

We are facing our 7th Annual meeting. Historic number. It seems it was yesterday when we were outlining the details of this annual event, having dinner in a fresh garden, in the middle of a typical summer evening in Madrid. It was 2008. We wished to engage industry, and researchers and engineers from over 60 companies joined us. We wished to show our research, and more than 200 papers and posters were presented by CEI researchers in our Annual Meetings. We wished to learn from others, to envisage the future, to see the world from a different perspective, and many speakers gave their view in the plenary, technical and poster sessions. We learned how our industry partners focus their research, we discussed about megatrends in the society, about the electric car, about energy in integrated circuits, about entrepreneurship in electronics, about the opportunities of graphene and we even tried to learn how the brain works. This year we focus on Smart Grids. Energy is one of the great challenges for a sustainable world. Energy efficiency is becoming a priority, and we wish to learn and contribute with our continuous effort and knowledge. We keep moving forward, our students receive awards, they finish their Master Thesis and Doctoral Dissertations and they join industry and academia in different countries: China, Ireland, Austria, Switzerland... and even in Spain!

In the last months two important facts occurred. Our department (Control, Electronics and Computer Science) merged with the Electrical Engineering department. This will be for the benefit of cooperation. Additionally, our Doctoral program became inter-university, between UPM and University of Oviedo.

Our research lines around industrial electronics are more and more integrated and multi-disciplinary: energy management, power electronics and power systems, embedded digital systems, reconfigurability, wireless sensor networks, embedded intelligence, RF communications, instrumentation and bioengineering. An appropriate diversity and critical mass to have an impact on industry and people.

The editorial board

## Master Theses

04/10/2013

Noise-agnostic self-adaptive evolvable hardware for real time video filtering applications.

**Author:** Javier Mora

**Supervisor:** E. de la Torre & A. Otero

Diseño del control para convertidor de puente completo con fase desplazada.

**Author:** Carlos A. Rodríguez

**Supervisors:** J.A. Oliver & P. Alou

Modelling, analysis and optimization of analog controls for a Buck converter.

**Author:** J. Cortés

**Supervisor:** P. Alou

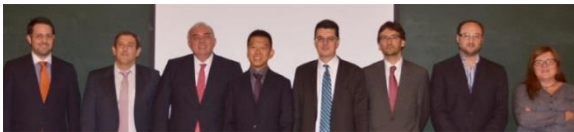
## PhD Theses

19/07/2013

Design and Validation of an Optimized MB-OFDM

Ultra Wideband Transceiver System by **Guixuang Liang**

**Supervisor:** T.Riesgo & J. Portilla



05/09/2013

Multiple Input-Output Bidirectional Solid State Transformer Based

on Series Resonant Converter by **Zoran Pavlović**

**Supervisors:** P. Alou & J.A. Oliver



## New Doctoral Program in Electrical and Electronic Engineering

A new inter-university doctoral program in the field of Electrical and Electronic Engineering (DEEE) has been jointly approved at UPM (Technical University of Madrid) and University of Oviedo. The admission procedure for students in the 2014/2015 academic year is now open. Please visit the web site of both universities. Electrical Engineering and Electronic Management of Electrical Energy jointly to Electronic Embedded Systems are the research lines at UPM, while the research activity at University of Oviedo is oriented to Power Electronics and Power Quality. There is some desired overlapping in the scope of research at both universities. This joint initiative intends to develop one of the best doctoral programs in the field.

## Journals

- V. Šviković, J.A. Oliver, P. Alou, O. García, J.A. Cobos Synchronous Buck Converter With Output Impedance Correction Circuit **IEEE Trans. on Power Electronics** pp. 3415 - 3427, vol. 28, iss. 7, July 2013
- R. Salvador, A. Otero, J. Mora, E. de la Torre, T. Riesgo, L. Sekanina Self-Reconfigurable Evolvable Hardware System for Adaptive Image Processing **IEEE Trans. on Computers** pp. 1481-1493, vol. 62, iss. 8, August 2013
- O. García, M. Vasić, P. Alou, J.A. Oliver, J.A. Cobos An Overview of Fast DC–DC Converters for Envelope Amplifier in RF Transmitters **IEEE Trans. on Power Electronics** pp. 4712 - 4722, vol. 28, iss. 10, October 2013
- S. Vesti, T. Suntio, J.A. Oliver, R. Prieto, J.A. Cobos Effect of Control Method on Impedance-Based Interactions in a Buck Converter **IEEE Trans. on Power Electronics** pp. 5311 - 5322, vol. 28, iss. 11, November 2013
- Y.A. Durrani, T. Riesgo High-Level Power Analysis for Intellectual Property-Based Digital Systems **Journal on Low Power Electronics** pp. 435-444, vol. 9, iss. 4, December 2013

## Seminario Anual de Automática, Electrónica e Informática Industrial

The 20th edition of the Seminario Anual de Automática, Electrónica e informática Industrial (SAAEI'13) took place last July at our school and was hosted by the Centro de Electrónica Industrial (CEI-UPM). The traditional good atmosphere of this conference was ideal to develop technical and plenary sessions, exhibition and some contests. According to the number of attendees (150) it can be said that it was a success. Very important in this conference are also the social events: we visited the Dalí exposition at the Reina Sofía Museum and we had dinner at the Hipódromo de la Zarzuela watching horse races in a very nice summer night. If you want to browse the technical content of the conference and to see the pictures, the web site of the conference (<http://www.saaei.org/edicion13/>) is still available. Many thanks to all of the participants.



## 7TH CEI-UPM Annual Meeting



This year the Opening Session will be devoted to **Smart Grids** in a broad sense, from **Nano to Mega Grids**. On the other hand, a variety of special events, lectures, and exhibitions are planned throughout

March 27<sup>th</sup> in the afternoon and 28<sup>th</sup> in the morning to bring together faculty, staff, students and enterprises representatives to celebrate our joint R+D+I interests, current and future cooperation and challenges.

We will have an excellent opportunity to celebrate CEI contributions in education and R+D+I in national and international scenes. We hope that everyone will connect with others sharing past experiences and, perhaps, finding mutual interests for future collaborations.

The program will be very similar to previous years.

**THURSDAY afternoon**, March 27th: Panel Debate: “**Smart Grids**“. Poster session in the lab: CEI-UPM researchers will show their work in a poster session in our lab.

**FRIDAY morning**, March 28th: Technical sessions by CEI researchers and some Industry partners .

## Books

**La Universidad española en cifras 2012**, J. Uceda et al. Ed. Conferencia de Rectores de las Universidades Españolas, ISBN 978-84-938807-5-0  
**Proceedings 2013 International Conference on ReConfigurable Computing and FPGAs**, Editors: E. de la Torre, M. Wirthlin & R. Cumplido ISBN 978-1-4799-2078-5

## NEWS BRIEFS

Our students received the **Best Engineering Degree Final Project Award** by the F2I2 Foundation, Academic year 2012-2013

- “Implementación de hardware evolutivo en un array sistólico mediante circuitos reconfigurables virtualmente” by **Iván Flores**
- “Implementación de un sistema evolutivo escalable” by **Ángel Gallego**

Our colleagues **David P. Daza** was honored with the **Best Student's Record Award (IAEI Grade)** by the ETSII-UPM, Academic year 2012-2013, and **Alfonso Rodríguez** was honored with the **Best Students's Record** of the promotion of graduates in Industrial Engineering /Majoring in Automatics and Electronics

**Javier Uceda** received the medal of Honor from the School of Architecture of UPM on September chaired by the UPM Dean.

### Best paper award on International Conferences

- “Radio propagation modeling and measurements for ZigBee based indoor wireless sensor networks”, by **D. He, G. Mujica, G. Liang, J. Portilla, T. Riesgo**, **Jornadas de Computación Empotrada**, Sept. 2013, Madrid (SPAIN).
- “Modulation-mode and Power Assignment in SVD-assisted MIMO Systems with Transmitter-side Antennas Correlation”, **A. Ahrens, F. Cano-Broncano, C. Benavente-Peces**, **SIGMAP&WINSYS**, July, Ryekjavik (Iceland)

### AWARDS

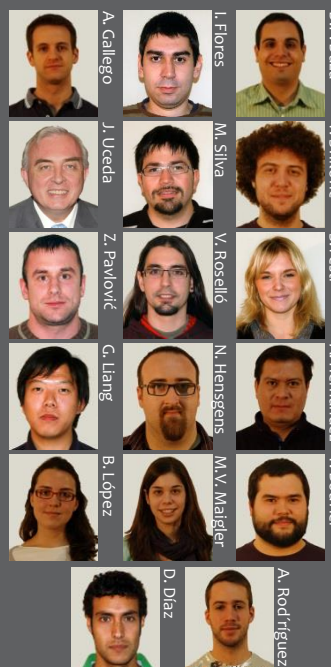
### OUTGOING VISITING researchers during this period

- **Sanna Vesti**, doctoral student, doing research stay at **Infineon Technologies** (Villach, Austria) since 1/5/2013 until 31/7/2013
- **Marcelo Silva**, doctoral student, stayed at **ETH** (Zurich, Suiza) since 25/06/2013 until 30/09/2013
- **Vladimir Šviković**, doctoral student, stayed at **INSA Lyon** (Francia) since 01/06/2013 until 30/09/2013

**FAREWELL...** to **Sanna Vesti**, who joined INFINEON (Austria), **Daniel Díaz** (Spain) at UTRC (Cork, Ireland), **Nico Hensgens** (Luxemburg) at EMC PARTNER (Suiza) and **Víctor Roselló** (Spain) at Greennomit.

**Guixuan Liang** (China), **Zoran Pavlović** (Serbia) who finished their PhD in July and September, respectively. Dr. Liang is now working in Provincial Government of Baotou (China) and Dr. Pavlović in Tyndall (Ireland).

**WELCOME...** to new members who have joined CEI-UPM during this period: **Blanca López**, **M<sup>a</sup> Victoria Maigler** and **Yann Bouvier** as full-time researchers and Master students. We also welcome **Sergio Díaz** (from Colombia), who came for a 4 months pre-doctoral stay funded by Universidade Federal de Minas Gerais (Brasil), and **Roland Dobai**, assistant professor of Univ. of Brno (Czech Republic) from September, 20th until November 15th, 2013.







by J. PORTILLA

# Cyber-physical Systems, Internet of Things and Wireless Sensor Networks



Cyber-physical systems (CPS) bridge the cyber world (information, communication, and intelligence) to the physical world through sensors and actuators. A CPS may consist of multiple static or mobile sensor/actuator networks integrated under an intelligent decision system. In other words, CPS is the integration of computation with physical processes. Over the last 20 years, significant efforts have been carried out to obtain massive amounts of measurements from the environment (i.e. temperature, light, motion sensors, etc.) and use these big chunks of data to perform specific tasks such as: monitoring, statistical analysis, and control, among other functions. This field has been referred to by many different titles depending on the application and the type of data. These titles include: distributed embedded systems, wireless sensor networks, mobile ad-hoc networks, pervasive computing, and ubiquitous computing.

Cyber Physical Systems encompass all of the ideas contained in the fields mentioned above, but it expands these concepts by connecting different networks together (such as ZigBee and the Internet) and providing more intelligence to the systems. The so-called ‘Internet of Things’ (IoT) is aligned with this idea, however it is more orientated to the networking and connection of devices, while CPS closes the loop since it is focused more on information and feedback to control the physical world.

At CEI-UPM, researchers have been working on Wireless Sensor Networks (WSNs) for the last 10 years in different areas related to hardware platforms, security, debugging and maintenance, planning, remote programming, and node reconfiguration in hardware. All of this experience affords CEI to be in a privileged position to expand the frontiers of the cyber world by adding new features to embedded systems in the framework of Cyber Physical Systems.

## Conferences

### Seminario Anual de Automática, Electrónica Industrial e Instrumentación (SAAEI), July, 2013, Madrid (Spain)

- J.M. Molina, S. Zhao, J.A. Oliver, P. Alou, O. García, J.A. Cobos, 3-Phase Rectifier System with very demanding dynamic load: Architecture analysis and Control strategy
- M. Patiño Gómez, D. Tena Ramos, F.J. Ortega González, J.M. Pardo Martín, C. Benavente Peces, J. Torres López-Sepúlveda, D. Madueño Pulido, Amplificador de Potencia de RF Clase AB de Banda Ancha usando Transistores basados en Tecnología GaN HEMT
- Z. Pavlovic, J.A. Oliver, P. Alou, O. García, J.A. Cobos, Analysis and validation of a multiple output series resonant converter
- V. Roselló, J. Portilla, T. Riesgo, Arquitectura de Radios Wake-up para redes de sensores inalámbricas basada en FPGA
- D. Díaz, O. García, J.A. Oliver, P. Alou, J.A. Cobos, Convertidor CC-CC Reductor Síncrono con Red de Cancelación de Rizado para un Amplificador de Envolvente de Alto Ancho de Banda y Alto Rendimiento
- B. Díez Sánchez, Y. Torroja Fungairiño, Criterios previos de utilización de RTOS para el desarrollo de aplicaciones en sistemas embebidos
- D. Meneses, O. García, P. Alou, J.A. Oliver, R. Prieto, J.A. Cobos, Forward Micro-inverter with Primary-Parallel Secondary-Series Multicore Transformer
- O. García, A. Francés, J.M. Fernández, P. Varela, G. Catalanotto, P. Alou, J.A. Oliver, R. Asensi, R. Prieto, J. Uceda, J.A. Cobos, Fuente de Alimentación para los Imanes Superconductores del Acelerador de Partículas Europeo XFEL
- M. Silva Faúndez, N. Hensgens, J.M. Molina, M. Vasić, J.A. Oliver, P. Alou, O. García, J.A. Cobos, Interleaved Multi-Cell Isolated Three-Phase Rectifier for Aircraft Applications

- V. Sviković, P. Alou, J.A. Oliver, O. García, J.A. Cobos, Improvement of the Dynamic Performance of a Multiphase Current Controlled Buck Converter using an Auxiliary Synchronous Buck Converter as an Additional Energy PathJ. Cortés, V. Sviković, P. Alou, J.A. Oliver, J.A. Cobos, Stability analysis of ripple-based controllers of power converters
- S. Vesti, J.A. Oliver, R. Prieto, J.A. Cobos, T. Suntio, Systematic Method to Assess Small-Signal Stability of DC-Distributed Power-System-Architecture
- M.V. Maigler, J. Valverde, J. Portilla, T. Riesgo, Wireless Sensor Network Solution for Sustainable Food Production

### IEEE Energy Conversion, Congress and Exposition ECCE, September, 2013, Denver (Colorado, USA)

- D.Díaz, O.García, J. A. Oliver, P. Alou, M. Vasic, J.A. Cobos, M. Patiño, D. Tena, F.J. Ortega, High Efficiency Power Amplifier Applying the Envelope Elimination and Restoration Technique with a Single Stage Envelope Amplifier with Ripple Cancellation Network
- S. Vesti, J.A. Oliver, R. Prieto, J.A. Cobos, T. Suntio, Performance metrics for small-signal stability assessment of DC-distributed power-system-architecture comparisons

### Annual Conference of the IEEE Industrial Electronics Society (IECON), November, 2013, Viena (Austria)

- D. He, J. Portilla, T. Riesgo, A 3D Multi-objective Optimization Planning Algorithm for Wireless Sensor Networks
- G. Mujica, V. Rosello, J. Portilla, T. Riesgo, On-the-fly Dynamic Reprogramming Mechanism for Increasing the Energy Efficiency and Supporting Multi-Experimental Capabilities in WSNs
- P. Cortes, J.Huber, M.Silva, J.W. Kolar, New Modulation and Control Scheme for Phase-Modular Isolated Matrix-Type Three-Phase AC/DC Converter

### Other

- A. Ahrens, F. Cano-Broncano, C. Benavente-Peces, Modulation-mode and Power Assignment in SVD-assisted MIMO Systems with Transmitter-side Antennas Correlation, **Int. Conf. on Signal Processing and Multimedia Applications & Int. Conf. on Wireless Information Networks and Systems**, July, Reykjavik (Iceland)
- S. Bhasin, W. He, S. Guilley, J.L. Danger. Exploiting FPGA block memories for protected cryptographic implementations. **Reconfigurable and Communication-Centric Systems-on-Chip (ReCoSoC)**, July, Darmstadt (Germany).
- D. He, G. Mújica, G. Liang, J. Portilla, T. Riesgo, Radio propagation modeling and measurements for ZigBee based indoor wireless sensor networks, **Jornadas de Computación Empotrada**, Sept, Madrid (Spain)
- D. Díaz, M. Vasic, O. Garcia, J.A. Oliver, P. Alou, J.A. Cobos, M. Patiño, D. Tena, F.J. Ortega, Integración de un amplificador de alto rendimiento con un amplificador de envolvente con red de cancelación de rizado mediante la técnica EER, **Síposium Nacional Unión de Científica Internacional de Radio (URSI)**, Sept, Santiago de Compostela (Spain)
- F. Veljkovic, J. Mora, T. Riesgo, L. Berrojo, R. Regada, A. A. Sánchez & E. de la Torre, Prospection of Reconfiguration Capabilities using Space Qualified SRAM-based FPGAs for a Satellite Communications Application, **AIAA International Communications Satellite Systems Conference (ICSSC)**, October, Florence (Italy)
- J. Mora, Á. Gallego, A. Otero, E. de La Torre, T. Riesgo, A Noise-Agnostic Self-Adaptive Image Processing Applications Based on Evolvable Hardware, **Conf. on Design and Architectures for Signal and Image Processing (DASIP)**, October, 2013, Cagliari (Italy)
- D. He, N. Mitton, D. Simplot-Ryl, An Energy Efficient Adaptive HELLO Algorithm for Mobile Ad Hoc Networks, **ACM Conference on Modeling, Analysis and Simulation of Wireless and Mobile Systems**, November, Barcelona (Spain)
- Á. Gallego, J. Mora, A. Otero, R. Salvador, E. de La Torre, T. Riesgo, A Scalable Evolvable Hardware Processing Array, **Int. Conf. on ReConFigurable Computing & FPGA (RECONFIG)**, December, Cancún (México)

## current research projects

### Modeling & Simulation of power architectures, circuits and components

- ANSYS** PExprt and SMPS Library (PExpert-SMPS) funded by ANSYS, 1/5/2007 to 1/5/2017
- Modelos rápidos equivalentes para gestión de redes electrónicas de energía (MORE\_GREEN)** funded by **M° Ciencia e Innovación**, 1/1/2011 to 31/12/2013

### Optimization of Power Architectures

- Fuentes de alimentación para los imanes superconductores del XFEL europeo (XFEL)** funded by **M° Ciencia e Innovación**, 1/12/2010 to 30/11/2013
- indra** Modelado y optimización del rectificador para la cadena de alimentación del radar electrónico, (MORE-CARE), funded by **INDRA**, 1/1/2013 to 31/7/2013

### Integrated DC/DC Converters

- Fuentes de alimentación con rápida respuesta dinámica para gestión de la energía (FAST)** funded by **M° Ciencia e Innovación**, 1/1/2011 to 31/12/2013
- POWER SoC With Integrated PassivEs (PowerSwipe)** funded by **European Comission Frame Program 7**, 01/10/2012 to 30/9/2015

## new research projects

- Active and Isolated Rectifier unit for more electric aircraft: Design and Manufacturing of a 10kW AC-DC Converter Unit (AIR)**, funded by European Comission (Program CleanSky), 1/10/2013 to 30/9/2015

The partners of this project are INDRA and CEI and it is developed for AIRBUS. The main goal of the project is to develop and transfer to AIRBUS advanced Power Electronics technologies to design and manufacture isolated three phase rectifiers. Most relevant technologies are reviewed and compared like: passive rectifiers, active rectifiers, isolated DC/DC topologies, wide band gap semiconductors (SiC, GaN), planar transformers, amorphous and nanocrystalline magnetic materials, digital control etc. After the detail comparison, the most appropriate solution for the considered specifications will be designed and tested in a 10kW prototype for an avionic application.

- ALSTOM** Desarrollo de un circuito para desmagnetizar una máquina síncrona mediante IGBTs en paralelo funded by **Alstom Renovables España S.L**, 1/11/2013 al 15/05/2014  
The main objective of the project is to develop a protection for a synchronous generator based on IGBT technology. The circuit is mounted ton the rotor of the generation and it is monitoring the status of the machine being able to disconnect and demagnetize it in case of short-circuits. This work is been done in collaboration together with the Grupo de Máquinas Eléctricas of this school of the UPM.

### Reconfigurable Embedded Systems

- Dynamically Reconfigurable Embedded Platforms for Networked Context-Aware Multimedia Systems (DREAMS)** funded by **M° Ciencia e Innovación**, 1/1/2012 to 31/12/2013
- Source FPGA Accelerator & Hardware-Software Codesign Toolset for CUDA Kernels (FASTCUDA)** funded by **European Commission FP7-SME-2011 (Capacities)**, 1/11/2011 to 31/10/2013
- Reconfigurable Ultra-Autonomous Novel Robots (RUNNER)** funded by **Comisión Europea / CDTI / ISIS**, 1/12/2010 to 30/11/2013

### Sensor Networks

- Sistema de Iluminación Inteligente LUIX (TECALUM)** funded by **INNPACKTO. M° Ciencia e Innovación**, 1/11/2011 to 30/11/2014
- ICT tools greening food processing businesses (GIST)** funded by **European Commission CIP ECO INNOVATION** 12/9/2011 to 11/9/2014
- WSN Development, Planning and Commissioning & Maintenance ToolSet (WSN DPCM)** funded by **Artemis/MICyT**, 1/10/2011 to 30/9/2014

### Wide Band-gap devices

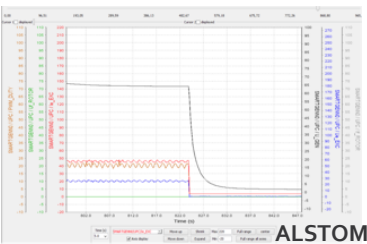
- Advanced Wide band gap semiconductor devices for rational use of energy (RUE)** funded by **M° Ciencia e Innovación**, 1/11/2009 to 31/10/2014

### Telecommunications consulting

- NetAdvanced: Despliegue de Red de Comunicaciones Avanzadas en Entornos Desfavorables** fundedn by **M° de Industria (Program AVANZA) and M° de Economía y Competitividad**
- LAMP: Plataforma de Distribución y Asignación de Anuncios en nuevos Paradigmas de Acceso a TIC basada en Perfilado Anónimo de Usuarios.**, funded by **M° Ciencia e Innovación** (Plan Innovación 2010. Program INNPACKTO)
- ECOLOG. Nueva solución de pesca integral, responsable y sostenible para la mejora de la productividad y el aprovechamiento en el sector pesquero**, funded by **Satlink and M° de Economía y Competitividad**

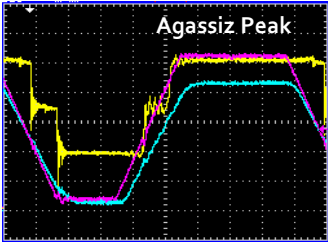
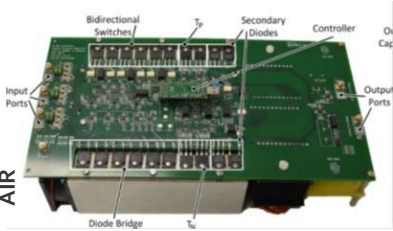
### Industrial Applications

- BOSCH Shorttest 2: Development of a PCB for the turn-to-turn short-circuit test of electric motor windings** funded by **BOSCH**, 22/4/2013 to 20/10/2013
- Desarrollo de controlador para recuperación de Calor (DCRC)**, funded by **CLASS MANUFACTURING S.A.**, 1/6/2013 to 31/12/2013
- Convertidores de Alta VElocidad de conmutación multinivel y multifase para aplicaciones espaciales (CAVE)**, funded by **M° de Economía y Competitividad**, 1/1/2013 to 31/12/2016.



- APEX Agassiz Peak Research Project**, funded by **APEX Microtechnology**, 4/12/2013 to 3/8/2014

We are doing this project together with APEX Microtechnology, an US company, to develop a very fast envelope tracker. The project is very challenging since the envelope tracker should provide different trapezoidal pulses to a special load. The objective is to reduce the power losses of the current solution that is based on linear amplifiers.



## UPCOMING EVENTS

- Design and Architectures for Signal and Image Processing (DASIP)** will be hosted by CEI-UPM. The conference will be held at ETSII on October 8th-10th, 2014. <http://www.ecsi.org/dasip>
- Design of Circuits and Integrated Systems (DCIS)** will be hosted by CEI-UPM. The conference will be held in Madrid on November 26th-28th, 2014. <http://www.dcis.org>

Consider submitting a paper to these conferences organized by CEI-UPM !!!!