Advanced FPGA-based Controllers for Power Electronic and Drive Applications

Organizer: Professor Josep M. Guerrero, Associate Professor, Juan C. Vasquez

Lecturers: Professor Eric Monmasson, Assistant Professor Lahoucine Idkajine, University of Cergy-Pontoise

ECTS: 2

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Max no. of participants: 20

Description: Digital controllers are now extremely powerful. With the current Field Programmable Gate Array (FPGA), designing a controller is no longer limited to the programming of a microprocessor but includes also the programming of the architecture of the processor itself along with its peripherals and its computing accelerators. As a consequence, the control designer should be now a system architect who also needs a deep understanding of the final system to be controlled. Along this line, this course aims to propose a rational use of current FPGA reconfigurable platforms for controlling power electronic and drive applications.

The following topics are covered in the course:

- Introduction, presentation of the current trends in terms of digital control implementation for electrical systems.
- Description of FPGA components (Internal architecture of FPGAs, recent System-on-Chip extension, presentation of the corresponding development tools)
- Main design rules of an FPGA-based controller: Control algorithm refinement (design of a time continuous controller, internal delay issues, digital re-design, sampling issues, quantization issues). Architecture refinement (algorithm architecture matching, IP-modules reusability, Hardware-in-the-Loop (HIL) validation, system-on-chip extension)
- Presentation of practical cases: Current control of a synchronous motor drive, sensorless control techniques (Kalman filtering, high frequency injection).
- Hands-on the FPGA-based control of a three phase inverter connected to the grid (PI current controller, PR current controller, sliding mode current controller, predictive current controller)

Prerequisites: Matlab/Simulink knowledge is recommended for the exercises.

Link: [http://www.et.aau.dk/phd/phd-courses/](http://www.et.aau.dk/phd/phd-courses/)