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STPEC 2020

Keynote Speakers

Prof. Frede Blaabjerg

Aalborg University Aalborg, Denmark

Frede Blaabjerg (S'86–M'88–SM'97–F'03) was with ABB-Scandia, Randers, Denmark, from 1987 to 1988. From 1988 to 1992, he got the PhD degree in Electrical Engineering at Aalborg University in 1995. He became an Assistant Professor in 1992, an Associate Professor in 1996, and a Full Professor of power electronics and drives in 1998. From 2017 he became a Villum Investigator. He is honoris causa at University Politehnica Timisoara (UPT), Romania and Tallinn Technical University (TTU) in Estonia.

His current research interests include power electronics and its applications such as in wind turbines, PV systems, reliability, harmonics and adjustable speed drives. He has published more than 600 journal papers in the fields of power electronics and its applications. He is the co-author of four monographs and editor of ten books in power electronics and its applications.

He has received 32 IEEE Prize Paper Awards, the IEEE PELS Distinguished Service Award in 2009, the EPE-PEMC Council Award in 2010, the IEEE William E. Newell Power Electronics Award 2014, the Villum Kann Rasmussen Research Award 2014, the Global Energy Prize in 2019 and the 2020 IEEE Edison Medal. He was the Editor-in-Chief of the IEEE Transactions on Power Electronics from 2006 to 2012. He has been Distinguished Lecturer for the IEEE Power Electronics Society from 2005 to 2007 and for the IEEE Industry Applications Society from 2010 to 2011 as well as 2017 to 2018. In 2019-2020 he serves a President of IEEE Power Electronics Society. He is Vice-President of the Danish Academy of Technical Sciences too. He is nominated in 2014-2019 by Thomson Reuters to be between the most 250 cited researchers in Engineering in the world. Prof. Frede is also the recipient of prestigious 2020 IEEE Edison Medal.

Title of Keynote: Design for reliability in power electronic systems

Abstract: In recent years, the automotive and aerospace industries have brought stringent reliability constraints on power electronic converters because of safety requirements. Today customers of many power electronic products expect up to 20 years of lifetime and they also want to have a "failure free period" and all with focus on the financials. The renewable energy sectors are also following the same trend, and more and more efforts are being devoted to improving power electronic converters to account for reliability with cost-effective and sustainable solutions. This presentation will introduce the recent progress in the reliability aspect study of power electronic converters for power electronic applications with special focus on renewables. It will cover the following contents: the motivations for highly reliable electric energy conversion in renewable energy systems; the reliability requirements of typical renewable energy systems and its implication on the power electronic converters; failure mechanisms and lifetime models of key power electronic components (e.g., power semiconductor switches, capacitors, and fans); long-term mission profiles in Photovoltaic (PV) and wind power applications and the component level stress analysis; reliability analysis methods, tools, and improvement strategies of power electronic converters for renewable energy systems. A few case studies on PV and wind power based renewable energy systems will also be discussed.

Prof. Jih-Sheng (Jason) Lai

James S. Tucker Professor
Virginia Polytechnic and State University, USA

Jih-Sheng (Jason) Lai received M.S. and Ph.D. degrees in electrical engineering from the University of Tennessee, Knoxville, in 1985 and 1989, respectively. In 1989, he joined the Electric Power Research Institute (EPRI), where he managed EPRI-sponsored power electronics research projects. From 1993, he worked with the Oak Ridge National Laboratory as the Power Electronics Lead Scientist, where he initiated a high power electronics program and developed several novel high power converters including multilevel converters and auxiliary resonant snubber based soft-switching inverters. He joined Virginia Tech in 1996. Currently he is James. S. Tucker Endowed Chair Professor and the Director of Future Energy Electronics Center (FEEC). He is also a Visiting Professor of Nanyang Technological University, Singapore and a Mount-Jade Scholar Visiting Professor of National Chiao-Tung University, Taiwan.

Dr. Lai has published more than 480 refereed technical papers, one book chapter and 2 books. He holds 27 U.S. patents in the area of high power electronics and their applications. He received several distinctive awards including Technical Achievement Award in Lockheed Martin Award Night and 13 Best Paper Awards from IEEE conferences and journals. His teams won the First Prize Award in Texas Instruments Analog Design Competition in 2011, Grand Prize Award from International Future Energy Challenge in 2013, the Top Three Award from Google Little Box Challenge in 2016, and American Made Solar Prize Competition Finalist in 2020.

Dr. Lai is an IEEE Life Fellow and the recipient of 2016 IEEE Industry Applications Society Gerald Kliman Innovation Award. He is the Founding Chairs of Asian Conference on Energy, Power and Transportation Electrification (ACEPT-2016) and IEEE Future Energy Challenge (IFEC-2001), General Chairs of IEEE Workshop on Computers in Power Electronics (COMPEL 2000) and IEEE Applied Power Electronics Conference (APEC 2005). Currently he serves as the Publications Chair for IEEE Transportation Electrification Community and the Editor for IEEE Journal of Emerging and Selected Topics in Power Electronics.

Title of Keynote: Wide Bandgap Devices - Key Features and Impacts to Power Electronics Design

Abstract: Within only a few years on the market, silicon carbide (SiC) and gallium nitride (GaN) devices are already widely adopted in commercial products and are having shortage of supplies because even with their high price/VA-rating, the performance boosted by these WBG devices makes their integrated system much more cost effective as compared to the system using the well-optimized Si devices. On the horizon are gallium oxide (Ga_2O_3) devices, which promises a higher bandgap and breakdown voltage level that will further revolutionize the high power area. This presentation will first compare WBG device Figure of Merit (FOM) to see the trend of their application areas and then focus on existing the power electronics design considerations with the WBG devices.

The use of WBG devices, especially GaN devices is now challenged by the circuit components such as gate drivers and parasitic components. The main challenges with parasitic components are due to fast di/dt and dv/dt and magnetics. For a conventional voltage source converter, the parasitic inductance in the phase leg can introduce a large voltage spike that false-triggers the opposite side or other phase leg switches. This phenomenon is well known even with the traditional silicon devices, but it is much more severe with GaN devices because of their low threshold voltage. As these devices are pushed to mega-hertz switching for size reduction, more challenges will arrive. Even the PCB parasitics are impacting the circuit behaviors. The PCB capacitance adding on to the junction capacitance can result in long charging and discharging time for ZVS and also result in resonant frequency shift. The PCB traces can dramatically increase the resonant inductance, which not only results in resonant frequency shift, but also creates different resonant characteristic between individual phase-legs.

Another impact that is not obvious is the WBG related body diode voltage drop, which is typically 2 times with SiC and as high as 5 times with GaN. Traditional inverter designs with Si IGBT normally add a dead time of more than 2 μs in between upper and lower devices, and modify the PWM with dead-time compensation. During the dead time, the current must flow through anti-paralleled diodes, which will result in a large conduction loss and related heat with the use WBG devices. Synchronous rectification becomes essential now with dead time in 10's ns range, or two orders of magnitude reduction as compared to Si IGBT case. Such a big difference practically makes the traditional dead-time compensation techniques obsolete.

Overall for our new generation power electronics engineers to deal with the use of WBG devices, there is a need to learn a whole new set of knowledge base, skills, and design considerations.

Prof. Subhashish Bhattacharya

Duke Energy Distinguished Professor
North Carolina State University, USA

Subhashish Bhattacharya received his PhD from the University of Wisconsin-Madison in 2003. He worked in the FACTS (Flexible AC Transmission Systems) and Power Quality group at Westinghouse R&D Center in Pittsburgh, which later became part of Siemens Power Transmission & Distribution, from 1998 to 2005. He joined the Department of Electrical and Computer Engineering at North Carolina State University (NCSU) in August 2005, where he is the Duke Energy Distinguished Professor and a founding faculty member of NSF ERC FREEDM Systems Center, Advanced Transportation Energy Center [ATEC] and the US DOE initiative on WBG based Manufacturing Innovation Institute – PowerAmerica - at NCSU. A part of his PhD research on active power filters was commercialized by York Corporation Inc. [now part of Johnson Controls] for air-conditioner chiller products. His research interests are Solid-State Transformers, Integration of renewable energy resources, MV power converters enabled by HV SiC devices, FACTS, Utility applications of power electronics and power quality issues; DC Microgrids, high-frequency magnetics, active filters, and application of new power semiconductor devices such as SiC and GaN devices for power converter topologies. His research is funded by several industries, NSF, DOE, ARPA-E, US Navy, ONR. He has over 500 publications, 2 book chapters and 5 patents with several pending patent applications.

Title of Keynote: HV SiC Power Devices Enabled High Power, Medium Voltage Power Converters and Applications - MV Solid-State Transformers and High Speed Drives

Abstract: This presentation will outline the applications of High power and Medium Voltage power converters in all industry sectors - HVDC, FACTS and power quality, MV motor drives (including high-speed machines with high fundamental frequency), MV DC grids, MV grid connected converters for renewables such as solar, wind, etc., MV converters for mining applications, MV converters for traction applications, MV converters for industrial applications such as steel mills, cement, and others; with present OEM solutions. The improvements required in efficiency, power density, specific power and volumetric density metrics are forcing the industry to re-evaluate present state of the art Silicon power devices based solutions in terms of the potential offered by recently developed HV SiC power devices for HV and high power (MW class) power converters. The opportunities for HV SiC devices for MV and high power converters and utility applications and the challenges to apply these HV SiC devices successfully will be presented in-depth with SiC device voltage ranges from 1200V to 1700V MOSFETs, and HV 10 kV - 15 kV MOSFETs, JBS diodes, and 15 kV SiC IGBTs. The potential and challenges of the HV 10-15 kV devices to enable MV power conversion systems, including MV motor drives, FACTS and MVDC grids will be explored with demonstrated application examples of SST (Solid State Transformer), MV SiC power converters for grid tied solar applications, MV motor drives, shipboard power supply applications and MV DC grids.

Prof. Alberto Borghetti

University of Bologna, Italy

Alberto Borghetti was born in Cesena Italy on May 29, 1967. He has received a laurea degree cum laude in Electrical Engineering in 1992 at the University of Bologna, Italy. Since then he has been working at the Electric Power Systems Laboratory of the same University, currently as Professor of Electrical Power Systems. He has been serving as a member of the PhD Committee in Electrical Engineering of the University of Bologna since 2008. He has been a member of the board or external reviewer for the final evaluation of doctoral theses at various universities in Italy and abroad. He has been the scientific coordinator of two research projects between CESI and the Department of Electrical Engineering of the University of Bologna about issues related to distributed generation. He was local responsible for a national project PRIN 2005 on power systems vulnerability of and a project PRIN 2007 on heat and power co-generation units. He has been local responsible for the project SMARTGEN co-financed by the Ministry of Economic Development in the framework of the program “Research for the electricity sector” and the three-year European ENIAC JU project E2SG "Energy to smart grid" (2012-2015) coordinated by Infineon Technologies AG. He participates in the Centre for Industrial Research funded by the Administration of the Emilia Romagna Region under the European Regional Development Fund and in the Advanced research centre on electronic systems ARCES of the University of Bologna.

He is author or co-author of more than 150 publications in various journals, monographs, proceedings of national and international conferences. He is co-author of 6 brochures of CIGRÉ (International Council on Large Electric Systems), He is co-author of IEEE Standard 1410 - "IEEE Guide for improving the lightning performance of electric power overhead distribution lines".

He is an IEEE Fellow (class 2015) for contributions to modeling of power distribution systems under transient conditions. He has received the ICLP Scientific Committee Award 2016. He has received the 2018 CIGRE Technical Council Award for Study Committee C4. From 2010 to 2016 he served as an Editor of IEEE Transactions on Smart Grid. Since 2018 he serves as an Editor of IEEE Transactions on Power Systems. Since 2008 he is a member of the "Editorial Advisory Panel" of the international journal "Electric Power Systems Research", published by Elsevier. Since 2018 he serves as an Associate Editor of "Journal of Modern Power Systems and Clean Energy (MPCE)", SGEPRI Press and Springer. Since 2019, he serves as an Editor-in-Chief for Electrical Engineering – Archiv fur Elektrotechnik. With Shigeru Yokoyama he has been Guest Editor of the Special Issue "Lightning protection of power systems," Electric Power Systems Research, Vol 85, 2012. He regularly serves as reviewer for several journals including Electric Power Systems Research, IEEE Trans. on Power Systems, IEEE Trans. on Power Delivery, IEEE Trans. on Electromagnetic Compatibility, IEEE Trans. on Smart Grid, International Journal of Electrical Power & Energy Systems, IEEE Trans. on Sustainable Energy, IEEE Trans. on Industrial Informatics, IET Generation Transmission & Distribution. Since 2017 he is member of the advisory group AG C4.1 “Strategic directions” of Study Committee C4 “Technical performance”. He has served as Special Reporter for the Session 2018 for Study Committee C4. He has participated in the Management Committee of the European COST Action P18 "The physics of lightning flash and its effects" (2005 - 2009).

Title of Keynote: Resource Scheduling of a Local Energy Community

Abstract: The talk focuses on the operation of a local energy community. The community is a set of prosumers each of them may be equipped by local generation, energy storage systems and loads. The scheduling procedure must distinguish between the power exchanged with the external grid and the power exchanges between the prosumers in order to prioritize the use of local resources and self-consumption. The procedure should also provide the price of the internal transactions. The performances of the approach are shown for various operating conditions of a distribution network in which the direct transactions between prosumers are allowed.

Mr. Sushil Kumar Soonee

Advisor, POSOCO India

Sushil Kumar Soonee is an Electrical Engineering Honours graduate from IIT Kharagpur class of 1977. He also did research in Power System Operation in IIT Kharagpur (1983–84). After brief stint in Private Sector, he joined Central Electricity Authority (CEA) through Combined Engineering Services Examination. His deep interest in Power System Operation brought him to POWERGRID when the five Regional Load Despatch Centres were transferred from CEA to POWERGRID. He has more than three decades of experience covering technical, commercial, managerial, pool governance, regulatory affairs, interconnections, market development, open access, power exchange, power system technology, EMS/SCADA, settlement, Renewable Energy Certificate, Transmission Pricing etc. He has first-hand experience of grid management as RLDC head in three out of five regions in the country viz. Eastern, Southern and Northern.

He is actively involved in the GO-15 (formerly known as VLPGO i.e. Very Large Power Grid Operators in the world). He is very active in fostering the growth of Power System Operation faculty and building sustainable Institutional mechanism to support the rapidly developing Indian Power sector. He is steering the Power System Operation of the pan-India grid as the Chief Executive Officer of POSOCO which is a wholly owned subsidiary of Power Grid Corporation of India Limited. He has worked extensively for integration of state grids to form regional grid in Eastern and North-eastern region and later contributed in the formation of the synchronous N-E-W grid. He has been closely associated with drafting of the Indian Electricity Grid Code (IEGC), implementation of Availability Based Tariff (ABT) mechanism and introduction of Open Access in India.

He is a Fellow of Institute of Engineers, (India), a Senior Member of IEEE and Member of CIGRE with a keen interest in C2, C5 and D2 committees of CIGRE. He is also an active member of IEEE PES (i.e. IEEE Power and Energy Society) and TSO comparison. He has authored several technical articles that have been presented in various forums. His current area of interest besides power system operation is electricity market design and human capacity building. He received several distinguished Honors and Awards that includes, Distinguished Alumnus Award in the 60th Convocation of IIT KHARAGPUR, Industry Excellence Award NPSC 2014, 2011 PES Chapter Outstanding Engineer by the PES-IAS Delhi chapter for outstanding leadership and contribution in Power Grid Operation, Control & Regulatory Mechanism etc. He has authored many peer reviewed international and national journals and conference papers.

Title of Keynote: Power System development and operation in India

Abstract: Power system in India has evolved from fragmented small systems to one of the largest synchronous grids and emerging power markets in the world. The talk would trace this exciting journey and share insights and suggestions for the future.

Dr. Mangesh B. Borage

Raja Ramanna Centre for Advanced Technology, Indore, India

Mangesh Borage received B. E. degree (1993) from Shivaji University, Kolhapur, India, M. Tech. degree (1996) from Banaras Hindu University, Varanasi, India and Ph. D. (2012) from Homi Bhabha National Institute, Mumbai in electrical engineering. He joined Bhabha Atomic Research Centre (BARC), Mumbai in 1994. Since 1995, he is with Raja Ramanna Centre for Advanced Technology (RRCAT), Indore. He has developed a large number of power converters for electromagnets in Indus accelerators, Infra-Red Free Electron Laser at RRCAT and Facility for Antiproton and Ion Research (FAIR), Germany – a mega science project being realized in international collaboration, and, many other specialized applications such as laser diode drivers, induction heating, super capacitor chargers, high-power inverters etc. His research interests include soft-switching and resonant converters, power factor correction, high-frequency magnetic components and high-frequency power converters, in general. Dr. Borage is recipient of University Merit Certificate from Shivaji University in 1993, Dr. Homi Bhabha Award at BARC in 1995 as well as DAE Excellence in Science, Engineering and Technology Awards, namely, Scientific and Technical Excellence Award in 2012 and Group Achievement Awards in 2008, 2016 and 2018.

Title of Keynote: Power Converters for Particle Accelerators: Challenges and Opportunities

Abstract: Particle accelerators, used for variety of scientific, industrial, medical and societal applications, are complex machines involving several inter-related multidisciplinary sub-systems. Power converters form an important integral part of an accelerator, characterized by variety of types, unconventional functional requirements and stringent performance specifications that are largely different than the conventional applications. These challenges, coupled with their uniqueness, act as the major drivers for continued research opportunities as well as large-scale engineering in this area. The talk will touch upon these aspects of power converter topologies for particle accelerators, in general, with specific reference to some of the developments for power converters for Indus-1 and Indus-2, India's only Synchrotron Radiation Sources that are operated in round-the-clock mode as national facilities at Raja Ramanna Centre for Advanced Technology, Indore.

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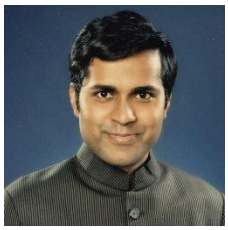

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