Poštovana čitateljice / Poštovani čitatelju,

pred vama je posebni broj 2/2012 časopisa AUTOMATIKA koji sadrži osam pozvanih radova vezanih za DC-DC pretvorbu te aktivno ispravljanje. Iako se učinska elektronika nalazi na raskrižju nakon 40 godina neprekinutog rasta, njezina će uloga još uvijek biti važna u nadolazećim godinama kao tehnologije prijenosa energije. Izazovi, kao što su globalno zagrijavanje, urbana zagađenja, te rizici upotrebe nuklearne energije, prouzročili su razvoj uređaja. Uređaji učinske elektronike omogućavaju optimalno korištenje električne energije od proizvodnje, prijenosa, pa sve do pretvorbe. Obnovljivi izvori energije, poput vjetra, sunca i malih hidroelektrana, fleksibilni su izvori koji zahtijevaju pretvaralače učinske elektronike kako bi obrađivali i upravljali električnom energijom. Ovaj je posebni broj prvenstveno posvećen preglednim člancima vrhunskih istraživača, koji pišu o smjeru razvijanja današnjih izazova, što bi u konačnici moglo pomoći čitaljima u vlastitom istraživačkom radu.

Prva dva rada ovoga posebnog broja pokrivaju područje poluvodičkih elemenata. Prvi članak Wide Band Gap poluvodički sklopci za učinsku elektroniku autora J. Millána, P. Godignona i A. Péreza-Tomása, obrađuje napredak u razvoju visokonaponskih Wide Band Gap (WBG) poluvodičkih učinskih sklopa utemeljenih na SiC i GaN tehnologiji te raspravlja učinak različitih ispravljača i preklopnika. Autori također opisuju materijale i tehnologije obrade WBG poluvodičkih sklopa, kao i budući razvoj te industrijalizaciju u njihovom razvoju. Drugi članak, Prikaz stanja silicijevih MOS upravljenih učinskih sklopa i PiN ispravljača autora J. Rebolloa, I. Cortésa, X. Perpiñà, i J. Millána, daje pregled trenutnog napretka silicijskih MOS upravljenih učinskih sklopa i ispravljača te razvoja tehnologija tih sklopa zajedno s novim revolucionarnim konceptima. Također, raspravlja se o razvoju IGBT-a metodama poput uporabe tankih pločica i optimizacije raspodjele plazme kod PT IGBT-a tijekom uključenog stanja. Na kraju, dan je pregled napretka u tehnologijama PiN dioda uključujući i nove koncepte u strukturama anoda i katoda.

Sljedeća dva članka posvećena su fotonaonskim sustavima te posebno ključnom problemu praćenja točke maksimalne snage. Autori G. Petrone, G. Spagnuolo, M. Vitelli u svom članku Distribuirano slijeđenje točke maksimalne snage: izazovi i komercijalna rješenja razmatraju trenutno stanje metoda za distribuirano slijeđenje točke maksimalne snage fotonaonskih sustava. Dan je pregled prednosti i nedostataka postojećih arhitektura te pregled trenutno postojećih proizvoda na tržištu i njihove primjene. Drugi članak Distribuirano praćenje točke maksimalne snage u fotonaonskim sustavima – nove arhitekture i metode upravljanja autora D. Shmilovitza i Y. Levrona razmatra probleme različitih arhitekture za distribuirano praćenje točke maksimalne snage te ih dijeli u dvije glavne grupe; grupu koja obrađuju cjelokupnu proizvedenu snagu i grupu koja radi na načelu djelomične obrade snage. Dok prva grupa arhitektura osigurava najbolje upravljanje, druga ima veću učinkovitost. Naglasak je na određenim osjetljivim problemima; arhitektura razlikuju slijeđenje točke maksimalne snage i upravljanje po negativnoj povratnoj vezi. Za sustave s više sklopa koji obrađuju snage izveden je potreban broj jedinica maksimalne snage te njihov razmještaj u globalnoj arhitekturi.

U petom članku Pregled AC–DC i DC–DC pretvarača za primjene u LED rasvjeti autori M. Arias, A. Vázquez i J. Sebastián analiziraju glavne karakteristike HB-LED rasvjete naglašavajući
utjecaj projektiranja izvora napajanja te predstavljaju glavne topologije od najjednostavnijih do najšloženijih zajedno s njihovim prednostima i nedostacima.

Sljedeći članak **Povećana elektromagnetska kompatibilnost (EMC) sklopnog energetskog pretvarača sa slučajnom modulacijom** autora F. Mihalića analitički i eksperimentalno analizira različite metode slučajne modulacije za sklopane energetske pretvarače. Nakon kratkog pregleda iskustva iz literature, članak predstavlja prednosti nekoliko metoda utemeljenih na slučajnoj modulaciji (tj. smanjenje elektromagnetskih smetnji i akustičke buke). Autor također predstavlja matematičku pozadinu za rad sa slučajnom modulacijom u rasponu srednjih frekvencija: metodu spektralne gustoće snage.

Sedmi članak **Pregled znanstvenih napredaka u učinskoj elektronici usmjerenih ka osiguravanju efikasnog rada i dužeg životnog vijeka PEM gorivnih čelija** autora C. Restrepoa, T. Konjedica, J. Calventea i R. Girala razmatra sustave gorivnih čelija. Pošto su gorivne čelije vrlo kompleksni sustavi, potrebno je poznavanje različitih područja znanosti poput kemije, elektrotehničke i mehanike kako bi se shvatio način rada te svi problemi koji se mogu pojaviti. Upravo iz toga razloga nužan je interdisciplinarni pristup pri razvijanju gorivnih čelija.

Posljednji članak **Aktivno potiskivanje nisko-frekvencijskih struja smetnji u pojnoj mreži djelovanjem na upravljačko-regulacijsku strukturu mrežnog sučelja pretvarača** autora N. Težaka, I. Bahuna i I. Petrovića opisuje način rada glavnog i pomoćnog pogona željezničkih vozila koji uzrokuje pojavu povećanog sadržaja neželjenih viših harmonika i međuharmonika u strujama pojnoj mreži. U radu su predložene aktivne metode potiskivanja zasnovane na odgovarajućim dizajnu mrežnog sučelja pretvarača. Autori zaključuju svoj rad rezultatima dobivenim u laboratorijskim uvjetima kao i na vozilu.

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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.

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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.

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