Remus Teodorescu

He received the Dipl. Ing. degree in electrical engineering from Polytechnical University of Bucharest, Romania in 1989, and Ph.D. degree in power electronics from University of Galati, Romania, in 1994. In 1998, he joined Aalborg University, Department of Energy Technology, power electronics section where he currently works as a professor. Since 2003, he is a visiting professor at Chalmers University of Technology, Gothenburg, Sweden.

He has co-authored the book "***Grid Converters for Photovoltaic and Wind Power Systems***", ISBN-10: 0-470-05751-3 – Wiley and over 200 IEEE journals and conference papers. His areas of interests includes: design and control of power converters for photovoltaics and wind power systems, grid integration with wind power, HVDC/FACTS based on MMC, SiC-based converters, storage systems for utility based on Li-ion battery technology. He was the coordinator of the Vestas Power Program, 2008 – 2013.

Maciej Swierczynski

He received his B. Tech. degree from AGH University of Science and Technology, Poland in 2005 and M. Tech degree from AGH University of Science and Technology, Poland, Cracow in 2007 in Computer Engineering for Industrial Applications and from Aalborg University, Denmark in 2009 in Power Electronics and Drives.

In 2012 he completed his Ph.D. at Aalborg University, Denmark with PhD thesis: "Lithium ion battery energy storage system for augmented wind power plants". He is working currently as post-doctoral researcher at Aalborg University. His area of research is in energy storage technologies for wind applications, battery testing, modelling, and lifetime analyses.

Daniel Stroe

He received the Dipl.-Ing. degree in control engineering from Transilvania University of Brasov, Romania, in 2008. In 2010, he received the M.Sc.degree in the field of wind power systems from the Department of Energy Technology, Aalborg University. He is currently working toward the Ph.D. degree at Department of Energy Technology, Aalborg University. His research interests are in the area of renewable energy systems, energy storage and lithium-ion battery testing and modelling.

Erik Schaltz

He received the M.Sc. and Ph.D. degrees in electrical engineering from the Department of Energy Technology, Aalborg University, Aalborg, Denmark, in 2005 and 2010, respectively. From 2009 to 2012 he has been an Assistant Professor at the same department and he is currently an Associate Professor also the same place. He is the Programme Leader of the 'Automotive and Industrial Drives' research programme at the department and he is also a member of the Advisory Board of the Insero E-Mobility Cluster Network. His research interests include analysis, modeling, design, and control of power electronics, electric machines, energy storage devices including batteries and ultracapacitors, fuel cells, electric and hybrid electric vehicles, thermoelectric generators, and inductive power transfer systems.

Lecturers

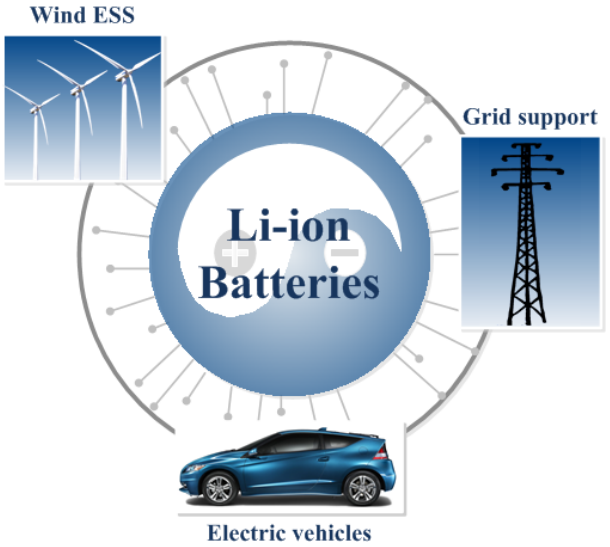
Remus Teodorescu, Professor, Aalborg University
Maciej Swierczynski, Post-Doc, Aalborg University
Daniel Stroe, Ph.D. Fellow, Aalborg University
Erik Schaltz, Associate Professor, Aalborg University
Industrial Speaker, To be announced

DEPARTMENT OF ENERGY TECHNOLOGY
AALBORG UNIVERSITY

Industrial/Ph.D. Course in

Storage Systems based on Li-Ion Batteries for Grid Support and Automotive Applications

2 – 4 June, 2014



www.et.aau.dk

Background of the course

Despite environmental friendliness, the wind power grid integration at a large scale faces several limitations, mainly related to wind variability, forecast accuracy and grid requirements. Since the accuracy of wind forecast is limited, even when the effect is reduced by large scale aggregation, the use of energy storage (ES) can be an attractive solution. Moreover, the future plans concerning the increase of the share of wind power in the electrical grid point to a major challenge that wind power integration implies: the need of transforming the behavior of wind power plant (WPP) closer to the one of conventional power plants. Therefore, the future WPPs are intended to function like conventional power plants, seen from the transmission system perspective by complying with grid codes and providing ancillary services. This is possible by integration of energy storage in the so called Virtual Power Plants (WPPs + ES). Besides, the grid support applications, ES have begun to enter in the automotive market. The use of ES in automotive applications is a promising option in order to replace the internal combustion engine (ICE) cars with ideally, zero emissions vehicles (full electric vehicles), or to controlled emission vehicles (hybrid electric vehicles and plug-in hybrid electric vehicles).

Different storage technologies are available for integration of ES in the VPPs, as well in automotive applications. Among the electrochemical battery solutions, the Li–Ion batteries represent promising candidates because of their advantages: high efficiency, quick response, low self-discharge rate, high voltage operation, high energy density etc.

The course starts with an overview of electrochemical battery storage technologies and of the grid support applications (services) that energy storage can provide to the power grid. Moreover, already existing applications of ES in WPPs will be introduced by an industrial guest.

Since the feasibility of integrating ES in WPPs is a key aspect, the second part of the course is dedicated to the performance and lifetime modeling of Li-ion batteries. During this part, aspects such as: impedance-based performance modeling, curve fitting and parameter extraction will be covered; participants will be able to develop their own Li-ion battery performance model.

The last part of the course is dedicated to the second important sector that integrates Li-ion batteries in their system, namely in automotive applications. In this part, aspects such as: battery management, as well modeling, sizing and control of battery powered vehicles will be covered.

Keep yourself updated at **www.et.aau.dk**

Course Program

Day 1: Battery Technologies and Grid Applications

08:30	Course Registration
09:00	Overview of Electrochemical Battery Technologies
10:00	Coffee Break
10:30	Overview of Stationary Applications
12:00	Lunch
13:00	Industrial Guest Lecture
14:30	Coffee Break
15:00	Matlab Exercise: Optimal Sizing of Storage in Different Applications

Day 2: Modeling of Li-ion Batteries

08:30	Li-ion Batteries: Fundamentals, Technology, Performance
10:00	Coffee Break
10:30	Performance Modeling of the Li-ion Batteries
12:00	Lunch
13:00	Degradation and Ageing Models of the Li-ion Batteries
14:30	Coffee Break
15:00	Matlab Exercise: Performance Modeling of a Li-ion Battery

Day 3: Automotive Applications

08:30	Battery Management in Automotive Applications
10:00	Coffee Break
10:30	Modeling, Sizing and Control of Battery Powered Vehicles
12:00	Lunch
13:00	Matlab Exercise: Battery Powered Vehicles
14:30	Coffee Break
15:00	Lab visit
15:30	End of Course

Language: English

Credits: 3.0 ECTS

Registration

To register, you must create an account by filling out the form available at:

https://phd.moodle.aau.dk/

You will be ready to register for course participation, after you will receive an e-mail and confirm your registration.

Registrations close on **May 12, 2014**.

Course Location

Aalborg University
Department of Energy Technology
Pontoppidanstræde 101
DK-9220 Aalborg East
Denmark

Organization

Further information

Maciej Swierczynski
Post Doc
Aalborg University
Department of Energy Technology
Phone +45 9940 3348
Email: mas@et.aau.dk

Hotel and Transport

For hotel, transport information and booking please check: www.et.aau.dk/phd/phd-courses

Fee

The fee for the course is **10.000 DKK** for Industry, **6.500 DKK** for PhD students/ Academics outside of Denmark, and **1.500 DKK** for PhD students in Denmark.

The registration fee includes: coffee and lunch for all days, gala dinner and the course materials.

Prerequisites

In order to be able to perform the exercises, the course participants should bring their own notebook with MATLAB software pre-installed (in case that it is not possible, some computers will be available).

Lab facilities

- FuelCon Battery Test Station
- Maccor Battery Test Station
- Digatron Cell and Module Tester
- FuelCon Portable EIS Analyzer
- Industrial Ovens and Climatic Chambers
- Real Time Digital Simulator (RTDS)
- dSpace 32-Cell Battery Emulator