Keynote Presentations

Keynote1

Title:

Stability in DC microgrids: what can we learn from AC world?

Speaker:

Mario Schweizer, ABB, Switzerland

Abstract:

In converter-based grids, such as DC microgrids, there is a certain risk of instability due to interactions of converter control loops. Over the years, many different analysis and design methods have been proposed to tackle this issue, but most of them are only suitable for simple and small microgrids. What about larger networks? In this talk, methods developed for converter-based AC grids are presented. Many solutions can be applied to DC microgrids as well and we can profit from the strong knowledge base related to stability issues in the AC world.

Bio:

Mario Schweizer received the M.Sc. and Ph.D. degrees in electrical engineering from ETH Zurich, Switzerland, in 2008 and 2012. Since 2013, he has been with ABB Corporate Research in Switzerland, where he is currently working as a Senior Principal Scientist. From 2017-2023, he was in addition a lecturer of power electronics and drives with the University of Applied Sciences and Arts Northwestern Switzerland. His research interests include advanced converter topologies, converter control, converter interactions in the future power grid and AC/DC microgrids.

Keynote 2

Title:

Evolution of the DC Grid: Challenges and Opportunities

Speaker:

Rajib Datta, GE Vernova, USA

Abstract:

With renewables as the primary source of generation, the grid of the future will be driven by power electronic converters. However, any asynchronous generation needs to go through several power electronic conversion stages today for grid integration. Based on the motivation of making the future grid architecture more efficient, flexible, and affordable, the talk will focus on the evolution of a DC-based grid. The gradual development of DC power conversion systems for power delivery will be discussed. Key technologies and architectures from high voltage DC (HVDC) to medium voltage DC (MVDC) will be presented, including gaps and potential areas of innovation. The talk will conclude with some thoughts on how to build an eco-system to accelerate the adoption DC architectures for faster deployment of renewables and address the existential challenge of climate change.

Bio:

Dr. Rajib Datta is the Chief Engineer at GE Vernova's Advanced Research Center in Niskayuna, NY. He has over 24 years of experience in power electronics and electrical systems in a broad range of industrial applications and is currently leading R&D projects for GE's energy related businesses. His specific interests are in the integration of renewables, energy storage, flexible AC transmission systems (FACTS), high voltage DC transmission (HVDC), and application of new power electronic devices. After finishing his

PhD from Indian Institute of Science, Bangalore, he started his career at ABB Corporate Research, Germany in 2000. Since joining the GE Research Center in 2002, he has held various positions, including manager of the power electronics lab and technology leader for silicon carbide power device applications. Dr. Datta has over 50 US patents in power conversion and has authored more than 35 publications in international conferences and journals.

Keynote 3

Title:

DC grids and ships: technological trends, proof of concepts, integrated ship design

Speaker:

Giorgio Sulligoi, University of Trieste, Italy

Abstract:

The keynote will present main trends and reasons for transportation electrification in the marine sector. The keynote will cover the following aspects:

- Ships power system evolution.
- Shipboard electrical technologies (Integrated Power & Energy Systems).
- MVDC power systems on ships. From concepts to high-performance.
- ETEF: the Electric TEst Facility in Trieste.
- Electric ship design (methods and tools).

Bio:

Giorgio Sulligoi (Senior Member IEEE) earned the Ph.D. (University of Padua, 2005) and the M.Sc. (University of Trieste, 2001), both in Electrical Engineering. He is the founder and Director of the Digital Energy Transformation & Electrification Facility (D-ETEF) at the Department of Engineering and Architecture of the University of Trieste. He joined the

University of Trieste as an Assistant Professor of Electric Power Generation and Control in 2007, tenured since 2010, appointed Associate Professor of Shipboard Electrical Power Systems since 2016 and elevated to Full Professor in 2019. Dr. Sulligoi has been Deputy Rector for Community Affairs and Business Relations of the University of Trieste, Italy in 2013-2019.

He is the author of about 200 scientific papers and 4 book chapters in the fields of shipboard power systems, all-electric ships, generators modeling and voltage control, where he also has earned some scientific awards. He is one of the technical program chairmen of IEEE ESARS (the International Conference on Electrical Systems for Aircraft, Railway and Ship Propulsion), recently also named as ITEC-EUROPE. He is a member of the technical committee of IEEE ESTS (Electric Ship Technologies Symposium). He is the General Coordinator of the V-ACCESS (Vessel Advanced Clustered and Coordinated Energy Storage Systems), a Horizon Europe Research & Innovation Action, and of the ETEF (Electric TEst Facility) research program (coordinator: University of Trieste; partners: Wartsila Italy, Fincantieri Group) He has been the Scientific Manager of MVDC Large Ship research program (funder: Regional Government of Trieste, lead partner: Fincantieri; research partners: University of Trieste, Polytechnic of Milan) and of the Naval Smart Grid research programs (funder: Italian Navy; research coordinator: University of Trieste; research partners: University of Trieste, Polytechnic of Milan, University of Rome “Sapienza”), in the field of the next generation integrated power systems for all electric ships.

Keynote 4

Title:

Towards Ideal DC Circuit Breakers: The Evolution of Series-Type Hybrid Circuit Breaker (SHCB) Concepts

Speaker:

John Shen, Simon Fraser University, BC, Canada

Abstract:

DC power is reemerging long after losing the War of Currents over a century ago. However, effective DC circuit breakers (DCCBs) must be developed for LVDC (<1kV), MVDC (<40kV), and HVDC (100's kV) power systems. A wide range of DCCB technologies have emerged in the past few decades. Presently, solid-state circuit breakers (SSCBs) can quickly interrupt a DC fault current within tens of microseconds but suffer from high conduction losses and weight and cost penalties associated with the cooling and semiconductor components, especially for high power applications. The most distinct advantage of semiconductor switches is their capability of switching current during fault interruption while the most distinct disadvantage is their nonnegligible on-resistance when conducting current. Unfortunately, semiconductors are used in SSCBs in the worst way possible—continuously dissipating power except during infrequent fault interruption. Numerous hybrid circuit breaker (HCB) schemes have also been investigated to offer an on-resistance 2-3 orders of magnitude lower than that of SSCBs. All the HCBs are of parallel type, in which an electronic path is in parallel with a main mechanical switch. The fault current in the mechanical switch is initially commutated to the electronic path to create artificial current zero crossings in various forms to aid the opening of the mechanical switch. The electronic path will then be interrupted with varistors (MOV) clamping the transient voltage surge. However, these HCB solutions offer only a moderate fault response time of several milliseconds. This may be too slow to limit the fast-rising fault current in low-impedance DC power networks. The most distinct disadvantage of all the parallel-type HCBs is the relatively long opening time of the mechanical switch to achieve a sufficiently wide air gap for sustaining the DC voltage, during which the fault current continues to rise through the electronic path. Recently, a new Series-type of HCB (SHCB) concept was proposed and demonstrated to offer both μs-scale response time and mΩ-scale on-resistance, breaking through the barriers of conventional SSCBs and HCBs. This talk will provide an overview of the basic concept, latest experiemental results, and remaining technological challenges of SHCB. It will further discuss a newer SHCB 2.0 topology to address these challenges towards the development of ideal DC circuit breakers.

Bio:

Dr. John Shen is a professor and director of the School of Mechatronics at Simon Fraser University, BC, Canada. He was Grainger Chair Professor of Electrical and Power Engineering at Illinois Institute of Technology between 2013 and 2021. He has more than 35 years of industrial, academic, and entrepreneurial experience in power electronics and power semiconductor devices with over 350 publications and 20 issued U.S. patents in these areas. He has been involved in circuit breaker research since 2013, and is an inventor of several patents and an author of over 40 publications on the subject. He served as PI or co-PI on several ARPA-E projects related to DC circuit breakers and co-edited a book on Directot Current Fault Protection (Springer 2023). He is a recipient of the 2023 IEEE PELS Technical Achievement Award for Integration and Miniaturization of Switching Power Converters and the 2012 IEEE Region 3 Outstanding Engineer Award. He has served the IEEE Power Electronics Society (PELS) in various capacities including Vice President of Products, AdCom member, Chair of Distinguished Lecturers Program, Deputy Editor-in-Chief of IEEE Power Electronics Magazine, Guest Editor-in-Chief of the IEEE Transaction on Power Electronics and the IEEE Journal of Emerging and Selected Topics in Power Electronics. He has been on the organizing or technical program committee of over 30 international conferences in the field, and served as the General Chair of the 2016 Energy Conversion Congress and Exposition (ECCE2016) and the 2018 International Symposium on Power Semiconductor Devices & IC's (ISPSD2018). He is a Fellow of IEEE and the U.S. National Academy of Inventors.

Keynote 5

Title:

Resilient hybrid microgrids for mission-critical systems

Speaker:

Don Tan, Fortune 500 Company

Abstract:

A remote, resilient hybrid microgrid for mission-critical systems are introduced. This structured microgrid features resiliency, energy balancing, autonomy, standard interface, fault tolerance, fault isolation, modularity, and scalability. The basic standard building modules/slices are introduced first. Typical system configurations are then presented to illustrate the versatility and its ability to reduce cost. Fault-tolerant design principles are discussed. A-minute-day simulation is then presented to demonstrate the system-level energy balance and smooth dynamic behaviors when entering and exiting the lunar eclipse. Fuse clearing transient capability is also discussed. A dead-bus recovery circuitry is presented, which ensures self-resiliency. The test results are presented to validate the system design and to demonstrate self-recovery from a dead bus. The measured peak power tracking accuracy and current sharing accuracy among multiple batteries are also presented. On-orbit performance supports the design capabilities and resiliency.

Bio:

Dr. Tan has served as Distinguished Engineer, Fellow, Chief Engineer-Power Conversion, Program Manager, Department Manager, and Center Director in a US Fortune 500 corporation. Don earned his PhD from Caltech and is an IEEE fellow. Unusually prolific as a visionary technical leader in ultra-efficient power conversion and electronic energy systems, he has pioneered breakthrough innovations with numerous high-impact industry firsts and record performances that received commendations from the highest level of US Government. He has developed hundreds of designs and thousands of hardware units deployed for space applications without a single on-orbit failure. His suite of world-class electronics performed flawlessly on the James Webb Space Telescope (JWST), located one million miles away, achieving world-record-breaking performances.

He is currently the President of IEEE Transportation Electrification Council, Chair of IEEE Fellow Advisory and Oversight Subcommittee, and Vice Chair of IEEE Industry Engagement Committee. Among numerous others, Don has served as Division II Director, IEEE Board of Directors; Fellow Committee Chair, IEEE PELS/PES eGrid Steering Committee Chair, PELS Long Range Planning Committee Chair, Nomination Committee Chair, PELS President, Editor-in-Chief (Founding) for IEEE Journal of Emerging and Selected Topics in Power Electronics, APEC (the fourth largest event in IEEE) General Chair, PELS Vice President-Operations, Guest Editor-in-Chief for IEEE Transactions on Power Electronics and IEEE Transactions on Industry Applications, Fellow Committee, PELS Vice President-Meetings, IEEE Chair for IEEE/Google Little Box Challenge (awarded $1M cash prize), and IEEE/DoD Working Group Chair, developed IEEE/ANSI standards 1515/1573. Don has delivered 80+ keynotes/invited global presentations. He has received more than $30M external customer funding for research and technology development. He also serves on many national and international award, review and selection committees.

Keynote 6

Title:

DC-Microgrid Application, Use Cases and Standardization in Europe

Speaker:

Berndt Wunder, Fraunhofer Institute, Germany

Abstract:

The increasing integration of renewable energy sources and the growing demand for energy-efficient technologies have driven the development and implementation of DC (Direct Current) microgrids across Europe. This talk explores the application of DC microgrids, highlighting specific use cases where these systems offer significant advantages over traditional AC power systems, like industrial DC microgrids.

Moreover, the talk delves into the current state of standardization for DC microgrids, examining the role of regulatory frameworks and standards in facilitating widespread adoption and interoperability of these systems in Europe. By analyzing initiatives led by organizations such as the IEC and VDE, we underscore the importance of standardized practices to ensure safety, compatibility, and operational excellence in DC microgrid implementations.

Our findings suggest that with appropriate standardization and tailored use cases, DC microgrids stand as a pivotal technology in Europe's transition towards a more sustainable and resilient energy landscape.

Bio:

Bernd Wunder completed his studies in Electrical Engineering at the Friedrich-Alexander University Erlangen-Nuremberg in 2010, graduating as a Diplom-Ingenieur. From 2010 to 2013, he worked as a research assistant at the Chair of Electronic Devices, developing various power electronic systems for electric vehicles. In 2013, he founded the research group for DC networks at the Institute for Integrated Systems and Device Technology (IISB) to develop new descriptive infrastructures for renewable and sustainable energy use. His main research areas are the design and architecture of DC microgrids; development of power electronics (DC/DC converters); analysis of electronic devices and systems; control and stabilization of microgrids.

As the elected chairman of VDE UK221.6 "DC Installations", he is involved in numerous standardization projects related to electromobility and direct current. He is also currently the head of the IEC project PT 63317 "LVDC industry applications".

Keynote 7

Title:

Photovoltaic Systems and Microgrids: A perspective from the U.S. Department of Energy's Solar Energy Technologies Office

Speaker:

George Stefopoulos, DOE Solar Energy Technologies Office, USA

Abstract:

Microgrids could play an important role in the deployment of distributed energy resources, like distributed photovoltaic systems, and in improving grid reliability and resiliency. Microgrids typically consist of loads and distributed generation assets that are connected via a small-scale AC grid and are controlled as a single entity with respect to the rest of the electricity grid. However, the concept of DC microgrids has been gaining interest as there are certain applications that are better aligned with and could benefit from DC microgrids. Broader adoption and deployment of such DC microgrids will critically depend on a compelling value proposition, technical advancement in modeling, operation, and control

technologies, commercial availability, and standardization of DC equipment and appliances, as well as development of appropriate reliability and safety standards. This talk will discuss the opportunities and challenges of DC microgrids and provide a perspective and future vision from the Solar Energy Technologies Office of the U.S. Department of Energy on their role in the deployment and grid integration of solar and, more generally, renewable energy and energy storage systems.

Bio:

George Stefopoulos is a Solar Innovation Technical Advisor for the U.S. Department of Energy, Solar Energy Technologies Office (SETO). He joined SETO as a support service contractor in September 2021 and currently works with the SETO's Manufacturing and Competitiveness team focusing, among other areas, on power electronics for solar applications, grid operations and integration of renewable energy resources, as well as building- and vehicle-integrated photovoltaics.

Prior to joining SETO, George was with the New York Power Authority (NYPA) for over 12 years where he held multiple positions of increasing responsibility engaging in the deployment of new technologies to modernize NYPA's transmission grid and generating facilities. His last role at NYPA was Director of NYPA's Advanced Grid Innovation Laboratory for Energy (AGILe), a newly created research, development, and testing facility focusing on grid modeling and real-time digital simulation, software/hardware-in-the-loop testing, grid automation, protection and control applications, renewable energy integration, power system communications, and cyber security.

George received his Ph.D. in Electrical and Computer Engineering from the Georgia Institute of Technology in 2009. He also received his M.S. in Electrical and Computer Engineering in 2002 from Georgia Tech and his Diploma in the same field from the National Technical University of Athens, Greece, in 2001. George also holds an MBA degree in Executive Management from Pace University of New York. He has authored or co-authored over 60 scientific papers and articles and has presented his work at many international scientific conferences. He has also delivered several invited talks at a variety of meetings and other events. He is a senior member of the Institute of Electrical and Electronics Engineers (IEEE) and a member of the Institute of Engineering Technology (IET).