PE:Region Newsletter - January 2018

Upcoming Events 2018

Industrial PhD Course

The Smart transformer

Impact on the Electric Grid and Technology Changes

21 - 23 February 2018

Christian-Albrechts-Universität zu Kiel

For further information and registration

Danish-German EMC seminar

Tuesday 27 February 2018, 9.00 - 16.00

Danfoss Silicon Power - Flensburg

EMC in Industrial Electronics

For further information and registration

Hot News

IEEE CPE-Powereng Conference 2019

23 - 25 April - Alsion in Sønderborg

We are proud to announce that the PE:Region project has a major share in attracting the IEEE CPE-Powereng Conference to Sønderborg in April 2019.

Project Manager, PhD., Kasper M. Paasch from Mads Clausen Institute, SDU Sønderborg, is heading the co-ordinating team:

- The fact that Sønderborg has been chosen as conference venue in 2019 is a scoop not only to our region but to whole Denmark and Schlesvig-Holstein in order to market ourselves as a hub within power electronics. The conference fits well into the strategy of SDU, the region, and Sønderborg Municipality within this field, says Kasper M. Paasch, where the establishment of the future Centre for Industrial Electronics is another major achievement.

The IEEE CPE-Powereng Conference 2018 is taking place in Doha, Quatar, on 10 - 12 April where Kasper Paasch has been invited to present the Danish conference ideas of 2019.

Staff News

Nils Nageler

As of 1 December 2017, Nils Nageler has been employed as a Project Engineer at R&D Center FH Kiel GmbH joining the PE:Region project. Nils is developing parts of the power module such as cooling and connection processes; eg lamination and wire bonding of the semiconductor.

In 2017, Nils Nageler graduated as MEng in Electrical Technologies from University of Applied Sciences in Kiel. His interest in semiconductors increased when joining Prof. Dr. Eisele's developing team during his master studies, and his master thesis focused on a sinter tool for groupwise adding shear bodies. Before his studies, Nils completed an education as a Mechatronics Technician at Hella GmbH & Co. KGaA

Bremen.

Demonstrator Status

Demonstrator #1: Increasing the renewable energy penetration by coordination of different voltage control devices

Undesired voltage variations in the electric distribution grid are affected by the penetration of renewable energy. In the scope of demonstrator #1, which targets to increase renewable energy integration, different devices such as transformers with OLTC, shunt capacitor banks and power electronics equipment (eg smart transformer) are investigated. Recently, a new centralized control strategy was proposed (as shown in Fig. 1), which coordinates the 3 devices together. The aim is to demonstrate that the new structure increases the hosting capability of renewable energy sources. In the meantime, the proposal achieves more flexibility of control and prolongs the lifetime of OLTC and shunt capacitor banks.

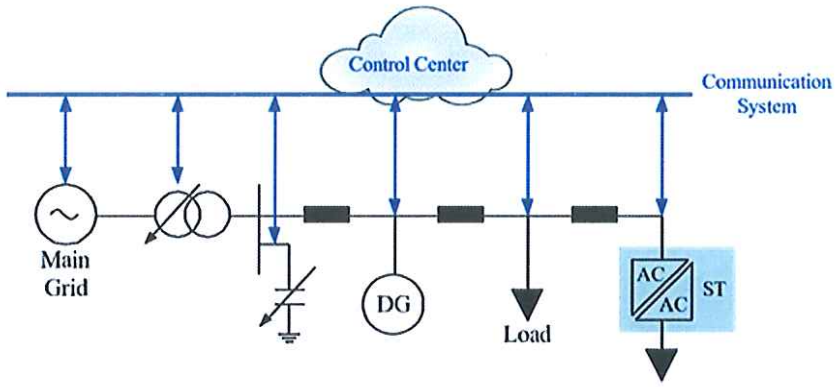


Fig.1: Distribution grid with a Smart Transformer (ST) and an advanced communication system.

Demonstrator #2: Controller design for energy efficient, reliable, and compact high speed drives

Recently for demonstrator #2, Model Predictive Control (MPC) strategies were tested and compared to modulator based strategies. The main advantages of MPC are the simple design, the speed, and the absence of a modulator. Two different MPC strategies were simulated. Finite Control Set (FCS) Model Predictive Control uses reference tracking, and objective can be customized by varying the cost function. Hysteresis based MPC (MPC with bounds) uses the model prediction to keep the current inside predefined bounds. To optimize the current THD, the known strategy is extended to multiple prediction steps. The performance and efficiency are simulated and experimental results are carried out.

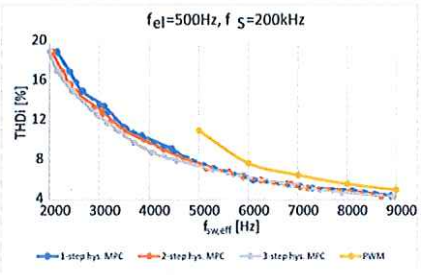


Figure 1: THD_i / $f_{sw,eff}$ for high speed drive at nominal operation point

Figure 1 shows the THD_i of the motor current over the effective switching frequency of the converters. It can be seen, that by using model predictive control, for a given THD_i the effective switching frequency can be reduced, or, for a given switching frequency, the THD_i can be improved. In fig. 2, preliminary experimental results with the DSpace setup and PMSM machine are shown. A boundary current of I_{Bound} = 1.5A is set. It can be seen, that after the reference step is given, the q component of the current is increasing very fast and the currents stay within the bounds.

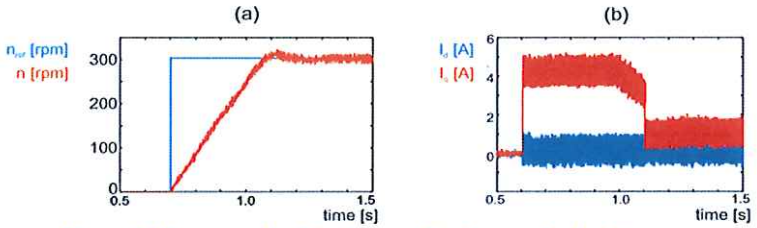


Figure 2: Exp. results: Step in speed reference for 1-step MPC with PMSM (a) speed (b) currents Id,Iq

In the future, the laboratory setup (fig. 3) will be connected to a RTDS system with 4-quadrant power amplifier to emulate different high-speed machines and test the control algorithms.

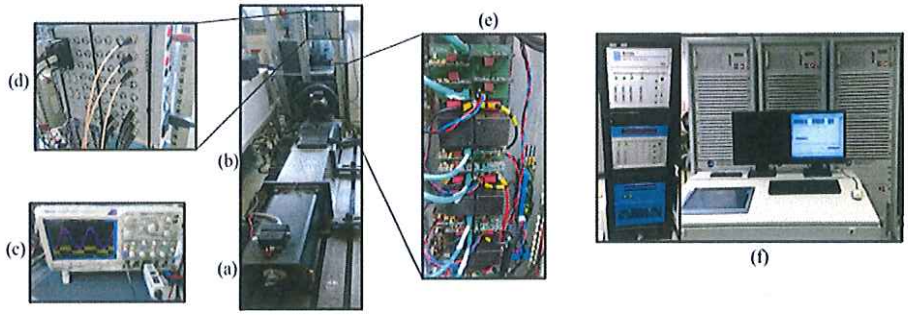


Figure 3 Experimental setup: (a) Siemens PMSM, (b) DC Load machine, (c) Oscilloscope, (d) DSpace MicroLabBox, (e) Converter, (f) RTDS System with Power

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

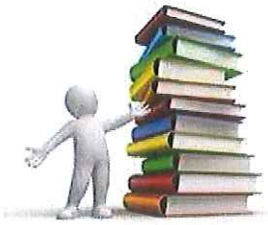
In connection with demonstrator #3, a novel power module layout has been designed and the parasitic components (ie the parasitic inductance (L), resistance (R), and capacitance (C)) have been simulated via 3D Finite-Element software ANSYS Q3D/Maxwell in cooperation with PE:Region partner FH Kiel. In particular the parasitic inductance (L) is of vital importance with respect to obtaining fast switching times for power modules.

All demonstrators were presented at the half-yearly PE:Region Demonstrator Workshop that took place on 28 November 2017 in the new TEK building at SDU Odense.

Related activities

Furthermore, work has progressed on the calorimetric test stand for efficiency measurements on power electronics and motors. SDU students in semester 5 (Experts-in-Teams) have designed the chamber and presented their work at SDU's annual TEK EXPO in December.

Publications



Concurrent Voltage Control and Dispatch of Active Distribution Networks by means of Smart Transformer and Storage

By X. Gao, F. Sossan, K. Christakou, M. Paolone and M. Liserre
(IEEE Transactions on Industrial Electronics, vol. PP, no. 99, pp. 1-1.)

The battery energy storage systems (BESS) helps integrate more solar energy. The paper analyzes the control of BESS by means of smart transformer (ST). The control performance is improved by our proposal in comparison to traditional method, which enables more penetration of solar energy into grid, ie Demonstrator #1.

www.pe-region.eu

Our mailing address is:
Charlotte Bolding Andersen, cba@mci.sdu.dk

Please contact us with any request and forward this e-mail to other relevant recipients.