

"Strive not to be a success, but rather to be of value" *A. Einstein*

We are living a long lasting economic crisis, so it is time to work harder and better. Everyone can do a lot, pushing in the appropriate direction. Our mission as an Engineering Research Center is to help engineers and industry to be more prepared, and to increase activities that create value.

Any research Center needs to handle money to keep things running, in many cases "seed" money, to launch and perform new research lines or to proof new concepts that will be converted into new products by companies later on. Creating value for industry is part of our mission. But research in university also needs the freedom and creativity that only "long term" planning may produce.

At CEI, we are very active, working in many projects. Since National funding is decreasing, we are more active in European Programs and even use our own resources, obtained in other projects with industry. Our research activity increased 2.5x in the last 3 years. Around 70 persons work hard every day to create value, in a seamless integration of young research students with experienced Doctors and Professors, being the full time Master and Doctoral students the core of the group. A special recognition to all, researchers, technicians and administration.

We are optimistic because young engineers and international students join us everyday, and new projects start. Four new projects just started, with both public (DREAMS and POWERSWIPE) and private funding (we thank BOSCH and FIDELIA GROUP, and hope to have a fruitful and long-lasting relationship with them).

The UPM Radio Engineering Group (GIRA) has also joined CEI, being effective July 2012. This complementary expertise is fundamental for industrial electronics education and research.

We also welcome Javier Uceda. His contributions as President of the University in the last 8 years have been outstanding. Now he is full time at CEI. This is added value for the Center. Our vision will strengthen, new horizons will come closer, and we will do more, and better.

Our wish is "keep going, keep investing in research"!

The editorial board

5th Annual Meeting

We enjoyed



You may watch it at:
<http://youtu.be/JclkmgyyT8A>

the fifth Annual Meeting of the CEI-UPM, that took place in the ETSII-UPM on **March 22nd and 23rd, 2012**. The Poster and Technical Sessions showed current research, including: Control Techniques, Modeling and Simulation, Optimization of Power Circuits, Power Topologies, Re-configurability & Evolvable Hardware, Wireless Sensor Networks

March 22nd, in the afternoon

In this Edition, the opening ceremony was led by the ViceDirector of research from the E.T.S.I. Industriales (UPM) and the Director of CEI. An overview of the history of CEI and the motivation to organize the annual meeting was given. It was devoted to show what we do at CEI, and to foster cooperation and research alignment with industry and other universities

After that, a Conversational Discussion called,

Entrepreneurship in Electronics, from ideas to facts, how to face challenges in electronics spin-offs?

was carried out. Four relevant participants shared with us their own experience: Juan B. Genua from LUIX (San Sebastian-Spain), Juan M. Carrasco from Green Power (Sevilla-Spain), Luis Redondo from INETSIS (Madrid-Spain) and Pedro Moneo from OPINNO (San Francisco-USA). Their complementary points of view, their past experience, their expectations and their challenges helped us to know about entrepreneurship in a wide range area of electronic applications.

March 23rd, in the morning

The Friday technical sessions were structured in three parts: CEI, University and Industry sessions. For the CEI oral sessions, some of the key contributions of our Center were selected, covering several topics of our research lines. In this edition, contributions of four outstanding groups of several Spanish universities were received. We appreciate very much presentations from U. Carlos III, U. de Las Palmas de Gran Canaria, U. de Zaragoza and U. Politecnica de Catalunya. Finally, in the industry session, four of our associated companies showed us some of the challenges they were facing. Special thanks to Thales Alenia Space, Intel, CRISA and Enpirion and the speakers for their willingness to collaborate.

Social event

After one day and a half, the relaxing cocktail was a very nice chance to discuss and to share opinions while enjoying and tasting some appetizers and, surely, to wish a very warm *see you next year at the 6th CEI Annual Meeting*



Theses

- | | | |
|--|---|------------------------|
| <ul style="list-style-type: none"> Plataforma de integración hardware-software para testbed de redes de sensores inalámbrica
 Author: Gabriel Mujica | <p>Thesis Supervisors: J. Portilla</p> | <p>Date: 16/4/2012</p> |
| <ul style="list-style-type: none"> FPGA based wireless sensor node architecture for high performance applications
 Author: Juan Valverde | <p>Thesis Supervisors: J. Portilla & E. de la Torre</p> | <p>Date: 16/4/2012</p> |
| <ul style="list-style-type: none"> Model predictive control for multi-phase buck converter with variable output voltage
 Author: Giuseppe Catalanotto | <p>Thesis Supervisors: J. A. Oliver</p> | <p>Date: 16/4/2012</p> |

Master

- Doctoral**
- Design and optimization of power delivery and distribution systems using evolutionary computation techniques by Leonardo Laguna
 Thesis Supervisors: R. Prieto Date: 26/3/2012



NEWS BRIEFS

- Spanish research team comprising José A. Cobos, Oscar García, Roberto Prieto, Pedro Alou, Jesús A. Oliver and Miroslav Vasić from CEI, have been awarded the SEMIKRON Innovation Award for their concept "RF Power Amplifier with Increased Efficiency and Bandwidth". These awards, presented at this year's PCIM Europe in Nuremberg, are awarded by the SEMIKRON Foundation and the European Center for Power Electronics (ECPE) for excellent projects, products and services and innovative concepts in the field of power electronics (May 2012).



J. Uceda

- We would like to give a very warm welcome to Javier Uceda. After many years of service to the University in the most important management positions (Vice-director & Director of ETSII, Vice-president & President of the UPM), he has recently finished his 8 years term as President of the UPM. We are happy to count on him, full-time, again. CEI will take advantage of his vast experience and his intuition in both research and strategic decisions.

- CEI researchers Javier Mora, Andrés Otero and Eduardo de la Torre, from the Reconfigurable Systems research line, made a demonstration of the fault-tolerant and self-healing adaptive HW system for image filtering at the University Booth at DATE 2012, the most important event on electronic design at European level. The Conference took place in Dresden (Germany), on March 12th-16th 2012.



A. Otero & J. Mora



- CEI incorporates RADIO engineering expertise. Being effective July 2012, the Research Group on Radio Engineering (GIRA) is joining CEI. After several years of joint activity on "Power Management for RF amplifiers", researchers from GIRA are officially CEI members. Radio expertise is fundamental for industrial electronics applications. Research and education will also benefit from this.



V. Suljovic

N. Hensgens

- Welcome... to the new CEI-UPM member who joined us during this period Noemí Nogar, as a lab technician.
- Farewell... to Pablo Varela, he is now working in Texas Instruments in Germany.



N. Nogar

- Nico H. Hensgens and Vladimir Šviković received the Technical Presentation award in IEEE Applied Power Electronics Conference and Exposition (APEC), Orlando (Florida, USA), February 2012

Monday Seminars

be aware of CEI-UPM results every two weeks

- | | | |
|-------------|--|-------------|
| FEB, 20 | Dynamic power supply design for high-efficiency wireless transmitters using GaN FETs | D. Cucak |
| MARCH, 5 | Virtual Prototyping and Multi-Objective Optimization of EMI Input Filters for Power Converters | N. Hensgens |
| APRIL, 9 | Design and Validation of a UWB Transmitter for FPGA Implementation | G. Liang |
| APRIL, 23 | Hardware-Software Integration Platform for Wireless Sensor Network Testbed based on the CAP | G. Mujica |
| MAY, 21 | Analytical models for precise losses calculations in magnetic components | F. Holguín |
| JUNE, 4 | Evolvable Hardware Solutions for Dependable Systems Design on FPGAs | J. Mora |
| SEPT, 10 | FASTCUDA Project Overview | A. Otero |
| SEPT, 24 | Auto-routing repair technique for achieving identical net pair in SCA-resistant dual rail logic | W. He |
| OCTOBER, 8 | Review and Comparison of Step-up Transformerless Topologies for Photovoltaic AC-Module Application | D. Meneses |
| OCTOBER, 22 | New approaches for low power image compression for WWSN | D. Aledo |

More information: <http://cei.etsii.upm.es/>

Specialized Seminars. Courses offered in the Master on Industrial Electronics

Three seminars with topics of current interest in the field of industrial electronics were given by experts in industrial electronics this semester.

- Current injection in three-phase rectifiers by P. Pejovic from Univ. of Belgrado (Serbia)
- Evolutionary design and evolvable hardware by L. Sekanina from Univ. Brno (Rep. Checa)
- Basic technologies for the management of cooperating objects and Sensor networks in smart cities by P.J. Marrón from Univ. Duisburg-Essen (Germany)

More information on the courses for 2012-13 in http://www.upmdie.upm.es/master_en.htm



by T. RIESGO

Embedded systems, research opportunities in the field of Industrial Electronics

The term Industrial Electronics is one of the widest we may find in the electronic field. It covers more than we could expect at a first glance. Traditional approaches identified Industrial Electronics with everything that had a relation with power electronics, power drivers and controllers, etc. During the last ten years, we have seen how this traditional approach was overcome by other aspects related with sensors and actuators, digital systems and networked elements. Nowadays, we can find more than seven different (very different!) tracks in specialized conferences like IECON (the major event of the IEEE Industrial Electronics Society) covering many different fields from very large installations to tiny elements needed to solve complex problems, from practical and challenging applications to modeling and simulation tools.

Following this stream, CEI-UPM (formerly UPMDIE) started some research lines related with embedded systems some decades ago. Starting in fields devoted to ASIC design, mainly for control applications, and following with the design and the tools related with complete systems, to nowadays activities that are focused to reconfigurable hardware, wireless sensor networks, embedded intelligence. All these activities are supported by the interest of industries and companies (both technology providers and final users) as well as the public authorities through their research programs (FP7, ARTEMIS, Plan Nacional, etc.). Among all the different technologies, techniques and applications, I would like to highlight some of the opportunities that start to open in front of us, and that CEI-UPM is addressing as some challenges of our activity.

The use of reconfigurable hardware is opening the possibility of doing self-healing circuits, capable of doing self-reconfiguration of their internal structure in real time, when they detect a failure or a mis-functioning in its behavior. Applications in critical or unattended systems may be the key for having these elements in real industrial products. The use of massive number of interconnected elements, in a seamless way, with no network infrastructure and with additional sensing capabilities, may be the real starting point of cooperating objects, allowing the deployment of wireless sensor networks in critical scenarios, industrial places or even in smart cities, to measure and monitor the environment and even to improve it. At last, but not least, new human-machine interfaces, innovative uses of technology, may put embedded systems closer to final users, and therefore is not only a question of the internal structure of these embedded systems, but also, the external elements that allow their practical use.

The projects that are currently being held at CEI-UPM in the embedded systems area, show many of these techniques and applications: environmental monitoring, energy efficiency in lamps, energy metering, context-aware multimedia systems, self-awareness in hardware structures, enhanced security in networks, efficient planning of WSN scenarios, interactive systems, are some of a larger list of the examples that are currently being run in our research center.

Journals

- J. Valverde, V. Rosello, G. Mujica, J. Portilla, T. Riesgo, *Wireless Sensor Network for Environmental Monitoring: Application in a Coffee Factory*, *International Journal of Distributed Sensor Networks*, pp.1-18, vol.2012, ID 638067, 2012
- M. Vasic, O. Garcia, J.A. Oliver, P. Alou, D. Diaz, J.A. Cobos, A. Gimeno, J. Pardo, C. Benavente, F. Ortega, *Efficient and Linear Power Amplifier based on Envelope Elimination and Restoration*, *IEEE Transactions on Power Electronics*, pp.5-9, vol.27, issue 1, January 2012.
- J. Valverde, A. Otero, M. Lopez, J. Portilla, E. de la Torre, T. Riesgo, *Using SRAM Based FPGAs for Power-Aware High Performance Wireless Sensor Networks*, *Sensors*, pp.2667-2692, vol.12, issue 2012, February 2012.
- M. Vasic, O. Garcia, J.A. Oliver, P. Alou, D. Diaz, R. Prieto, J.A. Cobos, *Envelope Amplifier based on Switching Capacitors for High Efficiency RF Amplifiers*, *IEEE Transactions on Power Electronics*, pp.1359-1368, vol.27, issue 3, March 2012.
- Q. Chen, X. Ren, J.A. Oliver, *Identifier-based adaptive neural dynamic surface control for uncertain DC-DC buck converter system with input constraint*, *Communications in Nonlinear Science and Numerical Simulation*, pp.1871-1883, vol.17, issue 4, April 2012.
- J. Popovic-Gerber, J.A. Oliver, N. Cordero, T. Harder, J.A. Cobos, M. Hayes, S.C. O'Mathuna, E. Prem, *Power Electronics Enabling Efficient Energy Usage: Energy Savings Potential and Technological Challenges*, *IEEE Transactions on Power Electronics*, pp.2338-2353, vol.27, issue 5, May 2012.
- R. Salvador, A. Vidal, F. Moreno, T. Riesgo, L. Sekanina, *Accelerating FPGA-based Evolution of Wavelet Transform Filters by Optimized Task Scheduling*, *Microprocessors and Microsystems*, pp.427-438, issue 36, June 2012.

Conferences

APEC Orlando (Florida, USA), February 2012

- J.M. Molina, O. García, R. Asensi, P. Alou, J.A. Oliver, J.A. Cobos, *Adaptive Control for ZVS Three Phase Full Active Bridge Converter with ARCN*
- Z. Pavlovic, J.A. Oliver, P. Alou, O. Garcia, R.Prieto, J.A. Cobos, *Bidirectional Dual Active Bridge Series Resonant Converter (DAB SRC) with Pulse Modulation*
- C. López, R. Asensi, R. Prieto, O. García, J.A. Cobos, *Finite Element Analysis Model of a Contactless Transformer for Battery Chargers in Electric Vehicles*
- M. Vasić, D. Diaz, O. Garcia, P. Alou, J.A. Alou, J. A. Cobos, *Optimal Design of Envelope Amplifier Based on Linear Assisted Buck Converter*
- S. Vesti, J.A. Oliver, T. Suntio, J. Huusari, R. Prieto and J.A. Cobos, *Practical Characterization of Input-Parallel-Connected Converters with a Common Input Filter*
- D. Meneses, O. García, P. Alou, J. A. Oliver, R. Prieto, J. A. Cobos, *Single-Stage Grid-Connected Forward Microinverter with Constant Off-Time Boundary Mode Control*
- V. Šviković, J.A. Oliver, P. Alou, O. Garcia, J.A. Cobos, *Synchronous Buck Converter with Output Impedance Correction Circuit*
Technical Presentation winner!!
- N. Hensgens, M. Silva, J. Oliver, P. Alou, O. García, J.A. Cobos; *Analysis and optimized design of a distributed multi-stage EMC filter for an interleaved three-phase PWM-rectifier system for aircraft applications*
Technical Presentation winner!!

Others

- V. Roselló, J. Portilla, T. Riesgo, *Wake-up architecture for Wireless sensor nodes based on ultra low power FPGA*, *European Conference on Wireless Sensor Networks (EWSN)*, Trento (Italy), February 2012.
- D. He, G. Liang, J. Portilla, T. Riesgo, *A Novel Method for Radio Propagation Simulation Based on Automatic 3D Environment Reconstruction*, *European Conference on Antennas and Propagation (EuCAP)*, Prague (Czech Republic), March 2012.
- D. Čučak, M. Vasić, O. Garcia, J. Oliver, P. Alou, J. Cobos, *Application of Gallium Nitride HEMTs for highly efficient Radio Frequency Power Amplifier*, *International Conference on Integrated Power Electronics Systems (CIPS)*, Nuremberg (Germany), March 2012.
- G. Liang, D. He, Jorge Portilla, T. Riesgo, *A Hardware In The Loop Design Methodology For FPGA System And Its Application To Complex Functions*, *VLSI, Design, Automation and Test (VLSI-DAT)*, Hsinchu (Taiwan), April 2012.

Next appointment

- Provisional dates for the **6th Annual Meeting**
More information:
<http://cei.etsii.upm.es/>



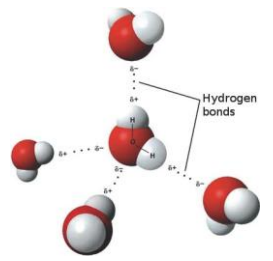
Research Projects

new research projects



- Dynamically Reconfigurable Embedded Platforms for Networked Context-Aware Multimedia Systems (DREAMS)** funded by **M^o Ciencia e Innovación**, 1/1/2012 to 31/12/2013
Summary DREAMS is a 3-year project whose main aim is to propose new methods and tools for networked embedded system design, considering aspects like complexity and heterogeneity of such electronic systems. In particular, DREAMS will address aspects like reconfigurability, validation, specification, performance analysis, HW/SW platforms, many-cores architectures, to cope with complex applications like context aware multimedia, with adaptability features. The project is led by CEI-UPM and the participants are ULPGC, UCLM and UC..

- Starting Cryogenic Analysis, (CRYOSTART)** funded by **Fidelía Group**, 1/6/2012 to 31/5/2013.
Summary.- The main objective of this project is to design and develop the necessary electronic equipment to apply electric and / or magnetic fields of the appropriate intensity and frequency to achieve the supercooling of water, so that ice crystals are not formed even lowering its temperature far below 0°C.
One of the expected applications of this technique is to enable the conservation of all types of body tissues, including organs for transplants. Nowadays, there is a tight time limitation (few hours) between donation and implantation. The organs cannot be frozen because ice crystals damage the cells. If a bank of organs were available, more people could be saved.



Electric motor under test

- Shorttest: Electronics subsystem for the short circuit test of electric motor windings** funded by **BOSCH**, 1/6/2012 to 31/12/2012
Summary.- The aim of the project is to design and develop a prototype for generating and applying the test voltage defined in the regulations for the shot circuit test between turns of electrical windings, in electric motors
- POWER SoC With Integrated PassivEs (PowerSwipe)** funded by **European Comission FP7** 01/10/2012 to 30/9/2015
Summary.- The PowerSwipe project will address the key technologies for PowerSoC by, for the first time, miniaturising and integrating state-of-the-art, high density trench capacitor substrate

technology with novel thin film magnetics on silicon to deliver a multi-component LC (inductor-capacitor) interposer which will be combined, in a 3D heterogeneous stack, using eWLB technology, with the μ Controller chip. All this supported by the development of Computer Aided Design and Optimization Tools.



Embedded Control Systems

- Enclavamiento Electrónico de Nueva Generación (ENCE-NG)** funded by **ELIOP SEINALIA S.L. (CDTI)**, 1/4/2011 to 30/11/2013

Modeling & Simulation of power architectures, circuits and components

- PExprt and SMPS Library (PEXPERT-SMPS)** funded by **ANSYS**, 1/5/2007 to 1/5/2017
- Consulting services for developing IC power module components for Simplorer** funded by **ANSYS**, 1/1/2011 to 1/1/2012
- Modelos rápidos equivalentes para gestión de redes electrónicas de energía (MORE_GREEN)** funded by **M^o Ciencia e Innovación**, 1/1/2011 to 31/12/2013

Power Quality

- Líderes en energías renovables oceánicas (OCEAN LÍDER)** funded by **AREVA (CENIT-E)**, 2009 to 2012
- Gestión automatizada de los datos de registradores de REE**, funded by **REE**, 1/10/2011 to 1/10/2012
- Modelos avanzados para el estudio de la calidad de onda de enlaces en corriente continua con convertidores en fuente de tensión**, funded by **REE**, 1/10/2011 to 1/4/2013
- Harmonic Modeling of Three Phase Rectifiers: Continuous Mode (HAMOTRE-CM)** funded by **Électricité de France**, 1/2/2011 to 1/3/2012

Optimization of Power Architectures

- Fuentes de alimentación para los imanes superconductores del XFEL europeo (XFEL)** funded by **M^o Ciencia e Innovación**, 1/12/2010 to 30/11/2013
- PhD work in virtual optimized EMC filter design for power electronic converters under consideration of real components and interconnects (ABB-MEC)** funded by **ABB Switzerland Ltd.**, 1/3/2010 to 28/2/2013
- Sistema de gestión de energía para alimentación de cargas de continua regenerativas desde un generador trifásico (HVDC BOOM)** funded by **INDRA (CENIT)**, 1/7/2010 to 31/3/2012
- Optimización de la cadena de alimentación para una aplicación radar de barrido electrónico (CARE)** funded by **INDRA SISTEMAS, S.A.**, 1/9/2011 to 31/12/2012

current research projects

Integrated DC/DC Converters

- Fuentes de alimentación con rápida respuesta dinámica para gestión de la energía (FAST)** funded by **M^o Ciencia e Innovación**, 1/1/2011 to 31/12/2013.

Reconfigurable Embedded Systems

- Open 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

RF Amplifiers

- Amplificadores de envolvente de banda ancha para etapas EER/ET y fabricación de dispositivos de nitruro de galio (GAN) (AEGan)** funded by **M^o Ciencia e Innovación**, 1/1/2010 to 31/12/2012
- Advanced Wide band gap semiconductor devices for rational use of energy (RUE)** funded by **M^o Ciencia e Innovación**, 1/11/2009 to 31/10/2014

Sensor Networks

- Sistema de Iluminación Inteligente LUIX (TECALUM)** funded by **INNPACTO. M^o 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
- Secure, Mobile visual sensor networks ArchiTexture (SMART)** funded by **Artemis/MICyT**, 1/5/2009 to 30/4/2012
- Tecnologías eficientes e inteligentes orientadas a la salud y al confort en ambientes interiores (TECNOCAI)** funded by **MTP (CENIT)**, 1/10/2009 to 31/12/2012
- WSN Development, Planning and Commissioning & Maintenance ToolSet ((WSN DPCM)** funded by **Artemis/MICyT**, 1/10/2011 to 30/9/2014

