13:00-08:00

Lab. 08 Comparison of Cascaded Voltage Control Schemes with Different Innerloop Feedback Variables

Lab. 09 Comparison of Different Voltage/Current Controller Combinations

Lab. 10 Voltage Control of Smart Transformer-fed MicroGrid

Lecturers

Prof. Marco Liserre, Kiel University, Germany
Dr. Rongwu Zhu, Kiel University, Germany
Dr. Sante Pugliese, Kiel University, Germany
Mr. Roberto Rosso, Kiel University, Germany

Marco Liserre received the Msc and PhD degree in Electrical Engineering from the Bari Polytechnic, respectively in 1998 and 2002. He has been Associate Professor at Bari Polytechnic and from 2012 Professor in reliable power electronics at Aalborg University (Denmark). From 2013 he is Full Professor and he holds the Chair of Power Electronics at Kiel University (Germany). He has published 452 technical papers (144 of them in international peer-reviewed journals) and a book. These works have received more than 30000 citations. Marco Liserre is listed in ISI Thomson report "The world's most influential scientific minds" from 2014.

He has been awarded with an ERC Consolidator Grant for the project "The Highly Efficient And Reliable smart Transformer (HEART), a new Heart for the Electric Distribution System".

He is member of IAS, PELS, PES and IES. He has been serving all these societies in different capacities. He has received the IES 2009 Early Career Award, the IES 2011 Anthony J. Hornfeck Service Award, the 2014 Dr. Bimal Bose Energy Systems Award, the 2011 Industrial Electronics Magazine best paper award and the Third Prize paper award by the Industrial Power Converter Committee at ECCE 2012, 2012, 2017 IEEE PELS Sustainable Energy Systems Technical Achievement Award and the 2018 IEEE-IES Mittelmann Achievement Award.

Rongwu Zhu received the Ph.D. degree in Energy Technology from the Aalborg University, Denmark, in Dec. 2015. He is currently a Senior Research Assistant at the Chair of Power Electronics of the Kiel University. He has authored and co-authoured more than 70 technical papers (over 30 of them in international peer-reviewed journals). He has been involved in several international projects in the field of Renewable Power Generation and Integration as well as Operation and Control of Electric Grid with High Penetration of Renewable Power Generation. He has organized more than 10 Tutorials and Special Sessions at the International Conferences.

Sante Pugliese received the M.Sc. degree in Automation Engineering and the Ph. D. degree in Electrical and Information Engineering from the Politecnico di Bari, Italy, in 2013 and 2018 respectively. In 2007, he was a visit scholar with the Chair of Power Electronics, Kiel, Germany, where he is currently a Post-Doc. His research interests include power converters and control techniques for distributed power generation systems based on renewable energies.

Roberto Rosso received the B.Sc. degree in Electronic Engineering and the M.Sc. degree in Electrical Engineering in 2009 and 2012, respectively, from the University of Catania, Catania, Italy. He is currently working toward the Ph.D. degree (since 2017) in electrical engineering at the Kiel University , Kiel, Germany. In 2013, he joined the R & D division of the wind turbine manufacture ENERCON (Wobben Research and Development WRD), where he is currently working at the Control Engineering Department. He has been involved in several research projects addressing analytical models of electrical machines and control of electric drive systems. His research interests include control strategies for grid integration of renewable energy systems.

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PE:Region Power Electronics Innovation
Interreg Deutschland - Danmark

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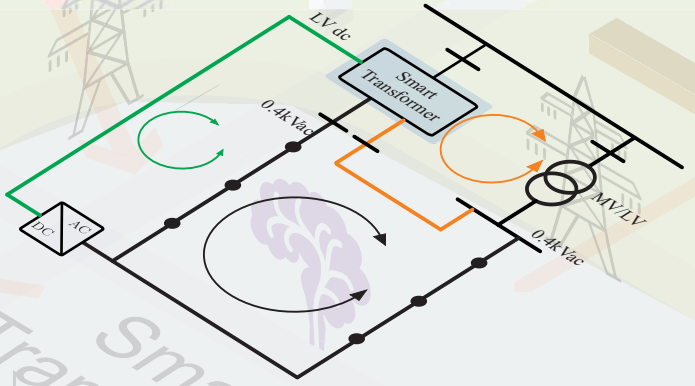
Christian-Albrechts-Universität zu Kiel

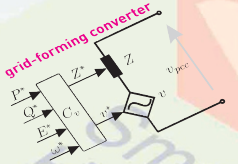
Faculty of Engineering



Industrial/Ph.D. Course

Grid forming Power Converters, Smart Transformers and Hybrid Grids

Feb 12-14, 2020



Description of the Course

The increasing penetration of renewables leads to exclusion of conventional synchronous generators, and consequently the electric grid experiences new challenges. The concept of grid-forming converters, which can emulate the behaviour of the conventional synchronous generator, initially proposed for micro-grid applications, has been recently discussed in the context of wide interconnected power systems, gaining interest from the power systems community.

The solid-state transformer-based Smart Transformer (ST), besides intrinsically behaving as a grid-forming unit, it can also provide advanced services to the distribution grid to support the grid management. Moreover, the ST can provide the dc connectivity in MV and LV level to enable hybrid grid operation. Due to the power flow control capability, the ST can also flexibly mesh the electric grids to optimize the power capability in the secondary substation, avoiding overload and high grid voltage violation.

The course starts with an introduction of the basic concepts of grid-forming converters and a description of their features compared to state-of the art grid-following units is given. The ST is defined and the topologies and controllers are explored on the first day. New services enabled with the ST technology, for instance load sensitivity evaluation in LV grids and voltage and frequency regulation in MV/HV grids, as well as features of grid-forming unit including the control and problem aroused by the grid synchronous, are explained on the second day. The last part of the course is dedicated to control of the meshed grids, control of the LV dc grid to improve the ant-interference capability, and control of the LV ac grid with the focus on the power quality and stability improvement.

Fee

€ 800 (€ 400*) for PhD students and € 1100 (€ 550*) for participants from industry.

Lunches, refreshments, a get-together dinner, and VAT are included in the price. *Only for theoretical part

Registration

For registration please send an email to Ms. Niehaus **niehaus@eek-sh.de** before January 31, 2020.

Afterwards you will receive an approval email containing necessary information and required documents. The registration should be completed before January 31, 2020.

Accommodation

The participants should arrange their own accommodation. A list of available hotels and guest houses will be provided upon request.

Further information

For more information about the administration and registration please contact:

Ms. Elisabeth Niehaus
EEK.SH - Competence Centre Renewable Energies and Climate Protection Schleswig-Holstein
c/o FuE - Zentrum FH Kiel GmbH
Schwentinestr. 24, 24149 Kiel, Germany
Phone: +49 431 218 4432, E-Mail: niehaus@eek-sh.de

For more information about the course contents please contact:

Mr. Federico Cecati
Chair of Power Electronics, University of Kiel
Kaiserstraße 2, 24143, Kiel, Germany
Phone +49 431 880-6107, E-mail: fc@tf.uni-kiel.de

Location

Lectures: Building D, Room: Aquarium,
Laboratory: Building B, Lab of Power Electronics,
Faculty of Engineering at Kiel University,
Kaiserstraße 2, 24143, Kiel, Germany.

Language

English

Prerequisites

Control and power electronics basics are recommended for the lectures and exercises.

Literature

[1] M. Liserre, G. Buticchi, M. Andresen, G. De Carne, L. Ferreira Costa, Z. Zou; "The smart transformer: impact on the electric grid and technology challenges," *IEEE Ind. Electroni. Magazine*, vol.10, no.2, pp.46-58, June 20, 2016.

[2] L. Ferreira Costa, G. Buticchi, M. Liserre, "Quad active bridge DC/DC converter as cross-link for medium votlage modular inverters," *IEEE Trans. Ind. Appl.*, vol.50, no.2, pp. 1243-1253, March 2017.

[3] G.De Carne, M. Liserre, C. Vournas, "On-line load sensitivity identification in LV distribution grids," IEEE Trans. Power Sys., vol.32, no.2, pp1-11, March 2017.

[4] http://www.heart.tf.uni-kiel.de/en/home

[5] R. Rosso, M. Andresen, S. Engelken, and M. Liserre, "Analysis of the interaction among power converters through their synchronization mechanism," *IEEE Trans. Power Electron.*, Vol.34, no.12, pp.12321-12332, Dec. 2019.

Course program:

February 12, 2020, 08:30-18:00

08:30-11:45
Lec. 00-01 Course introduction/grid forming unit
Lec. 02 Introduction on Smart Transformer
Lec. 03 Smart Transformer Architectures
Lec. 04 DC/DC Converters for Smart Transformer

13:00-18:00
Lab. 01 Introduction to PLECS
Lab. 02 Smart Transformer Operations in LV grid
Lab. 03 PHIL Evaluations of Smart Transformer-fed LV-Grid
Lab. 04 DC/DC Converters Topologies

February 13, 2020, 08:30-18:00

08:30-11:45
Lec. 05 Impedance and Load Identification
Lec. 06 Voltage and Frequency Control of LV-Grid
Lec. 07 Grid Forming Unit Features and Control
Lec. 08 PLL and Power Synchronization

13:00-18:00
Lab. 05 On-line Load Identification and Control
Lab. 06 Reverse Power Flow Limitation Controller
Lab. 07 Grid Forming Unit Operation

February 14, 2020, 08:30-18:00

08:30-11:45
Lec. 09 Control of Meshed Hybrid Grids
Lec. 10 Control of DC/DC Converters
Lec. 11 Voltage Control of ST LV side Converter Part-1
Lec. 12 Voltage Control of ST LV side Converter Part-2