EDITORIAL

Dear reader,

In front of you is the special issue of the journal AUTOMATIKA no. 2/2012, which contains eight invited papers related to DC-DC conversion and active rectifying. Although Power Electronics is at a crossroad after 40 years of continuous growth, its role must be still relevant in the coming years as transversal technology in energy processing systems. In a world dominated by important challenges like global warming, urban pollution and the risks of nuclear energy, power electronics appears as a key element in renewable energy systems with the aim of optimizing the electric energy employed in all stages of generation, transportation and conversion. Renewable energy sources like wind, solar, and small hydro-plants are flexible sources needing power electronics converters in order to process or manage electric energy. This Special Issue will be mainly devoted to survey papers by top researchers on the trends in some hot topics that could eventually help readers in their own investigation.

*The first two papers in this special issue cover the area of semiconductor elements. The first one **Wide Band Gap Semiconductor Devices for Power Electronics** is proposed by J. Millán, P. Godignon and A. Pérez-Tomás and deals with the progress in the development of high-voltage Wide Band Gap (WBG) power semiconductor devices based especially on SiC and GaN. The performances of various rectifiers and switches are discussed. Material and process technologies of these WBG semiconductor devices are also described as well as future trends and industrialization in device development. The second paper **A Review of Si MOS-Gated Power Switches and PiN Rectifiers**, written by J. Rebollo, I. Cortés, X. Perpiñà, and J. Millán, gives an overview of the recent progress in the development of Si MOS-gated power devices and rectifiers. The evolution of these devices' technologies together with the introduction of revolutionary device concepts is also discussed. Developments in IGBTs such as those based on the use of thin wafers and strategies for optimizing the plasma distribution in PT IGBTs during the on-state are also addressed. Finally, advances in PiN diode technologies including new concepts for both the anode and the cathode structures are also reviewed.*

*The next group of two papers is dedicated to photo-voltaic systems especially to maximum power point tracking, which is a crucial point in such systems. The first one **Distributed Maximum Power Point Tracking: Challenges and Commercial Solutions** is proposed by G. Petrone, G. Spagnuolo, M.Vitelli wherein the authors discussed the state of the art of distributed maximum power point techniques for photovoltaic systems. The latest architectures proposed in literature are reviewed and their points of strength and weakness are discussed. Finally, the products that are currently available on the market are presented and their fields of application and features are overviewed. The second one **Distributed Maximum Power Point Tracking in Photovoltaic Systems – Emerging Architectures and Control Methods**, presented by D. Shmilovitz and Y. Levron, deals with different distributed maximum power point architectures, which are categorized into two main groups; those that process the entire generated power and those that deal with partial power processing- based architectures. The first ones are found to be easier to control while the second ones exhibit higher efficiency. Some delicate control issues are emphasized; a distinction is made between maximum power point tracking and negative feedback control. For systems consisting of multiple power processors, it is derived the required number of maximum point tracking units and their adequate location within a global architecture.*

The fifth paper **An Overview of the AC–DC and DC–DC Converters for LED Lighting Applications***, proposed by M. Arias, A. Vázquez and J. Sebastián, explains the main HB-LED characteristics by highlighting the influence of the design of their power supplies. Subsequently, the main topologies are presented from the simplest to the most complex ones, and their advantages and disadvantages are discussed.*

The next paper **Improved EMC of Switched–Mode Power Converters with Randomized Modulation***, written by F. Mihalič, gives a survey with analytical and experimental results concerning different randomized modulation strategies in switched-mode power converters (SMPCs). After a short review of practical experiences within the literature, the paper presents the benefits of several randomized schemes for power converters (i.e. reduced electromagnetic interference - EMI, and lower acoustic noise). There is also an introduction to the mathematical background for dealing with randomized modulation within the medium-frequency range: power spectrum density (PSD) approach.*

The seventh paper **A Review of the Main Power Electronics' Advances in Order to Ensure Efficient Operation and Durability of PEMFCs***, presented by C. Restrepo, T. Konjedic, J. Calvente and R. Giral, discusses the fuel cell systems. As a fuel cell is a very complex system, a lot of knowledge of different areas is required, such as chemistry, electricity and mechanics, in order to completely understand its foundations and all the problems that can occur during its operation. It is for this reason that an interdisciplinary approach needs to be taken into account when designing fuel-cell energy systems.*

The last paper **Active Suppression of Low-Frequency Interference Currents by Implementation of the High-Performance Control System for the Grid-Interfaced Converters***, proposed by N. Težak, I. Bahun and I. Petrović, describes an operation of traction drive and auxiliary power supply converters installed aboard modern vehicles that causes increased content of line harmonics and inter-harmonic components in the line current. In order to remove them, an active suppression method based on proper design of the grid interface of the power converter and its corresponding control system is proposed. The authors conclude their work with tests performed under the laboratory conditions and also in the same vehicle.*

Guest Editors
Prof. Luis Martínez-Salamero, Ph.D.
Rovira i Virgili University
School of Electrical and Computer Engineering
Department of Electrical Electronic and Automatic Control Engineering
Prof. Miro Milanovič, Ph.D.
University of Maribor
Faculty of Electrical Engineering and Computer Science
Institute for Robotics