

## PE:Region Newsletter - July 2019

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### Staff News



#### Anatolii Tcai



Since June last year, Anatolii Tcai has been employed as a scientific staff member at the Chair of Power Electronics of Christian-Albrechts-Universität zu Kiel and has recently joined the PE:Region project.

In 2013, Anatolii obtained a diploma in engineering with honours from Tomsk State University of Control Systems, Russia. He worked as an engineer at Roscosmos R&D before starting his Master's studies in the Republic of Korea. In 2018, he obtained a MSc in Electrical and Computer Engineering at Ajou University, Republic of Korea.

For the PE: Region project, he will configure a working prototype and develop software for demonstrator #1 and focus on research on modulation methods of parallel converters.

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## Conference/Workshop Participation



### CPE-POWERENG 2019



#### **13th IEEE International Conference on Compatibility, Power Electronics and Power Engineering**

23-25 April 2019 at SDU Sønderborg, Denmark

PE:Region was the main organizer of the CPE-POWERENG2019 conference that took place at Alsion in Sønderborg in April as a close collaboration between SDU and Carl Albrecht Universitetet zu Kiel. The conference offered three internationally recognized keynote speakers and a total of 14 sessions of various power electronics topics. Prior to the conference, three tutorials were offered for free. In total 105 delegates found their way to Alsion during the conference representing more than 30 countries and all together presenting 87 papers. Finally, CPE-POWERENG2019 generated some positive [news articles](#) in the media.

Along with the conference, an exhibition took place with 8 companies presenting their latest products.

Here you will find [photos](#) from the three days in April.

### IEEE ICDEM2019

Kunibiki Messe - Matsue, Japan

23-25 May 2019

PE:Region was represented by two papers within the field of hybrid magnetics and PV-systems. (Please see the titles further below under the headline 'Publications').

## **Danish-German PE:Region Seminar**

## Fachhochschule Kiel

Thursday 27 June 2019 at 11.30 - 15.00 in Kiel

### Demonstrator Development for Intelligent Grid Integration, High Speed Drives and Battery Charging

This summer's biannual PE:Region demonstrator workshop took place at FhK where the status of these 3 project demonstrators were presented, and fruitful networking took place.

#1 - Intelligent grid integration of wind and sun (CAU)

#2 - Energy efficient, reliable and compact high speed drive (CAU)

#3 - High power onboard bidirectional battery charger (SDU)



Please find further information below under the headline 'Demonstrator Status'.

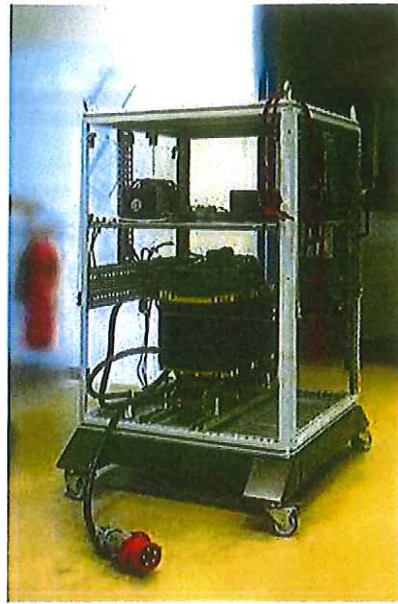
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## Demonstrator Status

### Demonstrator #1: Intelligent grid integration of wind and sun energy

For demonstrator #1, 40 kVA input-stage transformer, 20 kVA diode rectifier and two 0.3 mH filter inductances have been developed as shown in Fig. 1.





(a)



(b)



(c)

Fig. 1. Hardware for demonstrator #1: (a) Transformer, (b) Diode-rectifier and (c) Filter Inductance

For the EtherCAT communication digital signal processor (DSP), a microprocessor from Texas Instruments (TI) was selected as the main controller of the system. It can be directly connected to the EtherCAT card developed by the same manufacturer and uses high-speed communication between the card and the DSP.

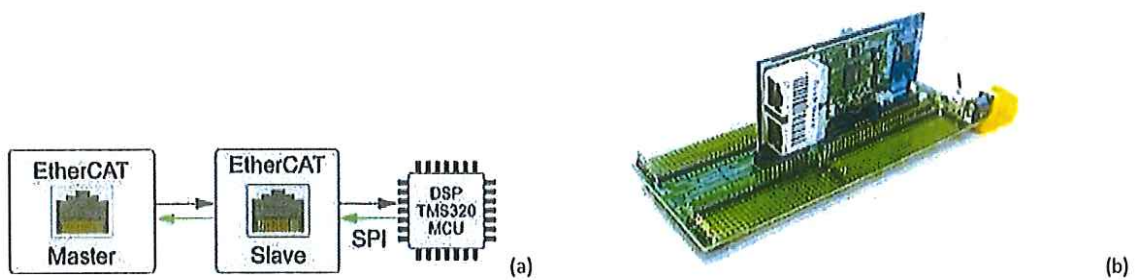


Fig. 2. EtherCAT communication topology: (a) EtherCAT connection and (b) DSP from TI with an EtherCAT Card

The EtherCAT network is a fieldbus system based on the Ethernet cable and was invented by Beckhoff Automation. The main feature is that the frame is not sent to every node on the network, but it passes through all devices forming a circular network and is processed "on the fly". This means that each node can read/write data on the EtherCAT telegram while the telegram passes through the node. In the next phase, the EtherCAT communication will be established tested for the demonstrator.

### Demonstrator #3: High Power on-board bidirectional battery charger

For demonstrator #3, the hardware prototype of the 20kW two-level three-phase power factor correction has been developed (Fig 3.1). The filter part is designed based on required attention for both differential mode and common mode, to fulfil EMI standards. The converter response related to load changing and EMI measurement will be performed as a future work.

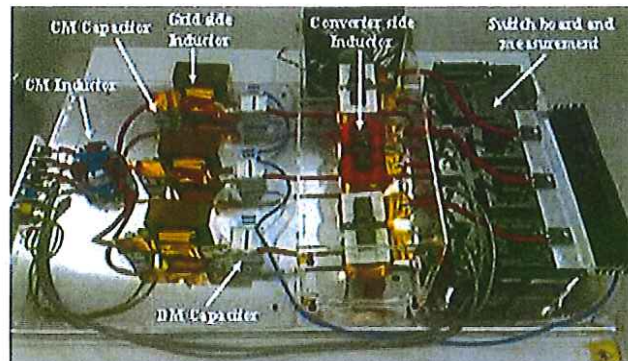


Fig. 3.1. Hardware prototype of the 20 kW two-level PFC

For the dc-dc converter part, power module from FH Kiel has been integrated with the drive circuit. Fig. 3.2 shows the hardware prototype of the power module integrated with the drive circuit. The 20 kW inductor for the dc-dc converter is also designed. In the next phase, prototyping of the inductor followed by the realization of the complete dc-dc converter and the testing of the converter will be performed.

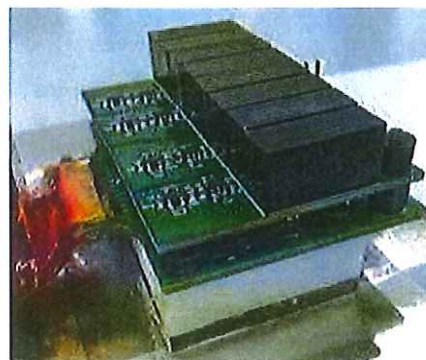


Fig. 3.2. Power module integrated with the drive circuit.

## Publications



S. Walz, G. Butticchi, M. Liserre, "Comparison of Finite Control Set and Hysteresis Based Model Predictive Control for NPC and T-Type Converter in case of low carrier ratio", 2019

M. Najjar, A. Kouchaki, and M. Nymand, "An Efficient Active Common Mode Filter: Comparison of Feedback and Feedforward Based Methods for a 20 kW 3-phase Inverter" 2019 13th IEEE International



Conference on Compatibility, Power Electronics, and Power Engineering (CPE-POWERENG-2019), Sønderborg, 2019.

M. Najjar, A. Kouchaki, and M. Nymand, "Evaluation of Active Common Mode Filter Utilization for Size Optimization of a 20 kW Power Factor Correction" 2019 13th IEEE International Conference on Compatibility, Power Electronics, and Power Engineering (CPE-POWERENG-2019), Sønderborg, 2019.

C. Kjeldsen, C. Østergaard, M. Nymand, and R. Ramachandran, "Procedure to Compare Different Design Methods for Implementation-Ready High Power Inductors", 2019 13th IEEE International Conference on Compatibility, Power Electronics, and Power Engineering (CPE-POWERENG-2019), Sønderborg, 2019

W.K. Mo, K.M. Paasch, T Ebel, "Hybrid magnetic EMI filter design for Low Voltage DC distribution (LVDC) network-1", 2019 IEEE The 3<sup>rd</sup> International Conference in DC-microgrids (ICDCM2019), Matsue, 2019.

K.M. Paasch, C. Cornaro, M. Pierro, "PV-grid performance under dynamic weather conditions", 2019 IEEE The 3<sup>rd</sup> International Conference in DC-microgrids (ICDCM2019), Matsue, 2019.

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Enjoy summer!



(A Danish and German version of this newsletter will be uploaded to our homepage as soon as possible).

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Our mailing address is:

Charlotte Bolding Andersen, [cba@mci.sdu.dk](mailto:cba@mci.sdu.dk)

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