EPE 2013 tutorial announcement

TITLE
Power Electronics and Control for Renewable Energy Systems

NAME AND AFFILIATION OF THE AUTHORS
Johanna Myrzik, Technical University of Dortmund, Germany
Mike Meinhardt, SMA Solar Technology AG, Germany (Coordination of Tutorial)

SCOPE AND BENEFITS
Low-carbon generation has an important part to play in sustainable energy supply in the 21st century. A key component of this is the integration of renewable energy resources into the power supply network –particularly at the low-voltage distribution level.
Power electronics is the key of future developments of the electrical power supply. All distributed generators (like photovoltaic, wind turbines, micro turbines and fuel cells) as well as storage devices are connected to the grid through power electronics. Power electronic offers also a lot of opportunities of controlling grid parameters like power balancing, frequency control and voltage regulation.

This tutorial will give an overview of recent developments of photovoltaic inverters in research and industry. It will also be shown how renewable energies are connected to the utility grid as well as power electronics can offer additional benefit to the grid e.g. improve the power quality of the supply. Further, control aspects for grids of grid-feeding and off-grid inverters be discussed. After this course the participant is in state to assess the todays and future role of power electronics in utility networks.

CONTENTS
Power electronics and control concepts for grid-tied and off-grid PV-systems – the industrial perspective (M. Meinhardt)
A basic introduction in requirements on power electronics specific for decentralised energy generation like PV-, Wind-, Hydro-, Fuel Cell- or Combined-Heat-and-Power-Applications will be given. In the following a description, comparison and assessment of all common PV-system and inverter concepts (incl. Central inverter, Multi-String inverter, String inverter, Module-integrated inverter) is given. Another part of the tutorial will deal with topologies used for single-phase and three-phase PV-inverters
One major part will also deal with the control of grid-tied PV and off-grid inverters including the general control structure used in PV inverters and the design of a current and voltage controller for a grid-tied inverter as an example.
Furthermore a comprehensive comparison of inverters for grid-tied PV, Off-grid and drive applications is presented. Targets, pathways and limits for both cost reduction and efficiency improvements of PV inverters are discussed.
Finally, requirements for power PV inverters in the kW power range with respect to batch production are presented including topics like power electronics packaging and design for high-reliability.

Grid related requirements and auxiliary grid services of grid connected RE Systems (J. Myrzik)
Inverters for grid connection must fulfil numerous requirements demanded by utilities and other bodies (e.g. remote controllability, active and reactive power control or fault ride through capability). On the other hand future inverter systems in grids can offer auxiliary grid services not covered in standards and regulation (e.g. power quality improvements via injection of selected harmonics) and provide more grid stability. These and other grid aspects related to grids with high penetration of Renewable Energy Systems (RES) will be presented.

DRAFT SCHEDULE (8 x 45 min)

09:30 - 11:00	Power electronics and control concepts for grid-tied and off-grid PV-systems – the industrial perspective (part 1)
11:00 - 11:30	Coffee break
11.30 - 13:00	Grid related requirements and auxiliary grid services of grid connected RE Systems (Part 1)
13:00 - 14:00	Lunch break
14:00 - 15:30	Grid related requirements and auxiliary grid services of grid connected RE Systems (Part 2)
15:30 - 16:00	Coffee break
16:00 - 17:30	Power electronics and control concepts for grid-tied and off-grid PV-systems – the industrial perspective (part 2)

WHO SHOULD ATTEND

This tutorial is interesting to beginners and advanced participants from university and industry as it includes a perfect mixture of different aspects of power electronics for renewable energy systems. The tutorial comprises theoretical parts on power electronic topologies and control structures as well as practical aspects on design consideration and manufacturing methods of inverters for photovoltaic applications.

ABOUT THE INSTRUCTORS

Johanna Myrzik, Technical University of Dortmund, Germany

Prof Johanna M.A. Myrzik was born in Darmstadt, Germany in 1966. She received her MSc. in Electrical Engineering from the Darmstadt University of Technology, Germany in 1992. From 1993 to 1995 she worked as a researcher at the Institute for Solar Energy Supply Technology (ISET e.V.) in Kassel, Germany. In 1995 she joined to the Kassel University, where she received the PhD in the field of solar inverter topologies. From 2000 to 2009, Johanna Myrzik is with the Eindhoven University of Technology, the Netherlands. From 2000 to 2002 she worked as a postdoc in the field of resonant converters for drive applications. In 2002, she switched to the group “Electrical Power Systems” and became an assistant professor in the field of distributed generation. Between 2008 and 2009 Johanna Myrzik was an associate professor on “residential electrical power systems” at the TU/e. Since 2009 Prof Myrzik is Professor at the technical university of Dortmund and deputy director of the Institute of Energy Systems, Energy Efficiency and Energy Economics. Her fields of interests are: electrical power supply, distributed generation, power quality, power electronics and integration of renewable energy. She is author/co-author of more than 80 publications and is regularly giving lectures and presentations in distributed generation and power electronics.

Mike Meinhardt, SMA Solar Technology AG, Germany

Dr. Mike Meinhardt received his Dipl.-Ing. (Master's) degree in electrical engineering from Darmstadt University of Technology in 1991. From 1991 to 1997 he worked at Darmstadt University of Technology in the field of "Power Electronics for drives and grid connection of renewable energies". In 1997, he received his Dr.-Ing. (Ph.D.) degree in Power Electronics from Darmstadt University of Technology. In 1997 he joined Power Electronics Ireland Technologies Group of the National Microelectronics Research Centre in Cork, Ireland where he worked as a Senior systems integration engineer on Systems integration of Power Electronics and the design of magnetic components for Power Converters and Module-Integrated PV-inverters in particular. Since 1999 he is with SMA Solar

Technology AG in Kassel, Germany. Here was initially responsible for the development of grid-tied inverters for PV and Fuel Cell Apllications and off-grid inverters. Since 2005 he's responsible for knowledge management and education of engineers within SMA. He is also a guest lecturer for Simulation and Power Electronics and PV at different European Universities. Mike Meinhardt is author of about 60 publications covering the area of inverters for photovoltaic, fuel cell and off-grid applications, magnetic components and systems integration for power electronics.

Prof. Dr. Johanna Myrzik

Dr. Mike Meinhardt