IFEEC 2019 – Plenary Session Programme and Speakers Information (updated 18 October 2019 and subject to changes)

Speaker	Designation & Organisation	Topic	Date/ Time
Professor Hirofumi Akagi	University Distinguished Professor Tokyo Institute of Technology, Japan IEEE Fellow	High-Power Bidirectional Isolated DC-DC Converters Using SiC-MOSFET Modules	26 November 09:00 - 09:30
Professor Gyu-Ha Choe	President, Korean Electrotechnology Research Institute (KERI), South Korea	The Emerging Role of Power Electronics Technology for Resolving Recent Global Problems	26 November 09:30 – 10:00
Professor Mark Dehong Xu	Professor, Zhejiang University, China IEEE Fellow	Impact of Wide-Band-Gap Devices on Three-Phase Power Conversion Systems	26 November 10:00 – 10:30
Professor Dushan Boroyevich	University Distinguished Professor Associate Vice President of Research and Innovation and Director, Center for Power Electronics Systems (CPES), Virginia Tech, USA IEEE Fellow	Power Converters for Future Electronic Energy Systems	27 November 08:30 – 09:00
Professor Jun-ichi Itoh	Professor, Nagaoka University of Technology, Japan	AC to AC direct conversion technology and its applications	27 November 09:00 – 09:30
Professor Edward Chang-Yi	Senior Vice President Dean of International College of Semiconductor Technology Chair Professor of the Department of Materials Science and Engineering and Department of Electronics Engineering National Chiao Tung University, Taiwan IEEE Fellow	An Enhancement-mode GaN FEG-HEMT device for power switching applications	27 November 09:30 – 10:00
Professor Jinjun Liu	University Distinguished Professor of Power Electronics Director, The Institute of Power Electronics and Industrial Automation Director, Power Electronics and Renewable Energy Center School of Electrical Engineering Xi'an Jiaotong University, China IEEE Fellow	Technical Challenges to Future Power Systems with More Electronic Converters and More Distributed Generations	27 November 10:00 – 10:30

Professor Hirofumi Akagi
University Distinguished Professor
Tokyo Institute of Technology, Japan
IEEE Fellow

Presentation Title: High-Power Bidirectional Isolated DC-DC Converters Using SiC-MOSFET Modules

Abstract:

A remarkable advance in the research and development of SiC (Silicon Carbide) device technology has made the 1.2/1.7/3.3-kV SiC-MOSFET modules available from the market. Moreover, the latest commuter trains with a nominal dc catenary voltage of 1.5 kV in Japan have been using 3.3-kV, 1.5-kA SiC-MOSFET modules for traction inverters.

A bidirectional isolated dc-dc converter, or a dual-active-bridge (DAB) converter, with a unity turns ratio of a medium-frequency transformer is symmetrical in circuit topology when it is seen upstream and downstream of the transformer. Connecting an auxiliary loss-less snubber capacitor across each SiC-MOSFET device allows the dc-dc converter to achieve zero-voltage switching (ZVS). This allows the power ratings to range from a few tens to several hundreds of kilowatts, depending strongly on available power switching devices and their practical switching frequencies. However, one of the most important research targets for putting it into practical use is to improve the dc-to-dc efficiency of the converter operating at a medium frequency.

This talk begins with a historical review of high-power bidirectional isolated dc-dc converters, including single-phase and three-phase versions. Then, the speaker pays much attention to the 850-Vdc, 100-kW, 16-kHz bidirectional isolated dc-dc converter using 1.2-kV 400-A SiC-MOSFET H-Bridge modules. The conversion efficiency from the dc-input to the dc-output terminals is accurately measured to be 99.3% at the rated power (100 kW) operation. The peak conversion efficiency is as high as 99.5% at 34-kW operation, and the “10%-load” efficiency is 99.2% at 10 kW (=10% of 100 kW). Note that the gate-drive, control-circuit, and cooling-fan losses are eliminated from the total power loss. The dc-dc converters are so flexible that series and/or parallel connections of their individual input and output terminals make it easy to expand the voltage and/or current ratings for various applications such as the so-called “solid-state transformer” or “power electronic transformer.”

Biography:

Hirofumi Akagi received his Ph. D. degree in electrical engineering from the Tokyo Institute of Technology, Tokyo, Japan, in 1979. Since 2000, he has been Professor, currently Distinguished Professor, at the Tokyo Institute of Technology. Prior to it, he was Professor at Okayama University, Okayama, Japan, from 1991 to 1999, and Assistant and then Associate Professor at Nagaoka University of Technology, Nagaoka, Japan from April 1979 to 1991.

His research interests include power conversion systems and their applications to industry, transportation, and utility. He has authored and coauthored some 140 IEEE Transactions papers, and three invited papers in *the Proceedings of the IEEE*.

Dr. Akagi was elevated to the grade of the IEEE Fellow in 1996. He has received six IEEE Transactions Prize Paper Awards, and 16 IEEE Industry Applications Society Committee Prize Paper Awards. He is the recipient of the 2001 IEEE Power Electronics Society William E. Newell Award, the 2004 IEEE Industry Applications Society Outstanding Achievement Award, the 2008 IEEE Richard Harold Kaufmann Technical Field Award, the 2012 IEEE Power & Energy Society Nari Hingorani Custom Power Award, and the 2018 IEEE Medal in Power Engineering.

Dr. Akagi served as the President of the IEEE Power Electronics Society from 2007 to 2008 for two years, and the IEEE Division II Director from 2015 to 2016 for two years.

Professor Gyu-Ha Choe
President,
Korean Electrotechnology Research Institute (KERI), South Korea

Presentation Title: The Emerging Role of Power Electronics Technology for Resolving Recent Global Problems

Abstract:

Since 1980's Power Electronics (PE) technologies have been being developed for the effectiveness in terms of efficiency, weight, size, volume, and cost of the target systems. For PV PCS's, the overall efficiency is increased up to 99%, and the size and/or weight are reduced up to 20% roughly. In brief, there are a lot rapid changes in the amount and the speed of technology advancement. Moreover, new technologies such as IoT, AI, Big Data would be considered to apply to the PE systems, which may want to feel, listen, see and even talk to the other systems including human being. The final goal of the intelligent PE systems might become humanlike.

However, the highly-developed technologies have aroused the global problems gradually in many aspects such as energy crisis, global warming, CO2 emission, climate change, and so on. At this moment U-turn would be necessitated in the final goal and direction of the technology development for improving the global problems. Since the whole mankind should protect the world from being the worse situation the technological progress and the related policies should be made simultaneously in harmony for the global-sustainable direction. To perform this emerging role, the PE technology may also be combined with the academic fields of humanities, art, music, and also would not forget to listen carefully to the voice of nature. Ultimately, the emerging challenges should be resolved within the 'SMART' PE world in near future.

Biography:

Gyu-Ha Choe was born in Busan, South Korea. He received his B.S., M.S. and Ph.D. degrees from Seoul National University, Seoul, Korea, in 1978, 1980 and 1986, respectively.

From 1980 to 2018, he had been with the Department of Electrical Engineering, Konkuk University, Seoul, Korea, where he was a Professor and the Director of the Energy Electronics Research Center. From 1987 to 1988, he was a Post-Doctoral Fellow in the Department of Electrical Engineering, Oregon State University, Corvallis, OR, USA; and from 1998 to 1999, he was a Visiting Scholar in the Department of Electrical Engineering, Virginia Tech, Blacksburg, VA, USA. From 1997 to 1998, he was the Dean of Academic Research Affairs, Konkuk University; and from 2002 to 2004, he was the Dean of Academic Affairs, Konkuk University. From 2007 to 2008, he was the President of the Korean Institute of Power Electronics (KIPE), Seoul, Korea. From 2012 to 2013, he was the Vice President of Konkuk University. Since April 2018, he has been with Korea Electrotechnology Research Institute (KERI), Changwon, Korea, where he is currently the President of KERI.

His current research interests include active power filters, PWM control, ac voltage regulators, inverter welding machines, the PCS design of photovoltaic generation and fuel cell generation, and the technologies for DC distribution, EV chargers and electrical safety.

Professor Mark Dehong Xu
College of Electrical Engineering
Zhejiang University, China
IEEE Fellow

Presentation Title: Impact of Wide-Band-Gap Devices on Three-Phase Power Conversion Systems

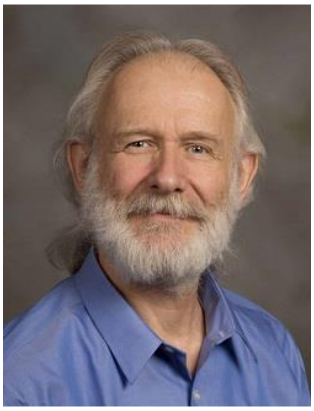
Abstract:

Increasing the switching frequency is critical to increase efficiency, power density and dynamic performance. Soft Switching Technology is an effective way to increase the switching frequency, which has been successfully applied in switching power supplies etc. However, applications of the soft switching technique to IGBT-dominated three-phase converters/inverters are not common up to now. Wide-Band-Gap（WBG） device may help pushing the applications of soft-switching to three-phase systems since Zero-Voltage-Switching is more effective to WBG devices than IGBT devices. Firstly a generic Zero-Voltage-Switching Pulse-Width-Modulation (ZVS-PWM) scheme for active-clamped three-phase converters/inverters are introduced. It can realize zero voltage switching for all switches including both inverter bridges switches and the auxiliary switch for three-phase either three-wire or four-wire converters/ inverters. Since the circuit basically operates as the PWM converter, it has higher efficiency and less extra voltage stress on the devices. Besides, the auxiliary switch only switches once in each switching period. Experimental results of a soft-switching 20 kW SiC MOSFET grid inverter with 300kHz switching frequency and 9kW SiC MOSFET three-phase back-to-back AC-AC converter are introduced. Finally the extension of the soft-switching concept to other power conversion circuits are discussed.

Biography:

Prof. Mark Dehong Xu received Ph.D. degrees from the Department of Electrical Engineering of Zhejiang University in China in 1989. He used to be a visiting professor in the University of Tokyo, Virginia Tech, and ETH. Since 1996, he has been with the College of Electrical Engineering, Zhejiang University, China, as a Full Professor. His research interests include power electronics topology, control, and applications for energy saving and renewable energy. He has authored or coauthored nine books and more than 200 IEEE Journal or Conference papers. He owns more than 43 China or U.S. patents. He is the recipient of five IEEE journal or conference paper awards. In 2016, he received IEEE PELS R. D. Middlebrook Achievement Award. He is the IEEE PELS Distinguish Lecturer in 2015-2018. He is IEEE Fellow.

He is At-Large Adcom Member of the IEEE Power Electronics Society from 2006 to 2008 and from 2017-2019. He is an Associate Editor of IEEE Transactions on Power Electronics and IEEE Journal of Emerging and Selected Topics in Power Electronics etc. From 2013, he is the President of the China Power Supply Society.



Professor Dushan Boroyevich
University Distinguished Professor
Associate Vice President of Research and Innovation and
Director, Center for Power Electronics Systems (CPES),
Virginia Tech, USA
IEEE Fellow

Presentation Title: Power Converters for Future Electronic Energy Systems

Abstract:

The unrelenting progress of the power electronics field has been a major enabler for massive deployment of renewable energy sources in the electrical power grid over the past several decades, silently insinuating a necessity for serious revision of the conventional practice in electricity production, distribution, and consumption. This change is unstoppable, and it will not be long before all human energy needs are dominantly provided by electricity, delivered through a hierarchical network of dynamically-decoupled, electronically-interconnected, sub-networks: the *Intergrid*.

The presentation will first define the Intergrid concept in which all subsystems are interfaced to the higher-level system through bidirectional power converters, and where utilization, size, and efficiency of energy sources with the varying outputs can be significantly improved if the energy is extracted in precisely controlled quantities and times. Presentation will then focus on the topology and control design of the main power conversion components of these future power systems, the *electronic energy routers*. Recent CPES experiences in implementing high-frequency, high power density converters using wide-bandgap semiconductor devices at different power levels will be discussed in some detail.

Biography:

Dushan Boroyevich received his Dipl. Ing. degree from the University of Belgrade in 1976 and his M.S. degree from the University of Novi Sad in 1982, in what then used to be Yugoslavia. He received his Ph.D. degree in 1986 from Virginia Polytechnic Institute and State University (Virginia Tech), Blacksburg, USA. From 1986 to 1990, he was an assistant professor and director of the Power and Industrial Electronics Research Program in the Institute for Power and Electronic Engineering at the University of Novi Sad. He then joined the Bradley Department of Electrical and Computer Engineering at Virginia Tech as associate professor. He is now University Distinguished Professor and Associate Vice President for Research and Innovation in Energy Systems at Virginia Tech, and Director of the Center for Power Electronics Systems.

Dr Boroyevich has led numerous research projects in the areas of multi-phase power conversion, electronic power distribution systems, modeling and control, and multi-disciplinary design optimization. He has advised over 40 Ph.D. and 40 M.S. students to graduation and has co-authored with them over 700 papers.

Dushan was the president of the IEEE Power Electronics Society (PELS) for 2011-12. He is a Fellow of IEEE and recipient of numerous awards, including the IEEE William E. Newell Power Electronics Technical Field Award, the IEEE PELS Harry A. Owen Distinguished Service Award, European Power Electronics Association (EPE) Outstanding Achievement Award, and the Award for Outstanding Achievements and Service to Profession by the European Power Electronics and Motion Control Council. He is an Honorary Professor at the Xi'an Jiaotong University in Xi'an, China, and received the K.T. Li Chair Professor Award at the National Cheng Kung University, in Tainan, Taiwan. Dushan was elected to the US National Academy of Engineering in 2014 for advancements in control, modeling, and design of electronic power conversion for electric energy and transportation.

Professor Jun-ichi Itoh
Nagaoka University of Technology, Japan

Presentation Title: AC to AC direct conversion technology and its applications

Abstract:

The power converter always requires high power density, high efficiency and long life time with low cost in order to achieve wide energy saving and innovation. AC to AC direct converters which is so called “matrix converter” do not need DC link part in conversion system. As a result, it has potential to achieve those requirements in high level.

There are two kind of matrix converters which are used for three-phase to three-phase conversion and three-phase to high frequency single-phase conversion. The first one is applied to adjustable speed drive system such as elevator, fans, pumps, HVAC and so on. The second one is applied to a front-end converter in three-phase isolated AC-DC converters.

In this presentation, current technologies in the AC to AC direct converters are introduced. Three-phase AC-AC direct converter (9-switch matrix), Single-phase AC-AC direct converter with active power decoupling capability by using indirect matrix converter, and three-phase of grid frequency to medium frequency of single-phase are presented. In addition, the practical applications of the matrix converters are introduced such as motor drive systems and isolated AC-DC convertors for quick EV chargers.

Biography:

Jun-ichi Itoh (M’04, SM’13) was born in Tokyo, Japan, in 1972. He received his M.S. and Ph.D. degree in electrical and electronic systems engineering from Nagaoka University of Technology, Niigata, Japan in 1996, 2000, respectively. From 1996 to 2004, he was with Fuji Electric Corporate Research and Development Ltd., Tokyo, Japan. He was with Nagaoka University of Technology, Niigata, Japan as an associate professor. Since 2017, he has been a professor. His research interests are matrix converters, dc/dc converters, power factor correction techniques, energy storage system and adjustable speed drive systems.

He received IEEJ Academic Promotion Award (IEEJ Technical Development Award) in 2007. In addition, he also received Isao Takahashi Power Electronics Award in IPEC-Sapporo 2010 from IEEJ, 58th OHM Technology Award from The Foundation for Electrical Science and Engineering, November, 2011, Intelligent Cosmos Award from Intelligent Cosmos Foundation for the Promotion of Science, May, 2012, and Third prize award from Energy Conversion Congress and Exposition-Asia, June, 2013, Prizes for Science and Technology (Development Category) from the Commendation for Science and Technology by the Minister of Education, Culture, Sports, Science and Technology, April 2017, and 4th Nagamori Awards, 2018.

Dr. Itoh is a senior member of the Institute of Electrical Engineers of Japan, the Society of Automotive Engineers of Japan and the IEEE.

Professor Edward Chang Yi
Senior Vice President
Dean of International College of Semiconductor Technology
Chair Professor of the Department of Materials Science and Engineering and Department of Electronics Engineering
National Chiao Tung University, Taiwan
IEEE Fellow

Presentation Title: An Enhancement-mode GaN FEG-HEMT device for power switching applications

Abstract:

GaN-based wide-bandgap semiconductor devices are promising for future high-power and high-frequency applications. In particular, the GaN high electron mobility transistor (HEMT) grown on large-size Si substrate is ideal for high power switching device applications with low cost potential. The GaN HEMT based convertors and inverters have been demonstrated for electric vehicle (EV) applications. For safety consideration, a normally-off device is a must. A new concept using a novel hybrid ferroelectric charge-trapping gate stack (FEG) to achieve a normally-off device will be presented in this talk. The proposed FEG GaN HEMT shows a record device performance of high threshold voltage (V_{th}), high maximum current density ($I_{DS,\ max}$) and high breakdown voltage (BV), simultaneously. Furthermore, to further reduce on-resistance (R_{ON}), the tri-gate architecture incorporated with FEG gate stack is demonstrated. Owing to the strong sidewall control, the fabricated tri-gate FEG-HEMT not only shows high V_{th}, high $I_{DS,\ max}$, low R_{ON} and high BV but also achieve a lowest specific on-resistance among the reported E-mode GaN devices with BV >650 V.

Biography:

Dr. Edward Yi Chang received the Ph.D. degree from University of Minnesota, Minneapolis, in 1985, and worked for Unisys Corp and Comsat Labs at USA from 1985-1992. In 1992, he joined National Chiao Tung University (NCTU), Hsinchu, Taiwan.

He is currently Senior Vice President of National Chiao Tung University, Dean of International College of Semiconductor Technology, and Chair Professor of the Department of Materials Science and Engineering and Department of Electronics Engineering. Prof. Chang is an IEEE Fellow and a Distinguished Lecturer of the IEEE Electron Devices Society. His current research interests include III-V and GaN based devices for logic, high frequency and power applications. Dr. Chang holds more than 40 patents worldwide and has been authored or co-authored of more than 250 journal papers in the related research areas.

Professor Jinjun Liu
University Distinguished Professor of Power Electronics
Director, The Institute of Power Electronics and Industrial Automation
Director, Power Electronics and Renewable Energy Center
School of Electrical Engineering
Xi'an Jiaotong University, China
IEEE Fellow

Presentation Title: Technical Challenges to Future Power Systems with More Electronic Converters and More Distributed Generations

Abstract:

Electric power systems have been experiencing many changes towards future, among which turning into more electronic, i.e. integrating more and more electronic power converters, and incorporating more and more distributed generations are the two major ones. The technical challenges that the future power systems will be facing accordingly are then identified in detail. The major issues caused by being more electronic and more distributed are discussed, with some possible candidate solutions introduced. The issues that are to some extent in dispute among different technical people with different backgrounds are also elaborated, including the concern about system inertia reduction, the worry about lower transient over-current tolerance, and the new system framework and specifications that needs to be set up. Detailed topics that requires further research efforts are addressed too.

Biography:

Jinjun Liu received the B.S. and Ph.D. degrees in electrical engineering from Xi'an Jiaotong University (XJTU), Xi'an, China, in 1992 and 1997, respectively.

He then joined the XJTU Electrical Engineering School as a faculty. From late 1999 to early 2002, he was with the Center for Power Electronics Systems, Virginia Polytechnic Institute and State University, Blacksburg, VA, USA, as a Visiting Scholar. In late 2002, he was promoted to a Full Professor and then the Head of the Power Electronics and Renewable Energy Center at XJTU, which now comprises 21 faculty members and over 150 graduate students and carries one of the leading power electronics programs in China. He coauthored 3 books, published over 400 technical papers in peer-reviewed journals and conference proceedings, holds nearly 50 invention patents (China/US). His research interests include power quality control and utility applications of power electronics, micro-grids for sustainable energy and distributed generation, and design and modeling methods for high power converters.

Dr. Liu received for eight times governmental awards at national level or provincial/ministerial level for scientific research/teaching achievements. He also received the 2006 Delta Scholar Award, the 2014 Chang Jiang Scholar Award, the 2014 Outstanding Sci-Tech Worker of the Nation Award, and the *IEEE Transactions on Power Electronics* 2016 Prize Paper Award. He is an IEEE Fellow, an Associate Editor for the *IEEE Transactions on Power Electronics*, and from 2015, the Vice President for membership of IEEE PELS. He is on the Board of China Electrotechnical Society and was elected the Vice President of the CES Power Electronics Society in 2013. Since 2013, he has been a Vice President for China Power Supply Society (CPSS) and since 2016, the inaugural Editor-in-Chief of *CPSS Transactions on Power Electronics and Applications*. Since 2013, he has been serving as the Vice Chair of the Chinese National Steering Committee for College Electric Power Engineering Programs.