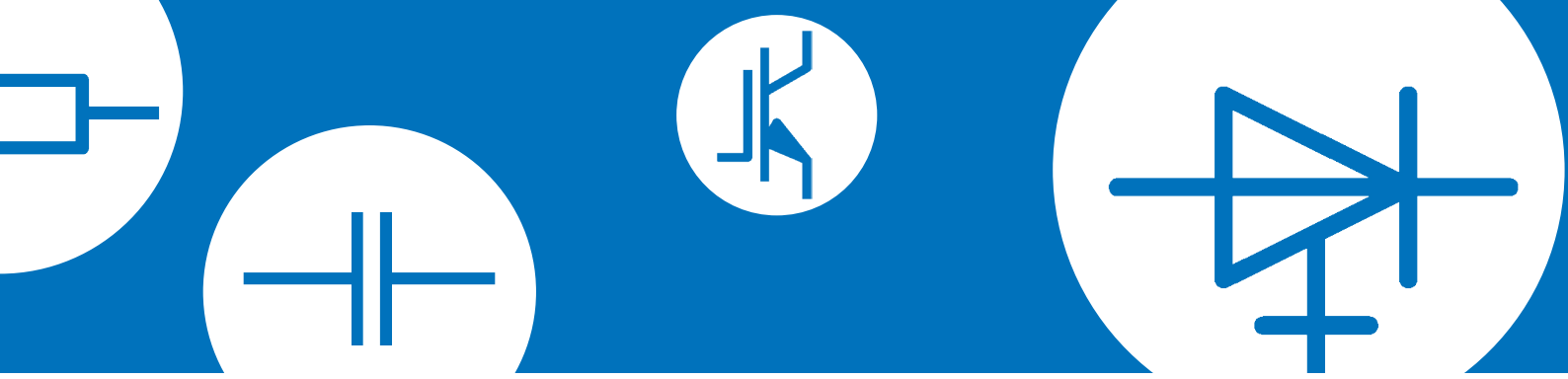


60 Years of Modern Power Electronics

FGLA / ISEA-PGS Colloquium

Ladies and gentlemen,
dear colleagues,
dear alumni,

We are happy to welcome you to our FGLA / ISEA-PGS Colloquium „60 Years of Modern Power Electronics“.
In this brochure, please find the final program.
We are grateful to the speakers for their excellent contributions and are thankful to our sponsors for making this colloquium possible.

September 14, 2018
Aachen

With kind regards,
Rik W. De Doncker and Dirk Uwe Sauer

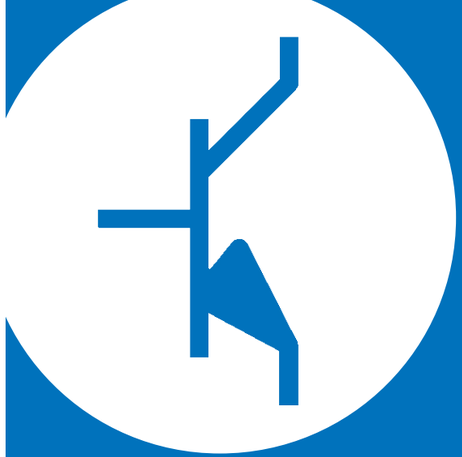
Prof. Dr. Rik W. De Doncker
Director E.ON ERC

Prof. Dirk Uwe Sauer
Institute for Power Generation and Storage Systems, E.ON ERC

1958 was a remarkable year of progress in research, innovation and industrial optimism. At the 1958 World's Fair in Brussels the atomic structure of iron was exemplified by the construction of the Atomium Building. In 1958 General Electric Company introduced the first silicon solid state power semiconductor to the market. The device, which was initially called Silicon Controlled Rectifier (SCR), nowadays better known as Thyristor, revolutionized energy conversion systems and gave birth to a new engineering field; power electronics. Compared to electronic tubes or rotating converters, power electronic devices enabled the construction of more efficient electrical energy conversion systems. Over the past six decades silicon power electronic devices (diodes, thyristors, transistors) evolved to ever more powerful semiconductors with voltage levels up to 10 kV and controllable currents up to thousands of amperes. Today, without power electronics state-of-the-art industrial drives, electric cars, PV and wind farms, home appliances, power supplies, battery chargers, etc. would simply not function. Together with communication technology, power electronics is a key enabling technology without which the digitalization of many sectors cannot be realized.

After sixty years of intensive development of power electronics a new era of this field is becoming apparent. Indeed, new power semiconductor devices based on wide bandgap materials are coming to maturity. These devices allow much higher switching frequencies thereby increasing significantly the power density of power electronic converters. Saving materials, reducing cost of passive components and, consequently, the cost of power electronic converters will remain the main drivers for research and development for years to come.

This colloquium reflects on the rapid development of modern, i.e. semiconductor based, power electronics, the lessons learned and looks into what new semiconductors can offer in the near future.



Speakers

Alan Mantooth, Distinguished Professor

Electrical Engineering Department, University of Arkansas, Director NCREPT and GRAPES
President of IEEE Power Electronics Society

Emerging Trends in Wide-Bandgap Power Electronics

Abstract

Economy and performance are benefits that come with high power density power electronics, just as in the case of VLSI electronics. High density power electronics require the heterogeneous integration of disparate technologies including power semiconductor devices, driver, protection and control circuitry, passives and voltage isolation techniques into single modules. One of the keys to advancing power electronic integration has been the commercial reality of wide bandgap power semiconductor devices made from silicon carbide and gallium nitride. The ability to design and manufacture wide bandgap integrated circuits as drivers, controllers, and protection circuitry allows them to be packaged in close proximity to the power device die to minimize parasitics that would adversely impact system performance. These impacts include excessive ringing, noise generation, power loss, and, potentially, self-destruction. This talk will describe emerging trends in silicon carbide analog and mixed-signal IC design for power electronic applications. Advanced 3D packaging techniques driven by multi-objective optimization techniques will also be described.

Biography

Alan Mantooth received his Ph.D. from Georgia Tech. He is currently Distinguished Professor of Electrical Engineering and 21st Century Research Leadership Chair at the University of Arkansas. Dr. Mantooth has 20 years of academic experience in addition to eight years in industry. He has served in several leadership positions in both industry and academe, and currently serves as Executive Director for the NSF Research Center on Grid-connected Advanced Power Electronic Systems (GRAPES) and as Deputy Director for the NSF Engineering Research Center for Power Optimization of Electro-Thermal Systems (POETS). Since its inception in 2005 he has served as the Executive Director of the National Center for Reliable Electric Power Transportation (NCREPT) and overseen its research and building program, which includes a 6 MVA test facility and cybersecurity testbed. He also serves as the Executive Director of the DoE Cybersecurity Center on Secure, Evolvable Energy Delivery Systems (SEEDS). Dr. Mantooth has published refereed articles and books in semiconductor device modeling, electronic design automation, IC design and power electronics design, and electronic packaging and integration. He is an IEEE Fellow, has served on the IEEE PELS Advisory Committee since 2004 and was elected PELS President for 2017 and 2018.

Jingxin Hu, M.Sc.
PGS | E.ON ERC, RWTH Aachen University

Fault Ride-Through Strategy of Dual-Active-Bridge Converter Based Intelligent Substations for Breakerless MVDC Grids

Abstract

Medium-voltage dc (MVDC) grids are discussed for various high-power applications being a superior solution over the well-established ac technology. Since dc has no natural zero crossing, the interruption of dc short-circuit currents in fault conditions demands specially designed dc circuit breakers. Due to the changing decentralized structure of power generation and power consumption, as well as the increasing amount of storage systems, future application scenarios and grid topologies necessitate the breakerless implementation of multi-terminal dc grids. As a key enabling component in the intelligent substations for multi-terminal MVDC grids, the dual-active bridge (DAB) dc-dc converters is not only a dc transformer to step up/down voltages, but also should be capable of limiting the short-circuit currents in dc fault conditions. A dedicated control strategy is designed for the DAB converters to ride through dc faults and limit the short-circuit currents in dc grids. Thereby, mechanical disconnectors can be applied to isolate the faulty line and allows the operation of MVDC grids without dc circuit breakers. During the fault ride-through operation stage, a space-vector-based asymmetrical duty-cycle control method is proposed and applied, which enables the DAB converter operating with controllable currents and maintaining the soft-switching operation even in zero-voltage fault conditions. With the fault ride-through capability and the associated protection scheme, the DAB converter based intelligent substations enable breakerless multi-terminal MVDC grids.

Biography

Mr. Jingxin Hu received bachelor degree from Northeastern University, China, in 2010, and master degree from RWTH Aachen University, Germany, in 2013, both in electrical engineering. During the master study, he was an intern at the ABB Corporate Research, Switzerland, working on integration of large-scale offshore wind energy, in 2012. Later, in 2013, he joined the General Electric Global Research Center, Munich, to conduct his master thesis research on developing a high-power high-performance dc-dc converter for transportation systems.
In 2014, Mr. Hu became a research associate at the Institute for Power Generation and Storage Systems, E.ON Energy Research Center at RWTH Aachen University, Aachen. His research interests include topology, modeling and control of power electronics converters for MVDC and LVDC grids. He is student member of IEEE and a recipient of an IEEE conference prize paper award at IPEC-Niigata, 2018.

Dr.-Ing. Peter Friedrichs
Senior Director Infineon Technologies

Wide-Bandgap Devices - Next Generation Power Semiconductors

Abstract

Designers of power supplies, motor control and inverter systems, RF circuitry, photovoltaic circuits and a variety of other power switching solutions are under unprecedented pressure to improve application performance while increasing power density, reducing board space and driving down component count. Silicon can offer only marginal improvements meanwhile. Thus, to address these on first glance conflicting challenges, engineers are increasingly looking to deploy future solutions based on wide band gap (WBG) materials such as silicon carbide (SiC) and gallium nitride (GaN).
The attraction of using WBG materials is clear. Switching at higher frequencies than conventional silicon can improve power density by shrinking the size of passive components. It can also help to save energy on cooling the overall system. Low charge and excellent dynamic performance in reverse conduction compared to silicon alternatives can enable more efficient operation in today´s applications at existing frequencies. And the much higher breakdown field strength and thermal conductivity of SiC devices allows manufacturers to create devices that outperform silicon alternatives– a key concern in areas such as photovoltaics, industrial motor drives, traction and electromobility. The key enabler is here the use of unipolar devices even at very high blocking voltages.

Biography

Dr. Peter Friedrichs was born in 1968 in Aschersleben, Germany. After achieving his Dipl.-Ing. in microelectronics from the Technical University of Bratislava in 1993, he started a Ph.D work at the Fraunhofer Institut FhG-IIS-B in Erlangen. His focus area of expertise was the physics of the MOS interface in SiC power MOSFETs. In 1996 he joined the Corporate Research of the Siemens AG and was involved in the development of power switching devices on SiC, mainly power MOSFETs and vertical junction FETs.
Peter Friedrichs joined SiCED GmbH & Co. KG, a company being a joint venture of Siemens and Infineon and originated from the former Siemens research group, on March the 1st, 2000. Since July 2004 he was the managing director of SiCED, responsible for all technical issues. In 2009 he achieved the Dipl.-Wirt.-Ing. From the University of Hagen. After the integration of SiCED's activities into Infineon he joined Infineon as Senior Director Silicon Carbide from April 1st, 2011. He is a member of the ECPE board and coordinates external affairs related to SiC for Infineon. He holds numerous patents in the field of SiC power devices and technology and is an author or co/author of more than 50 scientific papers and conference contributions.

Christoph van der Broeck, M.Sc.
ISEA, RWTH Aachen University

Monitoring Localized Degradation of Power Modules via In-Situ Thermal Impedance Spectroscopy

Abstract

The reliable and safe operation of the power electronics is of great importance in various applications. A conservative approach is the strategic oversizing of converters. In contrast to this, state-of-health monitoring is a cost saving alternative that avoids oversizing. It guarantees reliable and safe converter operation through early diagnosis of critical degradation and timely initiation of predictive maintenance. A critical class of degradation mechanisms are structural degradations of the power module, e.g. delamination of the power devices and the DCB as well as a deterioration of the convection process. State-of-the art technologies that aim at monitoring structural degradations in-situ, without interruption of converter operation, primarily focus on the detection of thermal resistance changes of the power module. Unfortunately, these technologies do not allow estimation of thermal resistance with high accuracy. Furthermore, monitoring thermal resistance can only detect the total structural degradation of the power module and cannot be used to separate different local degradations. To overcome these limitations, a methodology is introduced that enables the detection, separation and quantification of structural degradation modes without interrupting normal converter operation. The introduced in-situ thermal impedance spectroscopy excites the power devices by small signal loss injection, extracts the temperature response with a unique filtering technique and computes the thermal impedance in magnitude and phase over a wide bandwidth. In particular, the phase information is a key indicator of structural degradation and can be extracted with zero error. Consequently, the frequency response information is effectively processed by artificial neural networks to separate and quantify localized degradation modes. This creates an excellent sensor for remote state-of-health diagnosis and prognosis of future power modules in the field via the Internet of Things.

Biography

Christoph H. van der Broeck received the B. Sc. and M. Sc. degree in electrical engineering from RWTH Aachen, Germany, in 2010 and 2013. From 2011 to 2012 he joined the Wisconsin Electric Machine and Power Electronic Consortium (WEMPEC) at the University of Wisconsin, Madison, as a Fulbright Scholar to work on advanced control techniques for electrical drives. Between 2012 and 2013 he worked with AixControl GmbH on control design of power converters. Since 2014, he has been working towards a Ph. D. degree at the Institute for Power Electronics and Electrical Drives (ISEA), RWTH Aachen. From 2017 to 2018 he received a scholarship of the German Academic Exchange Service (DAAD) for advanced research on his dissertational work “Methodology for Thermal Modeling, Monitoring and Control of Power Electronic Modules” at the University of Wisconsin, Madison. His dissertation is jointly supervised by Prof. Rik W. De Doncker (ISEA) and Prof. Robert D. Lorenz (WEMPEC). He is a recipient of the 2018 W. Portnoy Best Paper Award of the IEEE IAS that he receives for his work on IGBT junction temperature sensing. His research interests include the multi-physics modeling, monitoring and control of reliable power electronics.

Prof. Robert D. Lorenz
University of Wisconsin Madison, Co-Director WEMPEC, M.Witter Foundation Chair and E. Kaiser Chair

Strategic Control and Sensing Developments for Power Electronics, Drives, Electric Machines, and Batteries

Abstract

There are a number of strategic control and sensing developments that integrate facets of power electronics, drives, electric machines, and batteries that will be undoubtedly become key elements for the next 60 years of ISEA research.
These include:

- how next generation PM electric machines will require detailed control of power electronic switching to save large amounts of energy,
- how power electronics can be enhanced for precision control of electric drives,
- how reliability of power electronics can be improved with active control to complement improved passive integration methods,
- how critical sensors can be effectively integrated into WBG power electronics,
- how precision of self-sensing drive controls can be dramatically enhanced,
- how wireless power transfer charging system for EVs can be made both safe and high efficiency,
- how actively controlling the dynamic rate-of-degradation for EV Li-ion batteries can change user lifetime.

This presentation will explore these topics as a potential outline for sustained long term collaboration between ISEA and WEMPEC.

Biography

Professor Robert D. (Bob) Lorenz received the B.S., M.S., and Ph.D. from the University of Wisconsin, Madison and M.B.A. from the University of Rochester, Rochester, NY. He joined the faculty in 1984 after spending 10 years in industry and 2 years in the US Army. His RWTH-Aachen connection started in the academic year 1969-70 when he did his Master thesis research at WZL at RWTH in sensing for adaptive control of machine tools. After leaving industry and joining the university, he re-kindled this connection by being a Visiting Research Professor at ISEA in the summers of 1987, 1991, 95, 97 and 99 respectively and was the SEW Eurodrive Guest Professor at ISEA for the 2000/2001 academic year. He regularly visits and maintains collaborative research activity with ISEA. He teaches and performs research in control and sensing in the area of motor drives, power electronics, and motion control. He is Co-Director of the Wisconsin Electric Machines and Power Electronics Consortium (WEMPEC) with over 86 international sponsors and 37 years of research and technology leadership. He has authored over 300 published technical papers and is the holder of 26 patents. He and his students have won 34 IEEE prize paper awards. He has completed over 210 graduate students with thesis/dissertation projects. Dr. Lorenz is a Life-Fellow of the IEEE, was on IEEE Board of Directors for 2005/2006, IEEE Industry Applications Society (IAS) President for 2001, a Distinguished Lecturer of the IEEE IAS for 2000/2001. He has received the 2002 Ragnar E. Onstad Service to Society Award, the 2003 IEEE IAS Outstanding Achievement Award, 2006 European Power Electronics Power Electronics and Motion Control (EPE-PEMC) Outstanding Achievement Award, 2011 IEEE IAS Distinguished Service Award, 2014 IEEE Richard H. Kaufman Technical Field Award, and 2014 EPE Outstanding Achievement Award.

Prof. Frede Blaabjerg
Institute for Energy Technology, Power Electronics and Drives, Aalborg University
President Elect of IEEEE Power Electronics Society

Power electronics - quo vadis

Abstract

The world is becoming more and more electrified combined with that the consumption is steadily increasing – at the same time there is a large transition of power generation from fossil fuel to renewable energy based which all together challenges the modern power system but also gives many opportunities. We see also now big steps being taken to electrify the transportation – both better environment as well as higher efficiency are driving factors. One of the most important technologies to move this forward is the power electronics technology which has been emerging for decades and still challenges are seen in the technology and the applications it is used. This presentation will be a little forward looking (Quo Vadis) in some exciting research areas in order further to improve the technology and the systems it is used in. Following main topics will be discussed

- The evolution of power devices
- Renewable Generation
- Reliability in power electronics
- Power Electronic based Power System stability

At last some discussions about other hot topics will be given.

Biography

Professor 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 at Tallinn Technical University (TTU) in Estonia.

Annegret Klein-Heßling, Dipl.-Ing. Dipl.-Wirt.Ing.
ISEA, RWTH Aachen University

Active DC-Power Filters for Switched Reluctance Drives under Single-Pulse Operation

Abstract

Switched reluctance drives require a comparatively large dc-link capacitance to filter the total machine current. A large dc-link capacitance increases the size, weight and cost of the inverter which is a significant drawback in the use of switch reluctance drives. Especially during single-pulse operation of a switched reluctance machine with a low number of phases, the current ripple can exceed the average current resulting in an alternating machine current.
The presentation focuses on the application of an active dc-power filter to minimize the dc-link capacitance of switched reluctance drives. The filter control algorithms and their implementation are presented in detail. The control algorithms are supplied with measured and estimated machine parameters to improve the filter performance. The complete control logic is implemented on an FPGA.

Biography

Annegret Klein-Hessling was born in Germany in 1986. She received her Diploma degree in electrical engineering and her Diploma degree in industrial engineering from the RWTH Aachen University, Germany, in 2012. Since October 2012 she has been working as a research associate at the Institute of Power Electronics and Electrical Drives (ISEA) at the RWTH Aachen University, Germany. Annegret has been a doctoral candidate in the post graduate program „Integrated Energy Supply Modules for Roadbound E-Mobility“ since 2014. In 2018 she successfully completed her phd-studies and started as a chief engineer at ISEA. Her research interests include the field of electrical drives, in particular switched reluctance drives and their control. Annegret Klein-Hessling is currently the chair of the IEEE student branch Aachen.

Dr.-Ing. Jürgen Reinert
Deputy CEO, CTO and COO SMA Solar

Sustaining Power-Electronic Production in a Dynamic Market with Fast Technical Changes

Abstract

The market for photovoltaics has always been, and will continue to be, highly volatile. On the one hand, significant regional dependencies exist regarding incentive programs and political framework conditions; on the other hand, customer needs and market models (self-consumption, storage systems, etc.) are also changing.
In particular, China's commitment in this market has led to significant commoditization, initially affecting PV modules but now also inverters in all power classes. The costs of solar energy are now just a tiny fraction of what they were 20 years ago. As a result, any differentiation on the basis of new technology (efficiency, lifetime) is now either impossible or possible only to a limited extent.
This development in combination with the widespread megatrends (digitalization, connectivity, decentralization, integrated energy, energy management, etc.) necessitate new business models, to be able to continue successful participation in the decentralized energy supply market.
Integrated PV systems with storage solutions, big data and comprehensive service offerings ("solutions") are now the focus of SMA's activities and are gaining in importance.
This affects not only the technological alignment of product development (platform mindset, etc.) but also the organization and required mindset as a whole. Agile methods, new management principles and new structural models are needed if we are to maintain our successful position as a top player in this environment.

Biography

After he studied Electrical Engineering in South Africa, Jürgen Reinert (b. 1968) received his Doctorate at the Institute for Power Electronics and Electrical Drives (ISEA) in Aachen, Germany, and began his career as Chief-Engineer there. From 1999 to 2011, he worked for the Emotron Group in Sweden, where he was board member with responsibility for Technology and Operations. From 2011 to 2014, he was head of the division Power Plant Solutions at SMA. Under his leadership, SMA successfully expanded its worldwide project business and developed turnkey system solutions for large-scale PV power plants. Since April 2014, Dr.-Ing. Jürgen Reinert is a member of the Managing Board at SMA and since January 2016 is responsible for Operations, R&D and the Business Units. Jürgen Reinert is a member of the Danfoss A/S Supervisory Board.

Dr.-Ing. Jochen von Bloh
CEO AixControl GmbH

Custom Power - Challenges and Opportunities for SMEs

Abstract

During the work at the ISEA, the clients of research projects requested more and more frequently a professional transfer of the acquired knowledge and the revision of the developed prototypes to a pre-series product. Often, these transfer projects took much longer than planned, and their field applicability was not always fully realized. To close the gap between academic contractual research and an industrial product development, AixControl GmbH was founded in 2002 as a classical spin-off. From that time the realization of a wide variety of projects increases the horizon of experience which characteristics are necessary for a successful product development:
In the concept phase both experience and creativity are needed. This combination can be particularly founded in SMEs, as the close cooperation in a smaller crew means that each employee constantly learns from colleagues, thereby expanding his or her own specialist knowledge and thus being able to bring in new ideas.
During the design phase, the focus is on an easy maintainability and the capability of remote diagnostics. These design features are extremely important for an SME not having a global service net at all.
Finally, the close interlocking of the individual departments also helps to put the products into operation quickly and efficiently.
These characteristics make SMEs as development partners not only interesting for medium-sized customers, but even global players use the AixControl GmbH to support their own product development.

Biography

Dr.-Ing. Jochen von Bloh studied semiconductor physics in the department of electrical engineering at the RWTH Aachen University. He joined the ISEA first in 1992 for his diploma thesis on IGBT driver stages. Between 1993 and 1997 he worked as research engineer in the field of battery monitoring systems at the company Digatron GmbH, Aachen. After his excursion to industry, he returned to the ISEA, setting up the high power workgroup at the institute. In his PHD thesis, he examined multilevel converters for medium voltage power transmission. In 2000, he became the second chief engineer in the institute, leading the power electronics and components group.
Two years later, he founded the AixControl GmbH as a classical spin-off. For the first two years, he was supported by the founding program PFAU of the federal state NRW. During this time he transformed the ISEADSP, a highly flexible DSP control board developed by colleagues at the ISEA, to the industrial power control prototyping system XCS 2000. In 2004, the company entered the global market with this product. Starting with 2 persons, the AixControl GmbH grew up to an innovating SME with more than 24 employees during the last 16 years. The AixControl is a leading manufacturer of high power grid simulators and converter test benches, worldwide installed in laboratories and production plants. Dr.-Ing. Jochen von Bloh is a sworn consultant and works as a special expert for automotive and aviation industry.

Prof. Adolf Müller-Hellmann
ISEA, RWTH Aachen University

Moderne Leistungselektronik - Herausragender Wegbereiter für Optimierungen von Bahnantrieben

Abstract

Modern power electronics - an outstanding enabler for the optimization of railway drives.
Special requirements are placed on railway drives with regard to their line interactions, more system capability, traction behaviour, efficiency, power weight and maintenance costs. The modern power electronics enabled the continuous optimization of these requirements. By inverters for power and frequency adjustment, alternating current commutator machines as well as DC and mixed-current machines could be replaced by rotary field machines and with 4 Quadrant controller the almost complete reduction of the Reactive power removal from the railway networks could be realized. In order to reduce the high weight of the 16.7 Hz transformers on the railway vehicles, several concepts with an increase of the frequency on the high-voltage side were developed.

Biography

Adolf Müller-Hellmann studied General Electrical Engineering in Osnabrück and Electrical Power Engineering in Aachen. After working as a development engineer with BBC in Mannheim und as a scientific assistant at the Aachen Technical University he completed his PhD (Dr.-Ing.) in 1979. From 1982 until July 2008 he worked in various positions at the German Association of Public Transport Companies (VÖV / VDV), from 1998 to the beginning of his retirement 2008 as its general manager. In 1987, 1993 and 1996 the Aachen Technical University invited him to lecture on „Electrical Public Transport Systems“, „Electrical Rail Drives Applications” and together with colleagues “ Electrical Power from Regenerating Energy”, respectively. 1995 he was appointed honorary professor at the Aachen Technical University. From 1993 until 1995 he was additionally managing director of the Euroteam of the International Union of Public Transport (UITP) in Brussels.Today he is Board member of the Forum for Transport and Logistics.

Agenda

September 14, 2018

09:00 - 09:05	Welcome
09:05 - 09:10	Greetings **Prof. Wilfried Mokwa** Dean Faculty of EE and IT, RWTH Aachen University
09:10 - 09:30	Introduction Prof. Rik W. De Doncker
09:30 - 10:10	**Emerging Trends in Wide-Bandgap Power Electronics** **Alan Mantooth, Distinguished Professor** Electrical Engineering Department, University of Arkansas, Director NCREPT and GRAPES President of IEEE Power Electronics Society
10:10 - 10:30	**Fault Ride-Through Strategy of Dual-Active-Bridge Converter Based Intelligent Substations for Breakerless MVDC Grids** **Jingxin Hu, M.Sc.** PGS | E.ON ERC, RWTH Aachen University
10:30 - 11:00	Break

11:00 - 11:40	**Wide-Bandgap Devices - Next Generation Power Semiconductors** **Dr.-Ing. Peter Friedrichs** Senior Director Infineon Technologies
11:40 - 12:00	**Monitoring Localized Degradation of Power Modules via In-Situ Thermal Impedance Spectroscopy** **Christoph van der Broeck, M.Sc.** ISEA, RWTH Aachen University
12:00 - 12:40	**Strategic Control and Sensing developments for Power Electronics, Drives, Electric Machines, and Batteries** **Prof. Robert D. Lorenz** University of Wisconsin Madison Co-Director WEMPEC, M.Witter Foundation Chair and E. Kaiser Chair
12:40 - 01:40	Break

01:40 - 02:20	**Power electronics - quo vadis** **Prof. Frede Blaabjerg** Institute for Energy Technology, Power Electronics and Drives, Aalborg University President Elect of IEEEE Power Electronics Society
02:20 - 02:40	**Active DC-Power Filters for Switched Reluctance Drives under Single-Pulse Operation** **Annegret Klein-Heßling, Dipl.-Ing. Dipl.-Wirt.Ing.** ISEA, RWTH Aachen University
02:40 - 03:20	**Sustaining Power-Electronic Production in a Dynamic Market with Fast Technical Changes** **Dr.-Ing. Jürgen Reinert** Deputy CEO, CTO and COO SMA Solar
03:20 - 03:50	Break

03:50 - 04:30	**Custom Power - Challenges and Opportunities for SMEs** **Dr.-Ing. Jochen von Bloh** CEO AixControl GmbH
04:30 - 05:00	**Moderne Leistungselektronik - Herausragender Wegbereiter für Optimierungen von Bahnantrieben** **Prof. Adolf Müller-Hellmann** ISEA, RWTH Aachen University
05:00	Closing Words Prof. Rik W. De Doncker

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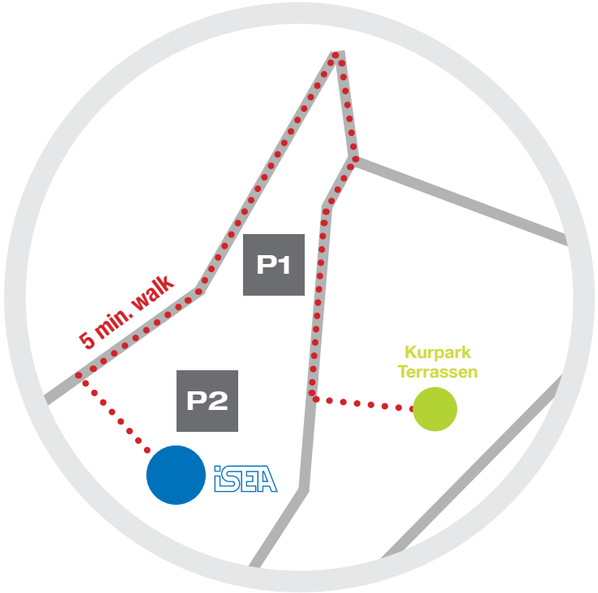

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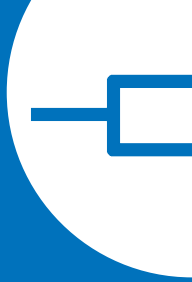

Thinking the Future
Zukunft denken