45 minutes)*
  - Principle of PQ compensators
  - Design, control, and analysis of PQ compensators
  - Advanced control and coordination of hybrid APFs

Break and Transition (5 minutes)

Part 3 – *AI Techniques in Power Electronics for DPGS* (Estimated time: 55 minutes)

- AI for Power Quality in DPGS *(20 minutes)*
  - Motivation and background
  - Digitalization and intelligence in DPGS
  - AI techniques for power quality improvement in DPGS
- AI for Operability of DPGS *(35 minutes)*
  - Fault diagnostics and fault-tolerant control
  - AI management and protection in DPGS
  - AI enabled virtual inertia and ancillary services
  - Stability enhancement with AI

Break and Transition (5 minutes)

Conclusion and Outlook (Estimated time: 5 minutes)

- Seminar summary
- Future trends

Provisional Schedule of the Tutorial:

Monday, Mar. 31, 2025 (the tutorial is planned for 3 hours)

10:00 - 10:55: Short Introduction / Part 1
10:55 - 11:00: Coffee break
11:00 - 11:55: Part 2
11:55 - 12:00: Coffee break
12:00 - 12:55: Part 3
12:55 - 13:00: Conclusion

About the Lecturers:

Yongheng YANG (Senior Member, IEEE) received the B.Eng. degree from Northwestern Polytechnical University, China, in 2009, and the Ph.D. degree from Aalborg University, Denmark, in 2014. From 2014 to 2020, he was with the Department of Energy Technology, Aalborg University, where he achieved the rank of tenured Associate Professor in 2018. In 2021, he joined Zhejiang University, Hangzhou, China, as a ZJU100 Professor. He became a Zhejiang Topnotch Scholar in 2023, which is awarded to him to tackle the issues for the large-scale integration of power electronics-based renewable energy systems. Prof. Yang served as the Chair of the IEEE Denmark Section in 2019–2020 and is an Associate Editor for several IEEE Transactions/Journals. He was the recipient of the 2018 IET Renewable Power Generation Premium Award and was recognized as an Outstanding Reviewer for the IEEE TPEL in 2018. He was the recipient of 2021 IEEE Richard M. Bass Outstanding Young Power Electronics Engineer Award from the IEEE Power Electronics Society and the 2022 IEEJ Isao Takahashi Power Electronics Award. In addition, he was the recipient of three IEEE Best Paper Awards. He was included on the list of the Highly Cited Chinese Researchers by Elsevier in 2022–2024. He is currently a Vice Chair of the IEEE PELS Technical Committee on Sustainable Energy Systems and a Council Member of the China Power Supply Society.

Chi-Seng LAM (Senior Member, IEEE) received the Ph.D. degree in electrical and electronics engineering from the University of Macau (UM), Macao, China, in 2012. He completed the Clare Hall Study Programme at the University of Cambridge, Cambridge, U.K., in 2019. In 2013, he was a Postdoctoral Fellow with The Hong Kong Polytechnic University, Hong Kong, China. He is currently an Associate Professor with the State Key Laboratory of Analog and Mixed-Signal VLSI and the Institute of Microelectronics, UM, and also with the Department of Electrical and Computer Engineering, Faculty of Science and Technology, UM. He has coauthored or co-edited four books and more than 160 technical journals and conference papers. He holds six U.S. and three Chinese patents. His research interests include power quality compensators, renewable energy generation, power management integrated circuits, and wireless power transfer.

Nick PAPANIKOLAOU (Senior Member, IEEE) received the Dipl. Eng. and Ph.D. degrees in electrical & computer engineering from the University of Patras, Patras, Greece, in 1998 and 2002, respectively. Prior to his Academic Career, he worked in the Hellenic Transmission System Operator and in the Electric Transportation Company of Athens. In 2013 he joined Democritus University of Thrace, Xanthi, Greece, where he is currently a Professor at the Electrical & Computer Engineering Department (ECE-DUTH), in the field of Power Electronics and their applications to renewable energy, distributed generation, electric transportations, and power quality improvement. He has led several research projects with Hellenic Industries, EU Institutions, and Companies and serves as an EU project evaluator and Visiting Professor (member of several PhD committees) in Universities abroad. Dr. Papanikolaou is an Editorial Board member of various scientific journals (Elsevier, Springer, CPSS and MDPI) and he is included in the Stanford list of top 2% scientists (Electrical & Electronic Engineering field). He also serves as the Vice President and the Director of the MSc & PhD Programs of the ECE-DUTH department.