IEEE ITALY SECTION
IA/PEL C&S Italy Joint CHAPTER
IA34/PEL35

ROMA TRE
UNIVERSITÀ DEGLI STUDI

ECPE Competence Centre

Roma Tre Summer Course on

Power Electronics and Applications

Organizer and Host Institution — Roma Tre University – Department of Engineering, Power Electronics and Electric Drives Laboratory, luca.solero@uniroma3.it

Technical Sponsorship — ECPE – European Center for Power Electronics

In cooperation with

Chairman — Fabio Crescimbini - *Roma Tre University*

Lecturers

Stefano Bifaretti - *University of Roma Tor Vergata*
Emilio Bueno – *University of Alcalá*
Fabio Brucchi, Valeriano Cardi – *Semikron*
Petar Grbovic - *Huawei Technologies*
Alessandro Lidozzi, Valerio Sabatini - *Roma Tre University*
Paolo Mattavelli (IEEE Distinguished Lecturer) – *University of Padova*
Vladimir Scarpa – *STMicroelectronics*
Slobodan Vukosavic – *University of Belgrade*
Pericle Zanchetta - *The University of Nottingham*

The course is scheduled in 2 weeks, 5 days a week, 30 hours lessons, 3 ECTS each week. Lecturers will be held during the 1st week, laboratory activities will take place during the 2nd week of the course. Each course week can be attended independently and as a single short course. The course is primarily intended for PhD and Master students; however, it is also open to staff of companies interested in the topic.
No fees for attending people.

Registration — Register before June 25th, 2018.
Please email a copy of the completed registration form to luca.solero@uniroma3.it

Venue — Roma Tre University, Department of Engineering
Via della Vasca Navale, 79 – 00146 Roma, Italy
Mechanical and Industrial Engineering Division, 2nd floor
Conference Room n. dir.01, Ph. +39 06 5733 3277

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2018 Roma Tre Summer Course on Power Electronics and Applications	
Registration Form (email to luca.solero@uniroma3.it) Week 1, July 2-6 ☐ Week 2, July 9-13 ☐	
Attendee:	
	Title, Given Name, Name
	Company, Department
	Full Address
	Phone, Fax
	Email
	Date, Signature

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Week 1 (3 ECTS) - Power Electronics in Electric Grid Applications

Monday, July 2nd

10.15-10.30	Welcome, Introduction	F. Crescimbini
10.30-12.45	New players in the electric mains and the energy balance in small grids	V. Scarpa
14.00-15.45	IGBT and SiCMOSFET, Basics and Applications trend	F. Brucchi
16.00-17.45	Design of Power Modules	V. Cardi

Tuesday, July 3rd

09.15-11.00 11.00-12.45	Control in Power Electronics: from basics to model predictive	S. Bifaretti P. Zanchetta
14.00-15.45	Control of the Grid-Side Inverters and their impact on electromechanical disturbances in ac power grids.	S. Vukosavic
16.00-17.45	Grid Connected Power Converters: Analysis, Design and from Theory to Practice	P. Grbovic

Wednesday, July 4th

09.15-11.00	Grid-side Inverters - Power Quality & Harmonics	S. Vukosavic
11.00-12.45	Power Converters for Energy Storage Devices & Applications	P. Grbovic
14.00-15.45	Small signal stability and power electronics converter interactions in migrogrids using impedance-based approach - Part I	P. Mattavelli
16.00-17.45	Multilevel converters for medium voltage applications (FACTs, traction, renewable energies, ...) – Part I	E. Bueno

Thursday, July 5th

09.15-11.00	Small signal stability and power electronics converter interactions in migrogrids using impedance-based approach - Part II	P. Mattavelli
11.00-12.45	Multilevel converters for medium voltage applications (FACTs, traction, renewable energies, ...) – Part II	E. Bueno
13.45-18.00	Tour at Semikron Italy Factory	V. Cardi

Friday, July 6th

09.15-11.00	Control platforms for Power Electronics and Drives Applications	A. Lidozzi
11.15-12.45	Multiple Choice Survey	L. Solero

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Week 2 (3 ECTS) - Practice on Power Electronics (Hands-on class)

Instructors: A. Lidozzi, V. Sabatini, L. Bigarelli

Monday July 9th 10.15-12.45 and 14.00-17.45
Tuesday July 10th 09.15-12.45 and 14.00-17.45
Wednesday July 11th 09.15-12.45 and 14.00-17.45
Thursday July 12th 09.15-12.45 and 14.00-17.45
Friday July 13th 09.15-13.30

Introduction

Nowadays, even a common power converter can exhibit an increased number of active devices and higher switching frequency than ever to satisfy a higher control performance demand. This results in an increased complexity related to the control board, where usually a combined μC (or μP, DSP) and FPGA are both installed. Those two 'actors' require a completely different programming approach and development tools from those employed by traditional boards.
Accordingly, control algorithm development is considered a 'time consuming' task within a research or industrial project. IDE (Integrated Development Environment), provided by the control platforms manufacturers or third parties, are constantly moving from the classical, old, text-based approach to a new, fast and simple to learn graphical programming method. Moreover, a high level of abstraction is usually requested in order to accelerate the learning time even on non-specialist workers; however, a full control on the hardware is still mandatory.
This hands-on week will cover the methodologies to switch to the newly graphical programming development environments, starting from a review and going into the most promising solutions.
Code splitting between targets, best practices, and code efficiency will be part of the tutorial.
The usage of FPGA has some inherent drawbacks such as the long compiling time: FPGA co-simulation and hardware-in-the-loop techniques will be also covered to help the designer workflow.

Outline

Theory and practice with the National Instruments sbRIO-9651 and Linux real-time OS. Insight view and develop of specific Power Electronics and Drives applications using LabVIEW integrated development environment.

- LabVIEW basic concepts, front panel and block diagram, debugging, programming guidelines. Application development. Graphical programming of the Real-Time and FPGA targets. Communication between targets. Code efficiency and best practices.
- Development of the FPGA main scheduler and synchronization with the on board μProcessor, PWM modulator with configurable dead-time.
- Floating-point math operations on FPGA target. (*a must have!*)
- Development of high performance control algorithms such as repetitive control, resonant controllers, Model Predictive Control and combined control structures. Code splitting between targets.
- LabVIEW FPGA/ NI-Multisim co-simulation, a very powerful tool to test the developed FPGA code.
- Closed loop tests with the Hardware-in-the-loop simulator.
- Discussion on the lab sessions.

Control board info: www.ped-board.com

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