CEI UPM
Centro de Electrónica Industrial

NewsLetter

of CENTRO DE ELECTRÓNICA INDUSTRIAL (CEI)

POLITÉCNICA

January – June 2010 | *"People learn while they teach"* (Seneca) | nr. 2

Even if many of us could not believe that we could do it again, here we are with the second issue of the Newsletter of the Center of Industrial Electronics of UPM. This issue covers the first half of year 2010, and once again we will try to show our main outcomes, news and maybe *gossip* ☺.

Thus, once *we took the first step*, we have decided to "*learn while we teach*". This is the reason why the CEI-UPM professors and researchers want to open our eyes and ears to new ideas, to new projects and we try to interact as much as possible with our environment (students, colleagues, companies…).

The activities of CEI-UPM have consolidated during the last semester. We have launched our new web page, with a very innovative design made by Nueveuno, and we encourage you to visit it at www.cei.upm.es. There are many subsections ready to be filled and more and more information will be feeding our web site to have a greater visibility and to have an information exchange reference in the Industrial Electronics world. Another important event in terms of communication has been the 3rd Annual Meeting of CEI-UPM, celebrated in May. This event is becoming a periodical meeting point for companies, academics, researchers and potential CEI-UPM members. The details of this event can be found in a following section of this Newsletter. During this period, we have held the first edition of the Advanced Seminars of the Master of Industrial Electronics. This year we have had three seminars covering three aspects of Industrial Electronics: Digital Control of power converters (by Prof. Aleksandar Prodic, Univ. of Toronto), Electronics in Space (Prof. Arturo Fernández, European Space Agency) and RFid, technology (Dr. Andrés García-Alonso, Donewtech). More details can be found below. And, of course, we continue with our daily task, trying to offer our best to the environment and working with the same energy as the first day.

In this second issue we include the following sections. First, you will find a summary with the best of the 3rd Edition of the CEI-UPM Annual Meeting. The Advanced Seminars included in our Master/PhD program are also detailed in this page. We include a section related with Reconfigurable Hardware as one of the main research activities of CEI-UPM during the last years. This is a contribution made by Dr. Eduardo de la Torre. We include regular sections where we present News Briefs, including visits, projects, etc. and the lists of projects, papers, Thesis and outcomes of the last six months.

Preparing this Newsletter regularly is not an easy task, but thanks to the contribution of many CEI-UPM members, we are being able to complete our duties.We really appreciate if you send us any suggestion, question or comment to cei@upm.es. Enjoy reading this Newsletter!… and more will come in a few months!

The editorial board

3rd Annual Meeting CEI-UPM

The Third Annual Meeting of CEI-UPM took place at ETSII-UPM on May 27th and 28th, 2010. The main aim of the Annual Meeting is to present the activities of the Centre and its partners', to create a space of scientific and technical exchange, to provide a networking environment around industrial electronics and to show the progress of our main research lines during the last year.

The program of this third edition was scheduled in two days (Thursday afternoon and Friday morning), with the following structure:

- Opening and welcome from Prof. Javier Uceda, Rector, UPM, Prof. Jesús Félez, Director of ETSII-UPM, and Prof. Teresa Riesgo, Director of CEI-UPM.
- Panel session on "Electric Vehicle". This panel was chaired by Prof. José A. Cobos and the participants were: Eduardo Fernández (SIEMENS), Carlos Redondo (Ministry of Industry), Felipe Jerez (PREMO), Enrique Meroño (IBERDROLA), Enrique Dede (GH Electrotermia), Nuria Fernández (Núcleo) and Gonzalo Alonso (GoingGreen). This company also brought an electric car that could be tested by the attendees
- Visit to the facilities of CEI and poster session, where the young researchers of the Center presented and explained their research to all the attendees in an "informal" atmosphere.
- Technical Sessions, dealing with Aerospace (with the participation of CRISA, Airbus and CEI), Sensor networks and reconfigurability (with the participation of INKOA, MTP and CEI), and Modeling, control and high frequency techniques.

The number of attendees this year was about 100 people among whom were professors, researchers and representatives of companies and other universities as well as the current CEI-UPM members. This year 17 different companies were present in the Annual Meeting.

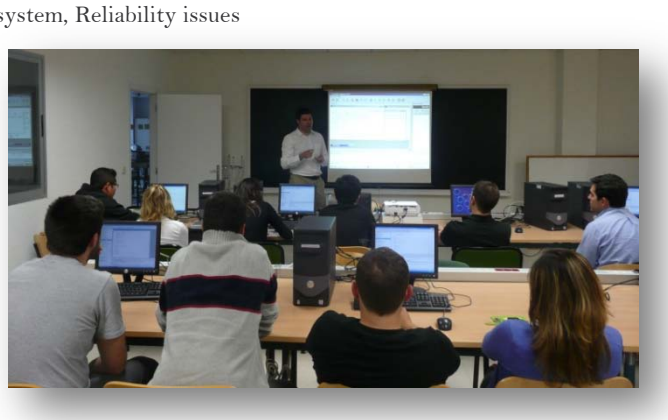
If you want more details of the Annual Meeting, please visit http://www.cei.upm.es/Seminario_CEI/cei_Seminario_2010.html and don't miss the video clip at http://www.cei.upm.es/Seminario_CEI/2010/Presentaciones/Seminario.avi

Master/PhD of Industrial Electronics: Advanced Seminars

The Master/PhD of Industrial Electronics has organised three seminars on different topics, as part of the academic program. These seminars took place during May 2010. Three seminars were programmed, in different topics related with the topics of the Master/PhD:

1st Seminar: "Introduction to Space Electronics. The power subsystem" by Prof. Arturo Fernández (European Space Agency, Universidad de Oviedo)

The course gave a general overview of the space missions, reviewing the main constraints and challenges and paying special attention to the power system. The course includes the use of a simulation tool. Including the following items: Types of missions, . Space environment, A typical spacecraft system, The power system, Reliability issues



2nd Seminar: "**Practical Implementation of Advanced Controllers for High Frequency Switch Mode Power Supplies**", by Prof. Aleksandar Prodic (University of Toronto).

The course dealt with design and on-chip or DSP-based implementation of controllers for high-frequency (HF) switch-mode power (SMPS) supplier. Various control methods were analyzed and challenges related to the practical implementation both in analog and digital domain were addressed too. Course also gave a review of hardware efficient control architectures and basic principles of their operation. Also, several novel features, such as auto-tuning, on-line efficiency optimization, parameter estimation, are enabled with the emergence of digital controllers, were presented.

3rd Seminar: "**RFID Systems and Applications**", by Dr. Andrés García-Alonso (Donewtech Solutions SL / CEIT).

The course was conceived as an introduction to RFID systems and applications. First, an overview of the history of this technology was presented. Next, the basic concepts were covered: readers, tags, RFID sensors, standards, and frequency bands. Successful applications were studied. Finally, intellectual property, legal aspects and business opportunities were analyzed. R&D challenges were also illustrated with a specific project presented as an example.

News Briefs

- The **renewed spaces** of CEI-UPM have started to be used in January 2010. These new spaces are located in the same place as they were, but we are enjoying a more "modern" style with labs that are better adapted to the new ways of teaching.

- Our new **web page** was launched in April 2010. We will be glad to receive your visit at www.cei.upm.es . Contents will start to be completed in the following months.
- During fifteen days in April, CEI-UPM was visited by a delegation of the Chinese company **Cheerful Technologies**, who attended an intensive course on Power Electronics, taught by CEI-UPM professors. CEI-UPM is developing a project in cooperation with this company.
- **Dr. Marta Portela** from Universidad Carlos III de Madrid, participated in a PhD course on Advanced Design Methodologies, with a lecture on "Methodologies for hardening digital circuits" (in January 2010).
- **Dr. Luis Fernández-Beites** has been designated as the UPM representative in the FUTURED technology platform.
- CEI-UPM organized the **Program Committee meeting of DCIS'2010** in June. The conference will take place in Lanzarote in November and is being hosted by IUMA-ULPGC (see www.dcis.org) (see www.suenosdesilicio.es)
- CEI-UPM has participated in the exhibition ***Sueños de Silicio***, held in the building of Tabakalera in San Sebastian (from February 9th, to March 21st). CEI-UPM has provided support for the installation of the work Protrude Flow of the Japanese artist Sachiko Kodama (see www.suenosdesilicio.es)

Watching *comings and goings*

- **Congratulations** to our colleague**, Dr. Pedro Alou,** who became Associate Professor in February.
- **Incoming visiting researchers** have joined us during this period:
  - **Danping He,** Erasmus Mundus MSc candidate from Politecnico de Torino, doing her Master Thesis within SMART project
  - **Teresa Cervero**, PhD candidate from Universidad de la Palmas de Gran Canaria, doing her PhD Thesis within DR.SIMON project.
  - **Qiang Chen**, PhD candidate from Beijing Institute of Technology, doing a six-month stay under the supervision of Dr. Jesús A. Oliver
- **Outgoing visiting researchers during this period:**
  - Dr. **Félix Moreno**, doing a research stay at New Mexico State University (USA), under the supervision of Prof. Ramírez-Angulo. From February to July 2010.
  - Master students **Mariana Molina** and **Juan Valverde**, doing a two-month research stay at ITRI (Industrial Technology Research Institute) in Taiwan, under the supervision of Dr. Jin-Shyan Li.
- **Farewell…** to **Dr. Yana E. Krasteva**, who left us January 1st. She is currently in a post-doc position in the Parallel Architectures Group at Universidad Politécnica de Valencia.
- **Welcome…** to the new CEI-UPM members who have joined us during this period: **Dejana Cucak** (from Serbia) as full-time researcher and PhD student, and **Pablo Varela** (from Spain), as full-time researcher and Master student.

The Future of Reconfigurable Hardware

by E. de la Torre

Traditional metrics to show how good or bad are electronic technologies are performance, energy consumption, resource occupation, or similar. However, flexibility and adaptability are getting close to the same importance levels.

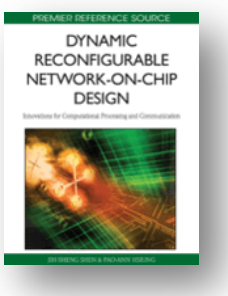
In order to show this fact, using today's well-known technologies, it is clear that a custom integrated circuit will probably perform much faster, consume less energy and require smaller silicon area than a microcontroller which solves the same problem by running an application software. Then, why is the software solution adopted in so many cases? Taking apart the cost reasons, which may decide one target technology or another, the other reason is flexibility.

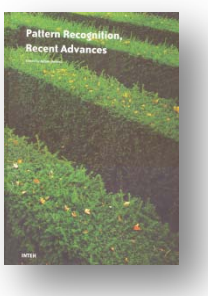
However, there are quite a large amount of application domains where performance requirements are pushing the limits and putting the microprocessor against the wall, while maintaining the flexibility requirement of software applications. Solutions go on two directions: multi-processing systems, which get flexibility from the software, or reconfigurable systems, which may take advantage of flexibility at hardware level. Not only that, if we think that the reconfigurable fabric can hold a variable number of custom processors, the so called MPSoC (Multi-Processor System on Chip), we have full flexibility of HW and SW.

Reconfigurabilty may contribute with added benefits in many application areas, but there are two important fields which may specially benefit from that unsurpassed flexibility: High performance computing Systems, and flexible embedded systems. In the area of High Performance Computing, many facilities which relied on clusters of hundreds or even thousands of microprocessors are moving to clusters of FPGAs, which may solve the problems faster and with smaller power consumption (could you figure out Google's electricity bill due to their server farms?). On the other area, the tendency for increased complexity in some embedded applications are forcing the inclusion of reconfigurable resources in order to be able to cover the increasing computing needs under the real time restrictions. So, within this context, there are many reasons why these needs may change: new requirements appear through the product life, new standards (i.e.: communications emerge and are adopted rapidly), system's features may be improved, corrected or updated during product's life, user may decide to change operation conditions, systems may evolve and adapt to changing environments, ...

There is still a lot of work to do in order to have some reconfigurable device inside everyone's personal computer or personal electronic gadget, but it is just a matter of waiting for the reconfigurable technologies to evolve a bit more, and the methods to come up with real reconfigurable applications to become more mature, to have this new generation of HW-flexible systems around as in an almost ubiquitous manner, like today's microcontrollers. CEI-UPM is actively contributing to this field, proposing new methods, architectures and implementing applications that make this technology a reality

Book Chapters





- F. Moreno, I. López, R. Sanz, *Embedded Intelligence on Chip: Some FPGA-based design experiences*, IN-TECH February 2010. ISBN:978-953-7619-90-9
- Y.E. Krasteva, E. de la Torre, T. Riesgo, *Dynamic Reconfigurable NoC (DRNoC) Architecture: Application to Fast NoC Emulation*, in the book: "Dynamic Reconfigurable Network-on-Chip Design". Edited by Innovations for Computational Processing and Communication, Information Science Reference. April 2010, ISBN: 978-1615208074

Journals

- R. Prieto, J.A. Oliver, J.A. Cobos, M. Christini, "Magnetic Component Model for Planar Structures Based on Transmission Lines", IEEE Transactions on Industrial Electronics, May
- M. Vasic, O. Garcia, J:A: Oliver, P. Alou, D. Diaz, J.A. Cobos., "Multilevel Power Supply for High-Efficiency RF Amplifiers", IEEE Transactions on Power Electronics, April.

Conferences

COMPEL University of Colorado, Boulder (USA) June

- M. del Viejo; P. Alou; J. A. Oliver; O. García; J. A. Cobos, *Fast control technique for high frequency DC/DC integrated converter based on non-invasive output capacitance current estimation*
- L. Laguna, R. Prieto, J. A. Oliver, J. A. Cobos, H. Visairo, *Platform for fast evaluation and optimization of power systems*

APEC Palm Springs (California, USA), February

- M.C. Gonzalez, P. Alou, O. Garcia, J.A. Oliver, J.A. Cobos, H. Visairo, *DC-DC transformer multiphase converter with transformer coupling for two-stage architecture*
- M.C. Gonzalez, M. Vasic, P. Alou, O. Garcia, J.A. Oliver, J.A. Cobos, H. Visairo, *Power analog to digital converter for voltage scaling applications*
- M. Vasic, O. Garcia, J.A. Oliver, P. Alou, D. Diaz, J.A. Cobos, A. Gimeno, J.M. Pardo, C. Benavente, F.J. Ortega, *High efficiency power amplifier for high frequency radio transmitters*
- M. Vasic, O. Garcia, J.A. Oliver, P. Alou, D. Diaz, J.A. Cobos, *Switching capacities based envelope amplifier for high efficiency RF amplifiers*

Other

- R. Salvador, F. Moreno, T. Riesgo, L. Sekanina, *Evolutionary design and optimization of Wavelet Transforms for image compression in embedded systems*, NASA/ESA Conference on Adaptive Hardware and Systems (AHS), Anaheim (California, USA) June
- E. de la Torre, A. Isturiz, J. Viñals, S. Fernández, R. Basagoiti, J. Novo, *Development of an aeronautical electromechanical actuator with real time health monitoring capability*, Recent Advances in Aerospace Actuation Systems and Component (R3ASC), Toulousse (France), May
- J.A. Otero Marnotes, Y.E.Krasteva, E. de la Torre Arnanz, T Riesgo, *Generic Systolic Array for Run-time Scalable Cores*, International Symposium on Applied Reconfigurable Computing (ARC2010), March, Mahanakorn University of Technology, Bangkok, (Thailand), March
- M. del Viejo, P. Alou, J. A. Oliver, O. García, J. A. Cobos, *Fast control technique for high frequency (5MHz) DC/DC integrated CONVERTER*, CIPS International Conference on Integrated Power Electronic Systems, Nuremberg (Germany), March

PhD Thesis

Author: Jorge Portilla

Title: Modular platform and generic transducer interfaces for Wireless Sensor Networks (Plataforma modular e interfaces genéricas para transductores en redes de sensores inalámbricas)

Thesis Supervisors: Teresa Riesgo & Ángel de Castro

Evaluation Committee: Dr. Javier Uceda (UPM), Dr. Roberto Sarmiento (ULPGC), Dr. Javier Garrido (UAM), Dr. Andrés García-Alonso (Donewtech), Dr. Yago Torroja (UPM)

Dissertation date: 21/05/2010 **Grade**: Apto cum laude

Abstract: Wireless sensor networks (WSNs) represent a new paradigm in the way to take measures from the environment. A WSN is a set of nodes deployed in a specific area to measure physical parameters and actuate if necessary.

In this PhD work, a new HW platform for the nodes is presented. Its main feature is modularity, which gives huge flexibility, allowing redesigning in a faster way than usual. Different layers can be interchanged in order to fulfill new application requirements. Therefore time to market can be remarkable reduced.

In the other side, not only flexibility in the node is required, but in the way to communicate to sensors and actuators. In this context, a library of analog and digital interface transducers has been developed, and intensive research has been carried out to provide universal communication between the nodes and the transducers.

Research Projects

New projects

•Tecnologías eficientes e inteligentes orientadas a la salud y al confort en ambientes interiores (TECNO-CAI), funded by MTP (CENIT). Ref.: CEN-20091010 (From 01/09/2009 to 30/11/2013)

Participants: Acciona Instalaciones, Advance Composite Fibers, Ancodarq, Aznar Textil, Domenech Hnos. Fakolith, Foresis, Guadaltel, Iberinsa, IDOM, IVI Siglo XXI, Keraben, DR. Echevarne, MTP, ODEL-LUX, RAMEN, Sistemas y Procesos Avanzados, Tradema.

Tecnocai is a very large Project, with strong participation from industry, that is oriented to the development of technologies for indoor comfort. In particular, its main aim is ""to develop knowledge and technology to provide a healthy indoor environment and ensure the comfort of its habitants". This will be achieved by combining multidisciplinary technology and knowledge, ranging from medical science to the development of novel materials, electronic solutions and profiling of social uses of buildings.

The role of CEI-UPM in the project is to develop new hardware motes for wireless sensor networks adapted to the application foreseen and that could integrate heterogeneous networks to increase the flexibility of the solution. The work of CEI-UPM is partially supported by MTP.

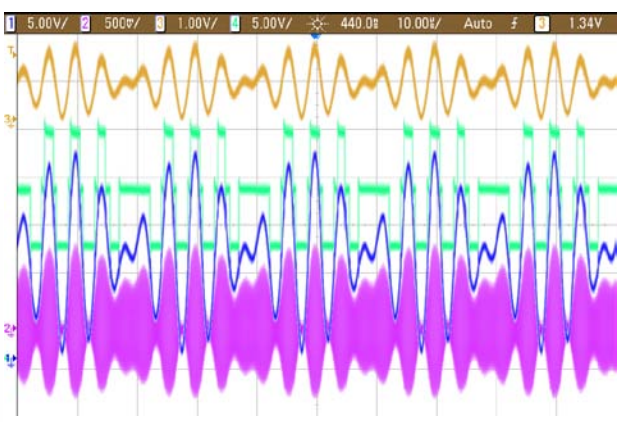
•Amplificadores de envolvente de banda ancha para etapas EER/ET y fabricación de dispositivos de nitruro de galio (GAN) (AEGan), funded by Ministerio de Ciencia e Innovación. Ref.: TEC2009-14307-C02-01 (From 01/01/2010 to 31/12/2012)

This is a 3-year project in collaboration with other 2 groups of our university (GIRA specialized in radio techniques and ISOM specialized in GaN semiconductors).

The aim of this project is improving the efficiency of Radio Frequency (RF) and microwave (MW) linear high efficiency power amplifiers for communication applications in the UHF and microwave bands.

The mentioned efficiency and linearity improvements will be obtained using and improving advanced linearization techniques based on Envelope Elimination Restoration (EER) and Envelope Tracking (ET), and using new semiconductor technology based on gallium nitride (GaN). The main objective is to achieve 10-20MHz Bandwidth with 50-100W output power amplifier to be use in base stations.

Some important communication services, for high speed data transmission using non constant envelope signals, for instance digital audio and video broadcasting (DAB and DVB), earth and satellite mobile communications (UMTS, GAN, BGAN) digital radio networks (WLAN, WiMAX, 3G, IEE802.xx) and radio communications for defense applications.



Running projects

•Advanced Wide band gap semiconductor devices for rational use of energy (RUE), funded by Ministerio de Ciencia e Innovación. (CONSOLIDER) Ref.: CSD2009-00046 (From 01/11/2009 to 31/10/2014)

•Soporte al desarrollo de componentes inductivos y sistemas electrónicos de potencia, funded by PREMO (From 01/11/2009 to 31/12/2011)

•Reconfigurabilidad dinámica para escalabilidad en redes orientadas a aplicaciones multimedia (DR.SIMON), funded by Ministerio de Ciencia e Innovación. Ref.: TEC2008-06486-C02-01 (From 01/01/2009 to 31/12/2011)

•Magnesium new technological opportunities (MAGNO), funded by FAGOR (CENIT) (From 01/11/2008 to 31/10/2011)

•Sistemas de gestión y regulación de energía eléctrica (ÍCARO), funded by INDRA (CENIT) (From 01/10/2008 to 30/09/2011)

•Power Delivery, distribution and Design Modeling Research (PD3T_2), funded by INTEL Corp. (From 01/09/2009 to 31/08/2011)

•Secure, Mobile visual sensor networks ArchiTecture (SMART), funded by Artemis. Ref.: ART-010000-2009-0006 (From 01/05/2009 to 28/02/2011)

•Tecnologías para la movilidad urbana sostenible y accesible (TECMUSA), funded by Ministerio Ciencia e Innovación (From 01/10/2009 to 31/12/2010)

•28V/500W and 5V/200W DC/DC converter (NEBULA), funded by Cheerful Technologies limited (China) (From 01/07/2009 to 31/12/2010)

•Desarrollo e Innovación en pilas de combustible de membrana polimérica y óxido solido (DEIMOS), funded by EADS-CASA (From 01/01/2007 to 31/12/2010)

•Plataforma tecnológica inteligente para la producción sostenible en industrias agroalimentarias (SUSTENTIC), funded by Ministerio de Industria, Turismo y Comercio (Programa Avanza I+D). Ref.: TSI-020100-2008-172 (From 01/09/2008 to 31/08/2010)

•Redes de sensores para prevención de catástrofes y gestión de crisis en túneles (TUNEL-CARE), funded by Ministerio de Industria, Turismo y Comercio (Programa Avanza I+D). Ref.: Variable según el año (From 01/09/2008 to 31/08/2010)

• Seguridad en Vías Ferroviarias (SAFETYRAIL), funded by Ministerio de Industria, Turismo y Comercio (Programa Avanza I+D). Ref.: TSI-02400-2009-24 (From 01/07/2009 to 30/06/2010)

•Low Cost Digital Control for Advanced Power Supplies, funded by ABB Switzerland Ltd (From 01/06/2009 to 31/05/2010)

•Diseñar y validar experimentalmente sistema de alimentación (ATLANTE), funded by INDRA-CDTI (From 01/05/2009 to 31/05/2010)

•Magnetic structure to enable new DC/DC conversion strategies and topologies, funded by INTEL Corp. (From 01/05/2008 to 30/04/2010)

•Developing IC power module component for Simplorer, funded by ANSOFT (From 01/10/2009 to 31/03/2010)

•Asesoria Técnica para la Instalación y Mantenimiento de la Obra Artistica "Protude-Flow 2008", funded by La Agencia Nature Ars (From 01/11/2009 to 28/02/2010)

•Detección preventiva de fallos en equipos electromecánicos de vuelo (HEALTH MONITORING), funded by INTERLAB (From 01/03/2009 to 28/02/2010)

•Developing the extraction algorithm for Jiles-Atherton hysteresis model and correct a convergence problem of its Simplorer implementation (Corel Model), funded by ANSOFT (From 01/10/2009 to 31/01/2010)