

Editorial for the Inaugural Special Issue on the Developing Trends of Power Electronics: Part 4

WITH this editorial, we sincerely welcome our readers to the brand-new publication — CPSS Transactions on Power Electronics and Applications (CPSS TPEA). It is sponsored and published by China Power Supply Society (CPSS) and technically co-sponsored by IEEE Power Electronics Society (IEEE PELS).

CPSS was founded in 1983 and has been the only top-level national academic society in China that solely focuses on the power supply/power electronics area. In the past 30-plus years CPSS has dedicated to provide to its members, researchers, and industry engineers nationwide with high quality services including conferences, technical training, and various publications, and this in deed has helped the society build up its membership rapidly, which now totals up to more than 4000 individual members plus 500 enterprise members. The fast growth of membership in turn compels CPSS to always work out better services for its members, one of which being the open-up of this periodical — a new journal in English language as a publication platform for international academic exchanging. This of course needs to be done through international cooperation, and that's why IEEE PELS is tightly involved, being the premier international academic organization in power electronics area and one of the fastest growing technical societies of the Institute of Electrical and Electronics Engineers (IEEE).

To fulfill the publishing need of the fast-developing power electronics technology worldwide is a more important purpose of launching this new journal. So far there are only 3 or 4 existing journals which are concentrated on power electronics field and have global reputation. For quite a few years people in the international power electronics community have had the feeling that, the existing journals have not even come close to meeting the huge demand of global academic and technology exchanges. E.g., the two existing IEEE power electronics journals, i.e. IEEE Transactions on Power Electronics (IEEE TPEL) and IEEE Journal of Emerging and Selected Topics in Power Electronics (IEEE JESTPE), now publish about 1000 papers a year, which is under a very low paper acceptance rate of around 25%, but still have a back-log of about one year for the newly accepted papers to finally appear in printed form to the public. The addition of this new dedicated journal would be an ideal improvement to fulfill such a tremendous need.

The booming of publishing need really is an indicator of how fast power electronics has been developing in recent years. Innovations have been continuously coming up from component (both active device and passive device), module, circuit, converter, to system level, covering different tech-

nical aspects as topology or structure conceiving, modeling and analysis, control and design, and measurement and testing. New issues and corresponding solutions have been continuously presenting as the applications of power electronics prevail horizontally in almost every area and corner of human society, from industry, residence and commerce, to transportations, and penetrate vertically through every stage of electric energy flow from generation, transmission and distribution, to utilization, in either a public power grid or a stand-alone power system. I personally believe that we are entering a world with “more electronic” power systems. The prediction around 30 years ago, that power electronics one day will become one of the major poles supporting the human society, is coming into reality. And I also believe, that power electronics is going to last for long time as an important topic since it is one of the keys to answer a basic question for human society, which is how human can harness energy more effectively and in a manner friendlier to both the user and the environment.

Therefore, I assume that there is probably no better fitting as for CPSS TPEA to publish its first few issues under a special topic about the developing trends of power electronics. We have invited a group of leading experts in different areas of power electronics to write survey/review papers or special papers with review/overview nature to some extent. To publish in a timely and regular style, we organize this inaugural Special Issue into different parts. Part 1, 2 and 3 were published in the December issue last year, the March issue and the June issue this year respectively, Part 4 appears in this September issue, and the last part is scheduled for the December issue.

In Part 4 we are honored to have 6 invited papers. The first three all address topics tightly related to wide-bandgap devices, from design and packaging to applications. The next two follow up with the state-of-the-arts in the motor drives area, and the last one deals with modulation techniques for multi-level inverters.

We begin with a paper on the silicon carbide power electronics design. It is authored by Dr. Alan Mantooth and his research group from the University of Arkansas. It describes recent advances of the research on the SiC-device-based power electronics, covering different aspects like integrated circuit design, semiconductor device modeling, 3D electronic packaging, and computer-aided design. These emerging trends really are leading to additional improvements in power density and more feasible operation at extreme temperatures.

The second paper provides a review on the SiC power

module packaging. It is written by Dr. Yong Kang and his research group from Huazhong University of Science and Technology. It presents a broad overview of the advanced module packaging techniques for SiC devices from module layout, packaging material system, up to module integration trend. The main challenges and potential solutions for the packaging of SiC modules are discussed.

The third paper is about the application of GaN devices to the totem-pole bridgeless AC-DC converter beating the traditional Si-based boost PFC. It is written by Dr. Alex Q. Huang and his research group, who recently moved to the University of Texas at Austin. It reviews the key technologies and designs for both hard-switching and soft-switching GaN totem-pole PFC indicating that the high frequency soft-switching solution is more preferable to achieve both high efficiency and high power density.

The fourth paper is written by Dr. Thomas M. Jahns and his research group from the University of Wisconsin-Madison, regarding the physical integration of power electronics and electric machines. The paper examines the future of integrated motor drive (IMD) technology by first reviewing the history of IMD products from the 1960s to today. A long-term vision for IMDs is then presented in detail, showing that wide-bandgap power semiconductor devices and a variety of other promising technologies are critical to realizing the full potential of IMDs.

The fifth paper is written by Dr. Ralph Kennel and his research group from the Technical University of Munich, discussing advanced control strategies for direct-drive PMSG wind turbine systems. It reviews and evaluates four control solutions in terms of their theoretical backgrounds, implementation approaches and control performances. The realizations and experimental assessments are also carried out with comprehensive evaluation results included in the end.

Last but not least, the sixth paper is written by Dr. Yongdong Li and his research group from the Tsinghua University in Beijing. The paper summarizes and compares five differ-

ent space-vector Pulse Width Modulation (SVPWM) techniques for multilevel inverters. It turns out that the technique which the authors call SVPWM based on imaginary coordinate is the simplest in implementation and provides a better control on zero-sequence component than the other four.

I'd like to thank the authors of all these 6 invited papers. It's their high-quality contributions that finally leads to the launching of this new journal. I'd like to thank Dehong Xu, President of CPSS, who in 2015 initiated the idea of publishing the new journal and since then has been persistently supporting my work as the founding Editor-in-Chief. I'd also like to thank Jiaxin Han, Secretary General of CPSS, Jan A. Ferreira, President of IEEE PELS, 2015-2016, Don F. D. Tan, President of IEEE PELS, 2013-2014, and Frede Blaabjerg, IEEE PELS Vice President for Products, 2015-2018, who form the CPSS and IEEE PELS Joint Advisory Committee for our new journal with Dehong Xu and myself. Other IEEE officers and leading staffs like Dushan Borovjevic, PELS President, 2011-2012, Alan Mantooth, PELS President, 2017-2018, Mike Kelly, PELS Executive Director, and Frank Zhao, Director of China Operations, IEEE Beijing Office, just to name a few, also provided continuous support and constructive advices. My earnest thanks also go to the CPSS Editorial Office led by Lei Zhang, Deputy Secretary General of CPSS, for their wonderful editing work. It would not have been possible to create a new journal in such a short time without their efforts. I'd like to finally thank all the members of the Executive Council of CPSS and particularly the leaders of Chinese power electronics industry. They always firmly stand behind CPSS TPEA and ready to help whenever needed.

JINJUN LIU, *Editor-in-Chief*,
Xi'an Jiaotong University,
28 West Xianning Road,
Xi'an, Shaanxi 710049 CHINA
E-mail: jjliu@mail.xjtu.edu.cn



Jinjun LIU received his B.S. and Ph.D. degrees in Electrical Engineering from Xi'an Jiaotong University (XJTU), China in 1992 and 1997 respectively. He currently holds the position of XJTU Distinguished Professor of Power Electronics, sponsored by Chang Jiang Scholars Program of Chinese Ministry of Education.

Dr. LIU coauthored 3 books (including a textbook), published over 200 technical papers in peer-reviewed journals and conference proceedings, and holds more than 30 invention patents (China/USA). He received for 7 times governmental awards at national level or provincial/ministerial level for scientific research achievements or academic/teaching career achievements. He also received the 2006 Delta Scholar Award, the 2014 Chang Jiang Scholar Award, the 2014 Outstanding Sci-Tech Worker of the Nation Award, and the IEEE Transactions on Power Electronics 2016 Prize Paper Award. His research interests are power quality control and utility applications of power electronics, micro-grids for sustainable energy and distributed generation, and more/all electronic power systems.

Dr. Liu has served as the IEEE Power Electronics Society (PELS) Region 10 Liaison and then China Liaison for 9 years, an Associate Editor for the IEEE Transactions on Power Electronics for 9 years, and starting from 2015 the Vice President for membership of IEEE PELS. He is on Board of China Electrotechnical Society (CES) and was elected to a Vice President of the CES Power Electronics Society in 2013. He is the Vice President for International Affairs, China Power Supply Society (CPSS) and the inaugural Editor-in-Chief of CPSS Transactions on Power Electronics and Applications.