Title of the Proposal: Advances and Trends in Modular Multilevel Power Converters for Medium Voltage Grid Applications

- Presenter(s):
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  - Ezequiel Rodriguez Ramos is with the Energy Research Institute at Nanyang Technological University, 639798 Singapore (e-mail: ezequiel.rr@ntu.edu.sg).
  - Glen Ghias Farivar is with the School of Electrical and Electronic Engineering, University of Melbourne, 3010 Australia (e-mail: glen.farivar@unimelb.edu.au).
  - Gorla Naga Brahmendra Yadav is with the School of Electrical and Electronic Engineering, Indian Institute of Technology Palakkad, 678623 India (e-mail: a0135566@u.nus.edu).

- Brief description:
This conference tutorial aims to provide a comprehensive overview of modular multilevel power converters (MMPC) for medium voltage (MV) power grids. The tutorial will cover the topologies, modulation, and control aspects of MMPC, including conventional and advanced methods, and fault diagnosis techniques. The speakers will focus on two specific applications of MMPC, namely MMPC-based STATCOMs and MMPC-based energy storage systems for renewable energy integration into the MV grid. Additionally, advanced topics such as low-capacitance STATCOM systems and hybrid energy storage systems with active power disparity constraints will be addressed. The tutorial will also explore the research problems and potential future paths for this family of power converters. Attendees will gain a comprehensive understanding of MMPC and its potential applications in the context of MV power grids.

- Duration:
The tutorial duration is of 3 hours, including a 15 min break.

- Outline:

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<td>MMPC for active power control in MV grids: Battery energy storage, PV</td>
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<td>MMPC for reactive power control in MV grids: Advanced topologies and</td>
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-Brief CV:

Josep Pou received the B.S., M.S., and Ph.D. degrees in electrical engineering from the Technical University of Catalonia (UPC)-Barcelona Tech, in 1989, 1996, and 2002, respectively. In 1990, he joined the faculty of UPC as an Assistant Professor, where he became an Associate Professor in 1993. From February 2013 to August 2016, he was a Professor with the University of New South Wales (UNSW), Sydney, Australia. He is currently a Professor with the Nanyang Technological University (NTU), Singapore, where he is Cluster Director of Power Electronics at the Energy Research Institute at NTU (ERI@N) and co-Director of the Rolls-Royce at NTU Corporate Lab. From February 2001 to January 2002, and February 2005 to January 2006, he was a Researcher at the Center for Power Electronics Systems, Virginia Tech, Blacksburg. From January 2012 to January 2013, he was a Visiting Professor at the Australian Energy Research Institute, UNSW, Sydney. He has authored more than 440 published technical papers and has been involved in several industrial projects and educational programs in the fields of power electronics and systems. His research interests include modulation and control of power converters, multilevel converters, renewable energy, energy storage, power quality, HVdc transmission systems, and more-electrical aircraft and vessels. He is Associate Editor of the IEEE Journal of Emerging and Selected Topics in Power Electronics. He was co-Editor-in-Chief and Associate Editor of the IEEE Transactions on Industrial Electronics. He received the 2018 IEEE Bimal Bose Award for Industrial Electronics Applications in Energy Systems.

Glen G Farivar received the B.Sc. degree in electrical engineering from the Nooshirvani Institute of Technology, Babol, Iran, in 2008, the M.Sc degree in power electronics from the University of Tehran, Tehran, Iran in 2011, and PhD in electrical engineering from the University of NSW Australia, Sydney, Australia in 2016. From 2017 to 2022 he was with the Nanyang Technological University, Singapore, as a senior research fellow at the Energy Research Institute (ERI@N) and a co-director of Power Electronics and Applications Research Lab. Since 2023 he joined the University of Melbourne as a lecturer in power electronics. He is a co-founder of SciLeap which aims to promote research integrity, accessibility, and openness. His research interests include renewable energy systems, high power converters, energy storage, FACTS, and electric vehicles.

Naga Brahmeendra Yadav Gorla received the M.S. degree in electrical engineering from the Indian Institute of Technology Madras, Chennai, India, in 2013, and the Ph.D. degree in electrical engineering from the National University of Singapore, Singapore, in 2019. From October 2013 to December 2015, he was a Research Engineer with Electrical and Electronics Department, Singapore Polytechnic, Singapore. From April 2019 to July 2020, he was a Research Fellow with Semcoro-NUS Corporate Laboratory, National University of Singapore. He was a Research Fellow with Energy Research Institute, Nanyang Technological University, Singapore between August 2020 and December 2022. He is currently an Assistant Professor at the Indian Institute of Technology, Palakkad, India. His research interests include common-mode and differential-mode noise analysis and mitigation in Wide Bandgap based power
converters, fault tolerance and resiliency in modular power electronic converters, and solid-state-transformer architectures and their control strategies.

Ezequiel Rodriguez was born in Tarragona, Spain, in 1994. He graduated with a bachelor’s degree in electrical engineering and a master’s degree in engineering and technology of electronic systems (topping the 2012 and 2016 graduating cohorts as Valedictorian) from Universitat Rovira i Virgili, Catalonia, Spain, in 2016 and 2017, respectively. He procured his Ph.D. degree in electrical engineering from Nanyang Technological University (NTU), Singapore, in 2022. He is currently working as a post-doctoral research fellow at the Energy Research Institute at NTU (ERI@N), and the co-director of the Power Electronics and Applications Research Lab at NTU (PEARL@NTU), Singapore.

Dr. Ezequiel received the prestigious Best Thesis Award from the EEE School at NTU in 2022. His research interests include modelling and the control of power electronics converters, with an emphasis on modular multilevel cascade converters for renewable energies, energy storage, e-mobility, electrolyser, solid-state transformers, and power quality devices.

- Relevant publications:


