Dear Readers,

The Corona crisis has impacted our daily lives considerably. Of course, the health of all our co-workers and colleagues has priority.

In anticipation of the stringent guidelines related to social distancing, that were imposed by our Ministry and University, we implemented strict rules beginning of March and mandated home office work for whomever did not need to be at the institute. Out of necessity we are all learning to continue work online, even our students are following all our courses online. However, we are pleased to be able to assure all our partners and clients that we will carry out almost all work and projects as planned. The many project progress reports in this Newsletter shows that the institute has shown great adaptation to this extraordinary situation, for which I am grateful.

I wish you a good read, stay healthy and I hope we can meet soon in person again.

Rik W. De Doncker

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ISEA News

News from the Institute for Power Electronics and Electrical Drives

No. 1/2020

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mobilEM

The Research Training Group Integrated Energy Supply Modules for Road-Based Electromobility (mobilEM) is a research alliance of nine institutes of RWTH Aachen University and the Department of Energy Technology of the University Duisburg Essen. Funded by the German Research Foundation (DFG), the college aims to research future mobility concepts by forming an interdisciplinary team from the various fields of engineering. This allows to analyze the overall concept of electric or hybrid drives in detail and to concentrate the expertise of several institutes in various subjects.

After a successful interim evaluation, the Research Training Group is in the second funding phase with the third cohort of doctoral students.
ISEA currently consists of 24 members who are working on the following topics: "Electrical Energy Storage Systems", "Electrical Drive System", "Range Extender Module", "Thermal Management" and "Control and System Simulation". ISEA is involved with a total of 6 colleagues in the areas of electrical energy storage systems and electrical drive systems. The focus is on battery research, as well as the optimization of power electronic systems and in the field of electrical machines.

In order to promote the interdisciplinary exchange within the research training group, various events take place on a regular basis. Every three months, one of the participating institutes organizes a basic seminar, where the respective basics of the institute-specific disciplines are introduced in a two-day lecture. In the past seminars, the participants were introduced to the topics "Topology & Thermal Management" and "Simulation & Control" by the institutes IKA/WSA and IRT of the RWTH. In addition, the members of mobilEM meet at regular intervals for doctoral seminars. Here, two colleagues present their research topic and their current results in a presentation and have the opportunity to discuss them within the group.

The program is complemented by the annual mobilEM colloquium, which also welcomes external guests. The two-day conference offers the members a platform to present their results in form of presentations and posters and to gain new ideas from talks with professors and external speakers. This year’s mobilEM colloquium will take place on 27/28 October 2020. It is the 7th edition of the successful format. Further information about mobilEM and the current members can be found on the homepage at http://www.mobilem.rwth-aachen.de/

**Electrical Drives | Condition Monitoring**

Increasing the availability of mobile work machines by forecasting machine status based on global data

Mobile machinery are part of a logistical chain in which the failure of one machine can result in the standstill of other machines. Even relatively small failures can cause high costs for the operator. Reliability and availability of the machines are therefore important parameters that have a decisive impact on planning certainty within construction and extraction processes. Nowadays, mobile machinery are equipped with a variety of sensors. However, due to cost reasons and a lack of evaluation methods, they have not been systematically used for condition monitoring.

ISEA’s focus in this project is the detection of synthetic faults in electrical machines and lifetime estimation of electrical drivetrains. Faulty machines are investigated under varying operating conditions to evaluate fault detection methods. By feeding the actually encountered loads into lifetime models, the lifetime estimation accuracy is increased. A combination of model-based lifetime estimation and failure diagnosis from sensor signals is used to build an on-board condition monitoring system.

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**Short & Compact I Awards**

**The STAWAG Dissertation Award 2019: Dr. Johannes Voss, Dr. Shenghui Cui and Dr. Jingxin Hu**

The STAWAG Dissertation Award 2019 was granted to Dr. Johannes Voss, Dr. Shenghui Cui and Dr. Jingxin Hu at the “Day of Electrical Engineering and Information Technology”. The STAWAG Dissertation Prize honors outstanding dissertations in the field of electrical grids.

**Drive-E Study Award for Lukas Ruppert**

The Fraunhofer-Gesellschaft and the Federal Ministry of Education and Research annually award the Drive-E-prizes for the best master and bachelor theses. Lukas Ruppert achieved the second place for his master thesis about the development of a highly efficient traction inverter for solar-powered electric vehicles.
Storage Systems | Battery Research in Germany

General Concept Battery Research Factory

The electrification of transport and the growth of renewable energies has put lithium-ion batteries at the center of industry as a key technology and is playing a pioneering role in the field of energy storage. The mastery of this technology along the entire value chain from material to battery cell to system and the associated recycling is a necessary basis for Germany’s current political, technical and economic development. For this reason, the BMBF has greatly expanded its activities in the field of battery research on the one hand and at the same time restructured them: this is what the name “Battery Research Factory” (German: "Dachkonzept Forschungsfabrik Batterie") stands for. The declared aim is to close gaps in the value chain, ensure rapid transfer to industry and research future technologies.

For the implementation of the goals, several so-called clusters have already been installed along the technology readiness level (TRL) of lithium-ion technology, e.g. “FestBatt", the "Excellent Battery Centres" (EBZ) and also "ProZell" (see project MEET HiEnD III in the last newsletter). FestBatt researches solid state batteries (TRL 1-3), EBZ current lithium-ion technology (TRL 3-5) and ProZell studies production processes (TRL 5-6).

The research production, which is now being built in Münster, fits seamlessly into this structure and, as a flexible battery production pilot line, is intended to ensure technology scaling to large-scale production (TRL 6-9). Furthermore, an associated pilot recycling plant is planned in Ibbenbüren (funded by NRW). ISEA is particularly active here between these two pilot plants, i.e. we take care of usage concepts and the most clever use of the produced batteries before they are recycled at the end of their life circle. This includes, for example, the precise assessment of the cells, life cycle analyses and modelling, and the identification of possible second use concepts.

Furthermore, further clusters are being created within the strategy of the BMBF, whereby ISEA is also strongly involved here (e.g. battery use, analysis and recycling). We will present our activities in more detail in the next newsletters this year. The promotion and at the same time strong focus on the transfer of results to industry is ensured by industrial advisory boards and offers the opportunity to expand the battery landscape in Germany on the one hand to expand large-scale cell production and on the other hand to catch up with Asian producers.

Electrical Drives | Extended Operating Range

Dynamic Winding Switchover for Electrical Drives

The requirements on the achievable operating range of an electric drive are nowadays mostly realized by oversizing of components or by using mechanical gears. This can lead to increased costs and a reduced utilization of the components. An alternative is the use of a winding switchover in the electrical machine. For example, a series-to-parallel switchover of the stator winding provides nearly double maximum speed or double maximum torque, depending on the desired performance. In order to achieve short switchover times in the millisecond range, the switchover is performed by means of controllable power electronics instead of mechanical switches. At the same time, the switchover process may be actively controlled.

Within the framework of the research project 873 I "Dynamic Winding Switchover for Electrical Drives", which is supported by "Forschungsvereinigung Antriebstechnik e.V." (FVA), the transient switchover process is investigated in detail. The aim of the project is to develop a method that realizes the switchover process dynamically under load with the least possible torque deviation and minimum time duration. Furthermore, the selection of the switchover moment is investigated, for example to enable an efficiency-optimized or a comfort-optimized switchover.

For these purposes, a machine model is developed that, in particular, reflects the transient effects during switchover. By means of an overall electrical drivetrain model including a power-electronics switchover unit, a switchover method is developed and evaluated. The method is implemented on a rapid control prototyping system and verified by measurements on an induction machine with switchable windings.
Storage Systems | Lifetime of Battery Cells

Research Project GradiBatt

The service life of lithium-ion batteries is largely determined by the temperature. It is generally known that ageing mechanisms that continuously reduce the available capacity of lithium-ion batteries accelerate in the safe operating window of a battery cell as temperatures rise. In the past, most ageing tests were carried out under homogeneous temperature conditions and thus sometimes differ significantly from the temperature boundary conditions experienced by battery cells in practical applications. In battery packs, the individual battery cells are exposed to significant temperature gradients due to cooling systems, for example, and their influence on the service life of the cells has not yet been adequately researched. In the research project 879 I “GradiBatt”, funded by Forschungsvereinigung Antriebstechnik e.V. (FVA), ISEA and the ZSW Ulm are therefore jointly investigating the influence of temperature gradients on the ageing behaviour of lithium-ion battery cells.

In the project, battery cells are controlled under various externally applied temperature gradients and aged in the laboratory in a defined manner. The condition of the cells is monitored by different methods during the ageing tests. To investigate the influence of the temperature gradients in detail, the cells are opened after the ageing tests and the condition of the cell interior is analysed. Since heterogeneous temperatures within a cell also cause a heterogeneous current distribution, further laboratory experiments are used to investigate how the currents within a battery cell are distributed to the individual electrode areas by a heterogeneous temperature distribution. At the end of the project, the findings obtained will be transferred into mathematical models.

Power Electronics | Gate Driver

SiCModul

Semiconductors based on silicon carbide (SiC) promise higher power density and an increased efficiency. However, they are currently only rarely used in automotive drive converters. The main drawbacks are the higher costs of the semiconductors and a complex packaging for effective cooling of the components. In the project SiCmodul, the partners AixControl, Bosch, Continental, Daimler, Fraunhofer IZM, Schweizer Electronic, TLK Thermo and ISEA are developing a new module design using PCB integrated SiC semiconductors. The module enables peak temperatures of the semiconductors of up to 200 °C, which allows a significant increase in power density. Additionally, the integration of the semiconductors leads to a longer lifetime of the module due to reduced thermal stress. In SiCmodul, ISEA is developing a high-temperature gate driver as well as a current, voltage and temperature sensor. The gate driver contains a fast overcurrent detection, which ensures a safe turn-off of the power module in case of a fault. Furthermore, the chosen gate-driver topology enables a variable gate resistance. Thus, it provides the possibility to influence the switching process, e.g., to reduce the voltage slope at the phase outputs to increase lifetime of the winding insulation of the connected electrical machine.

The validation of the module design is carried out by the construction of a six phase traction inverter with a power of 160 kW. The converter is integrated into an asynchronous machine. The six phase design offers particular advantages in terms of redundancy. In the event of failure of a single module, the converter enables limp-home operation with reduced power.

First characterizations of the power module already show the high potential of the design with PCB-integrated SiC-MOSFETs. The commutation inductance was measured to be 1.7 nH, which is significantly lower than the inductance of commercially available SiC modules.

Short & Comapct II Award

WEVJ Best Paper Award 2019

Jan Becker, Thomas Nemeth, Raphael Wegmann and Dirk Uwe Sauer: Dimensioning and Optimization of Hybrid Li-Ion Battery Systems for EVs
World Electric Vehicle Journal, 9 (2), 2018
Available online: https://www.mdpi.com/2032-6653/9/2/19
Storage Systems | Research Battery Storage

M5Bat successfully brings 3 MW primary control reserve to the market in 2019

The 5.4 MW/5.6 MWh research battery storage facility successfully participated in the primary control power (PRL) market throughout 2019 and contributed to grid frequency stabilization. In addition, the pre-qualified capacity was increased from 2 MW to 3 MW. Figure 1 illustrates the increased PRL energy throughput from calendar week 11 onwards. The blue, red and orange bars represent the energy feed-in and the purple and green bars represent the energy drawn from the grid.

The special feature of the battery storage system, which has been in operation since 2016, is the coupling of different battery cell technologies. In total, two different lead acid (OCSM and OPzV) and three different lithium ions (lithium-manganese-oxide (LMO), lithium-iron-phosphate (LFP) and lithium-titanate-oxide (LTO)) are installed. By means of a control system developed at ISEA, an intelligent power distribution to the respective technologies is achieved. This takes both into account the efficiency and the performance of each battery technology. This advanced operating concept should ensure that each individual battery technology is controlled according to its preferred state of charge and performance. We can show that by extending the service life, an improvement in economic efficiency can be achieved.

Figure 1: Converted energy in charging and discharging direction for the primary control power at the beginning of 2019

The diagram in Figure 2 shows the power distribution for the month of April 2019. It illustrates that the energy supply is mainly provided by the LMO technology, the largest unit in M5BAT. On the other hand, it is particularly suitable for many short power calls, which have to be provided mainly in the primary control power. The lead-acid strings (OCSM, OPzV) take over the longer and more energy-rich power calls.

Figure 2: Power division on different technologies in April 2019

Short & Compact III Award

Teaching Award 2019 for Prof. Dr. Dirk Uwe Sauer

Prof. Dr. Dirk Uwe Sauer was awarded the RWTH Teaching Award in the "Lecturer" category. RWTH Aachen has been awarding a teaching prize since 2001 to honor outstanding achievements in teaching at the university. The award recognizes the redesign of the Electrical Engineering I lecture. The award ceremony took place as part of RWTHtransparent on January 31, 2020.

The ISEA is pleased to receive this special award, which also recognizes the work of the employees who contribute to the design of this and a number of further lectures, exercises and exams every semester. Thanks also go to the HIWIs, the student council, the media office for teaching and many others Faculty and central university administration services, such as the psychological counseling center of the RWTH.

© ISEA
Prof. Dirk Uwe Sauer is coordinator of the competence cluster "Battery Utilisation Concepts"

With the umbrella concept "Battery Research Factory", the Federal Ministry of Education and Research (BMBF) is pursuing a topic-oriented, coherent, national approach to the promotion and further development of battery research in Germany. Within this framework four new competence clusters have been established. The cluster "Battery Usage Concepts" (coordinator team Prof. Dr. Dirk Uwe Sauer, Prof. Dr. Andreas Jossen, Dr. Axel Müller-Groeling) is to develop know-how for module or cell diagnosis including an end-of-life rapid characterisation or condition determination. For more information please read “Battery research in Germany: General concept of the Battery Research Factory".

DFG Review Board Election 2019: Reelection Prof. Sauer

Dirk Uwe Sauer was re-elected to the DFG Review Board 408-03 "Electrical Engineering and Information Technology: Electrical Energy Generation, Distribution, Application" as first on the list.

TorqueWerk I Spin-Off

ISEA start up operates under TorqueWerk GmbH and moves to new company premises

With the successful finalized EXIST Forschungstransfer at ISEA in September last year TorqueWerk GmbH moved to the Technology Park Herzogenrath near Aachen. The new Start-up and RWTH Aachen represented by its INNOVATIONS GmbH agreed over an IP-Licensing contract regarding the project results for the new company. Furthermore, all equipment from the project was transferred from the RWTH Aachen to the newly founded company as the founding rules required. This enabled the ongoing development of motors, test benches and further infrastructure at the new location.

Already in November 2019 TorqueWerk was able to present a new 60 kW segmented motor at the SPS fair in Nürnberg. The motor has 1000 Nm torque and has a weight of only 650 kg, left in the picture.

TorqueWerk GmbH develops, produces and sells industrial motors based on the principal of synchronous reluctance machines. The motor concept, which uses air cooling, allows high torque values and offers a high efficiency, as compared to other machine types. The motor can be driven as direct drive and replace geared motors or torque motors based on PM machines. The flat, disk like and segmented design due to tooth windings allows the direct integration in the application machine in an easy way. Thanks to the modular building blocks based on the motor segments TorqueWerk enables particularly small and mid-size company's new possibilities to build integrated machines and a way up to their own special purpose drive based on standard parts.

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ISEA News
www.isea.rwth-aachen.de
News from the Institute for Power Electronics and Electrical Drives
No. 1/2020

Short & Compact IV

Prof. Dirk Uwe Sauer is coordinator of the competence cluster "Battery Utilisation Concepts"

With the umbrella concept "Battery Research Factory", the Federal Ministry of Education and Research (BMBF) is pursuing a topic-oriented, coherent, national approach to the promotion and further development of battery research in Germany. Within this framework four new competence clusters have been established. The cluster "Battery Usage Concepts" (coordinator team Prof. Dr. Dirk Uwe Sauer, Prof. Dr. Andreas Jossen, Dr. Axel Müller-Groeling) is to develop know-how for module or cell diagnosis including an end-of-life rapid characterisation or condition determination. For more information please read “Battery research in Germany: General concept of the Battery Research Factory".
Center for Ageing, Reliability and Lifetime Prediction of Electrochemical and Power Electronic Systems

The building is progressing ...

### Events | Dates

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### Editor:

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Next Pages: Dissertations | Publications

Kai-Philipp Kairies ■ Arne Hendrik Wienhausen ■ Furkan Kaan Titiz ■ Martin Wünsch
Kai-Philipp Kairies

Auswirkungen dezentraler Solarstromspeicher auf Netzbetreiber und Energieversorger

Decentralized battery storage is a rapidly growing market. Between 2013 and 2019, more than 120,000 home storage systems with a cumulative capacity of more than 700 MWh were installed in Germany. As part of a scientific monitoring program for the German Federal Ministry of Economics and Energy (BMWi), the author of the dissertation has collected and analyzed the market and technology development of home storage systems in Germany since 2013. The aim of the dissertation is to provide a comprehensive, quantitative evaluation of the effects of decentralized home storage systems on energy suppliers and grid operators. Based on a comprehensive database, tools to integrate storage systems into existing simulation frameworks are developed.

The dissertation is volume 127 of the Aachener Beiträge des ISEA and is available online at [link].

Kai-Philipp Kairies worked from 2013 to 2017 as a research assistant in the research group "Grid Integration and Storage System Analysis". Since 2017 he is Director Technical Consulting at ISEA.

Arne Hendrik Wienhausen

High Integration of Power Electronic Converters enabled by 3D Printing

Since wide-bandgap power semiconductors became commercially available, a trend towards increasing power densities of power electronic systems can be observed. The advantages of wide-bandgap power components can only be fully exploited in conjunction with low-loss inductive components that are suitable for high switching frequencies. For this reason, a concept for power inductors based on 3D-printed bobbins is developed, featuring excellent high-frequency characteristics. Conventional fluid coolers typically feature a large volume and a heavy weight, which counteracts a high power density. To minimize size and weight, 3D-printed miniature fluid coolers are developed. Prototypes of the developed concepts for high-frequency power inductors and 3D-printed fluid coolers are used to realize a highly-integrated boost converter. Despite the use of discrete power semiconductor devices, a power density of 98 kW/dm³ is demonstrated.

The dissertation is volume 131 of the Aachener Beiträge des ISEA and is available online at [link].

Hendrik Wienhausen worked as a research assistant in the research group "Power Electronics" from 2016 to 2019. In 2019, he joined the research group "Battery System Design and Vehicle Integration".
Dissertations

Furkan Kaan Titiz

A Three-Phase Low-Voltage Grid-Connected Current Source Inverter

Even though current-source inverters (CSI) are mainly used in high power applications, they can be an alternative to voltage-source inverters for medium and low-power applications. In this thesis, a three-phase low-voltage grid-connected current-source inverter having reverse blocking IGBTs is investigated. First, fundamentals of CSI including the steady-state behavior are presented. This section is followed by the analysis, which examines the optimization of the DC-link inductor value, filter design, modulation and harmonic analysis and loss distribution. Furthermore, discontinuous conduction mode and modeling with different methods, such as state-space-averaged dq-model are described. Afterwards, the control method and its design are explained. The results cover steady-state and transient behaviors considering some nonideal behavior. In addition to that, simulation results of the low voltage ride through behavior with single, double and three-phase grid faults is given while a PV module is inserted as an input source. Finally, as a proof-of-concept, the realized prototype setup is discussed and experimental results are demonstrated for the validation of steady-state and transient cases. Evaluation of the simulation and experimental results including calculated and measured efficiency values conclude the work.

From 2009 to 2014, Dr.-Ing. Furkan Kaan Titiz worked at ISEA as a research assistant in the "Power Electronics" group. Currently, he is system engineer at Eberspächer Controls Landau GmbH.

Martin Wünsch

Separation of Cathode Aging in Lithium-Ion-Battery Cells Using Electrochemical Impedance Spectroscopy

In the present work, three different lithium-ion-battery cells (LIB) have been cyclically aged under different conditions. During aging, different states of charge and states of health were set to measure electrochemical impedance spectra. In laboratory cells, which contain a lithium reference electrode, it was noticeable that the cathode impedance influences the full cell impedance crucially in case of a NMC111 | graphite chemistry. Thus, the dynamics of the charge transfer resistances (CTR) of an overall cell impedance are dominated by the cathode. Hence, it could be used to evaluate the state of the NMC. Investigating prismatic cells, it became obvious that the sensitivity of the charge transfer resistance is transferable to larger automotive cells. Furthermore, the CTR can be used for the evaluation of particle cracking in the cathode. Additionally, it is dependent on the selected temperature and C-rate in course of cyclization. During the cyclic aging of pouch cells, a significant influence of the external applied mechanical stress on the lifetime was identified. In addition, a parameter is derived from the real part of the impedance, that indicates an optimal tension concept of battery cells early.

The dissertation is volume 134 of the Aachener Beiträge des ISEA and is available online at http://publications.rwth-aachen.de/record/773304/files/773304.pdf
A. Klein-Hessling, I. Ralev, R. W. De Doncker
A Band-Pass Based Position Filter for Electrical Machines Against Low-Order Harmonic Distortion
IEEE Energy Conversion Congress and Exposition (ECCE), Baltimore, MD, USA, 2019, pp. 6575-6580
https://doi.org/10.1109/ECCE.2019.8913255
Nowadays, controls of electrical machines often depend on a high-precision rotor position signal. The presented digital signal filter enables a high-precision position determination by dynamic elimination of position errors due to signal noise, quantization deviations and low-order harmonic distortions.

A. Stippich, T. Kamp, A. Sewergin, L. Fraeger, A. H. Wienhausen, D. Bündgen, R. W. De Doncker
A Highly-Integrated SiC Power Module for Fast Switching DC-DC Converters
IEEE Energy Conversion Congress and Exposition (ECCE), Baltimore, MD, USA, 2019, pp. 5329-5336
https://doi.org/10.1109/ECCE.2019.8912173
To harvest the full potentials of modern silicon-carbide semiconductors, a switching cell is designed that is optimized for the application in a dc-dc converter. Based on this, a dc-dc converter is developed that achieves high switching frequencies and a high power density because of smaller passive components.

N. Fritz, G. Engelmann, R. W. De Doncker
RC Snubber Design Procedure for Enhanced Oscillation Damping in Wide-Bandgap Switching Cells
21st European Conference on Power Electronics and Applications (EPE '19 ECCE Europe), Genova, Italy, 2019, pp. 1-10
http://doi.org/10.23919/EPE.2019.8915541
Due to the fast switching dynamics of wide-bandgap semiconductor devices, oscillations are caused during switching transients, which may raise EMC issues. This paper proposes an analytical, closed-form, experimentally validated design procedure for resistive-capacitive (RC) snubbers, maximizing the damping ratio of the switching cell.

S. Quabeck, D. Scharfenstein, R. W. De Doncker
Speed Dependency of the Induction Machine Phase Current Spectrum Under Fault Conditions
22nd International Conference on Electrical Machines and Systems (ICEMS), Harbin, China, 2019, pp. 1-6
https://doi.org/10.1109/ICEMS.2019.8921717
This paper investigates an induction machine with broken rotor bars under different operating conditions. An improved MCSA (motor current signature analysis) approach is presented and compared to the classical MCA concept.

M. Laumen, D. Heidenberger, N. Fritz, R. W. De Doncker
Rogowski-Coil-Based Current Sensor with Zero-Current Detection for Optimized Lower Cut-Off Frequency
21st European Conference on Power Electronics and Applications (EPE '19 ECCE Europe), Genova, Italy, 2019, pp. 1-9
http://doi.org/10.23919/EPE.2019.8915167
Rogowski coils are often used to measure currents with high-frequency components. However, the range of applications is limited as they are not able to measure dc offsets. This paper presents a method to extend the measuring range of Rogowski coils by using a zero current sensor.

N. Hartgenbusch, I. Ralev, R. W. De Doncker, T. Kojima
Stator Flux Trajectory Control Combined with Optimized Pulse Patterns for Interior Permanent Magnet Machines
22nd International Conference on Electrical Machines and Systems (ICEMS), Harbin, China, 2019, pp. 1-6
In medium-voltage drives, the switching frequency is often limited to <1kHz and so-called optimized pulse patterns, which are synchronous to the electrical frequency, are applied. This publication presents a predictive stator-flux-linkage control for permanent-magnet synchronous machines, which modifies the switching angles online.

C. H. van der Broeck, R. W. De Doncker
Thermal Monitoring of Power Electronic Modules with Minimal Sensing Effort
IEEE Energy Conversion Congress and Exposition (ECCE), Baltimore, MD, USA, 2019, pp. 5989-5996
This work proposes a technique that enables an accurate real-time monitoring of junction temperatures, 3-D distributed temperatures and degradation in power modules with minimal sensing effort. It only requires an electrothermal real-time model and temperature information of an NTC thermistor. Thus, it is easy to implement for most commercially available power electronic converters and enables effective thermal overload protection.
Selection of Recent Publications

J. Büngeler, E. Cattaneo, B. Riegel, D. U. Sauer
Advantages in energy efficiency of flooded lead-acid batteries when using partial state of charge operation
Journal of Power Sources, Vol. 375, 2018, pp. 53-58
We report on results obtained with flooded lead acid batteries demonstrating that with a management strategy which includes operation in a partial state of charge, energy efficiencies of about 0.87 can be reached with minimal impact on lifetime.

Long-term cycling induced jelly roll deformation in commercial 18650 cells
Mechanical effects cause deterioration in lithium-ion batteries. We show the influence of long-term cycling on the deformation of the jelly roll using computertomography.

M. Lewerenz, G. Fuchs, L. Willenberg, D. U. Sauer
Irreversible calendar aging and quantification of the reversible capacity loss caused by anode overhang
The Journal of Energy Storage, Vol. 18, 2018, pp. 149-159
Capacity loss of lithium-ion batteries can be reversible and irreversible. We establish a method that can be used for distinguishing these two types of capacity loss.

A. Farmann, D. U. Sauer
Comparative study of reduced order equivalent circuit models for on-board state-of-available-power prediction of lithium-ion batteries in electric vehicles
On-board management algorithms for the control of electric vehicle batteries need to be precise and as easily computable as possible. We here compare different model types to find the optimum.

C. Olk, D. U. Sauer, M. Merten
Bidding strategy for a battery storage in the German secondary balancing power market
This paper develops strategies for operating Battery Energy Storage Systems on the Secondary Balancing Power market in Germany.

F. Meishner, D. U. Sauer
Wayside energy recovery systems in DC urban railway grids
eTransportation, Vol. 1, 2019
Wayside energy recovery systems can be used to store excess energy and release it during acceleration of nearby vehicles. This paper provides an overview of actual demonstrations of various systems in public transport grids.

Analysis and evaluation of operations strategies based on a large scale 5 MW and 5 MWh battery storage system
Stable energy supply using renewables can be ensured using battery energy storages. Operation strategies are evaluated on a 5 MW / 5 MWh system.
CALL FOR PAPERS

Electric & Electronic Systems in Hybrid and Electric Vehicles and Electrical Energy Management

June 15-16, 2021 in Aachen /Germany
www.eehe.de

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› Author(s): academic degree, last name, first name, address, telephone and email address!

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Papers for the Conference Proceedings are strictly mandatory. Exceptions can only be approved by the Advisory Board.
Every contribution is scheduled with 20 minutes for the presentation and 10 minutes for questions and discussion. The conference language is German or English, simultaneous translation will be available. **Papers and slides only in English!** Additionally, posters will be presented in a poster exhibition.

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**MAIN TOPICS**

- **E/E Architectures for Hybrid and Electric Vehicles**
  - E/E Architectures, Topologies and Systems at High Voltage and 48 Volt
  - Electric Charging Systems
  - High Voltage Safety and Standards
  - Commercial Vehicles

- **Energy Management and Design Methods**
  - Electrical Energy Management and Operating Strategies
  - Battery Management, Diagnostics and Safety and their Impact on Reliable Power Supplies
  - Reliable Power Supply Systems for Automated Driving Features and their Diagnosis and Fault Handling
  - Power Supply Concepts for Domain (Zonal) and centralized Architectures
  - Low Voltage Energy Storage
  - Using Connectivity, Big Data, Cloud Computing and Cyber Security

- **Components for High Voltage and 48 Volt**
  - Components for Electrification
  - Semiconductors and Passive Components
  - New Technologies and Materials for Power Electronics and the Requirements for Qualification, Reliability and Robustness
  - Wiring Harnesses and Connectors

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**FOCUS TOPICS**

- **48 Volt Actuators and Mechatronic Systems**
- **Fuel Cell Vehicle Systems: technical Aspects, Technologies and Components**
- **Multilevel Powernet: Voltage Classes A, B1, B2 for High Power Systems; Power Supply for High Power Loads; Synergies and Redundancies**
- **Architectures and Integration: Methods for Evaluation (e.g. cost versus function); Management of Variants; Reuse and Communality between Hybrids and BEV;**
- **Fusing and Power Distribution Concepts for new Architectures and ADAS**
- **Complete Integration of Power Electronics in the Subsystems (e.g. inverter electronics in the propulsion subsystem) and Impact on Testing**
- **Trends in Standardization, Regulation and Legislation**

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**EXHIBITION**

The conference zone combines the lecture halls and an exhibition space which includes the catering facilities as well. The exhibition area is suitable for the presentation of large exhibits, and even complete automobiles can easily be displayed.

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**FURTHER MILESTONES**

**Confirmation to the authors:** January 31, 2021
**Deadline for the final papers (in English):** April 15, 2021
**Submission of the final presentations:** June 10, 2021

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