Editorial for the Special Issue on Vehicle Electrification

ELECTRIC, hybrid and fuel cell vehicles have attracted significant attention in the past decades due to the exhaustion of fossil fuel consumption and their environmental concerns. Electric vehicles use electronic subsystems—in comparison to conventional vehicles, which include electric machines, power electronics, electronic continuously variable transmissions (CVT), onboard chargers, and embedded powertrain controllers. Advanced energy storage systems, such as Li-ion batteries, ultra-capacitors, and fuel cells, together with intelligent energy management algorithms, are introduced in the next generation powertrains. In addition to these electrification components or subsystems, conventional internal combustion engines (ICE), mechanical and hydraulic systems may still present. As a result, the complexity of new powertrain designs and dependence on embedded software is a cause of concern to automotive research and development efforts. This leads to an increasing difficulty in predicting interactions among various vehicle components and systems.Therefore, the design and implementation of the mechanical and electrical components need to be considered carefully. In order to understand the difficulty and prospected challenge of the vehicle electrification, this Special Issue is a review of the state-of-art contributions and new discoveries in the field of power electronics and applications for the electric vehicle.

The Special Issue on Vehicle Electrification collected 4 papers on diverse topics, ranging from the overview to the new contributions on the power electronics for vehicle electrification. The first paper entitled "Parameter Identification of Capacitive Power Transfer System Based on Spectrum Analysis" as written by Chen Chen and his colleagues at the Institute of Electrical Engineering, Chinese Academy of Science (China). The multi-parameter identification method based on spectral information which using the rational fractional fitting algorithm and network synthesis theory is proposed in this paper. Some known-parameters are added to this method, the noise tolerance of the identification result is highly improved, resulting in z better accuracy. The experiment of the double-sided LC matched CPT system model with the vector network analyzer to collect the spectrum information of the circuit shows good results in effectively identifying the unknown parameters in the system model and achieving high accuracy.

The second paper on the "Adaptive DC-Link Voltage Control of LLC Resonant Converter" was proposed by Li-Chung Shih, Yi-Hua Liu and Yi-Feng Luo from National Taiwan University of Science and Technology, Taiwan. In this control technique, the DC-link voltage increases to compensate the voltage drop caused by load variation, which facilities the LLC resonant operates near the resonant frequency. Therefore, the frequency variation range can be reduced, and the efficiency is improved under different load conditions. Moreover, it also decreases the circulating energy and makes the optimal design of LLC converter possible. An experimental prototype was built to verify the feasibility of the controller.

The third paper contributed by Tuopu Na and his colleagues from Harbin Institute of Technology (China) is the "Active Power Filter for Single-Phase Quasi-Z-Source Integrated On-Board Charger". The paper proposes an active power filter (APF) quasi-z-source single phase integrated on-board charger for EV application which can eliminate the second harmonic power on the DC-link. Compared with the conventional quasi-z-source network, this proposed topology only need a small capacitance and inductance, results in space and weight savings. This paper also discussed the design of the APF, and the experimental prototype was built to verify this design.

The last paper is the "Adaptive Charging Strategy with Temperature Rise Mitigation and Cycle Life Extension for Li-ion Batteries" from Shun-Chung Wang and his colleagues from Lunghwa University of Science and Technology, Taiwan. The digitally controlled Li-ion battery charger with an adaptive charging strategy has been employed in this paper. The devised charger can generate the desired charging profile depending on the battery SOC state and temperature variation. Accordingly, the proposed strategy remains the capacity charging with fuzzy temperature control approach that can avoid using the high C-rate current to charge the battery with high RSOC; thus, the phenomenon of the battery aging aggravation due to the extreme electrochemical stress can be subdued. The control strategy is implemented in the power stage of synchronous rectified buck converter for further conduction loss reduction. The GUI is also employed by a low-cost microcontroller and LabVIEW software. The experimental results show the significant improvement of the average temperature-rise, charging efficiency, estimated cycle life compared with the conventional CC-CV control strategy.

We would like to express our big appreciation to the industriousness and carefulness of the guest associate editors for this Special Issue in the selection of these high-quality papers from numerous submitted manuscripts in consideration for publication. We would like to appreciate the tremendous efforts of the expert reviewers who have provided invaluable, in-depth comments and suggestions to improve papers into the highest quality.We also would like to thank all the authors who have a great passion to achieve the best goal of their research for this Special Issue publication.

Chris Mi
Huang-Jen Chiu
Guest Editors-in-Chief

Chris Mi is a fellow of IEEE and SAE, Professor and Chair of the Department of Electrical and Computer Engineering, and the Director of the US DOE funded GATE Center for Electric Drive Transportation at San Diego State University, San Diego, California, USA. He was previously a professor at the University of Michigan, Dearborn from 2001 to 2015. He received the B.S. and M.S. degrees from Northwestern Polytechnical University, Xi'an, China, and the Ph.D. degree from the University of Toronto, Toronto, Canada, all in electrical engineering. Previously he was an Electrical Engineer with General Electric Canada Inc. He was the President and the Chief Technical Officer of 1Power Solutions, Inc. from 2008 to 2011. He is the Co-Founder of SNC Technology.

His research interests are in electric and hybrid vehicles. He has taught tutorials and seminars on the subject of HEVs/PHEVs for the Society of Automotive Engineers (SAE), the IEEE, workshops sponsored by the National Science Foundation (NSF), and the National Society of Professional Engineers. He has delivered courses to major automotive OEMs and suppliers, including GM, Ford, Chrysler, Honda, Hyundai, Tyco Electronics, A&D Technology, Johnson Controls, Quantum Technology, Delphi, and the European Ph.D. School. He has offered tutorials in many countries, including the U.S., China, Korea, Singapore, Italy, France, and Mexico. He has published more than 250 articles and delivered 100 invited talks and keynote speeches and as a panelist in major IEEE and SAE conferences.

Dr. Mi is the recipient of "Distinguished Teaching Award" and "Distinguished Research Award" of University of Michigan Dearborn. He is a recipient of the 2007 IEEE Region 4 "Outstanding Engineer Award," "IEEE Southeastern Michigan Section Outstanding Professional Award." and the "SAE Environmental Excellence in Transportation (E2T) Award." He was also a recipient of the National Innovation Award and the Government Special Allowance Award from the China Central Government. He received two Best Paper Awards from IEEE Transactions on Power Electronics.

Dr. Mi was the Chair (2008-2009) and Vice Chair (2006-2007) of the IEEE Southeastern Michigan Section. Dr. Mi was the general Chair of the 5th IEEE Vehicle Power and Propulsion Conference held in Dearborn, Michigan, USA in September 6-11, 2009. Dr. Mi is one of the three Area Editors of *IEEE Transactions on Vehicular Technology,* Associate Editor of *IEEE Transactions on Power Electronics*, Associate Editor of *IEEE Transactions on Industry Applications.* He served on the review panel for the NSF, the U.S. Department of Energy (2007–2010), the Natural Sciences and Engineering Research Council of Canada (2010), Hong Kong Research Grants Council, French Centre National de la Recherche Scientifique, Agency for Innovation by Science and Technology in Flanders (Belgium), and the Danish Research Council. He is the topic chair for the 2011 IEEE International Future Energy Challenge, and the General Chair for the 2013 IEEE International Future Energy Challenge. Dr. Chris Mi is a Distinguished Lecturer (DL) of the IEEE Vehicular Technology Society.

He is Guest Editor-in-Chief of *IEEE Journal of Emerging and Selected Topics in Power Electronics – Special Issue on WPT*, Guest Co-Editor-in-Chief of *IEEE Transactions on Power Electronics Special Issue on WPT*, Guest Editor of *IEEE Transactions on Industrial Electronics – Special Issue on Dynamic Sireless Power Transfer,* and steering committee member of the IEEE Transportation Electrification Conference (ITEC- Asian). He is Program Chair or General Chair of a number of international conferences, including Workshop on Wireless Power Transfer (WoW), IEEE International Electric Vehicle Conference (IEVC), and IEEE International Transportation Electrification Conference – Asia-Pacific. He is also the chair for the IEEE Future Direction's Transportation Electrification Initiative (TEI) e-Learning Committee and developed an e-learning module on wireless power transfer.

Huang-Jen Chiu has been with the Department of Electronic and Computer Engineering, National Taiwan University of Scienceand Technology, Taipei, Taiwan, where he is a Distinguished Professor and the Director of Center for Power Electronic Technologies, now. His research interests include high efficiency/high power density bidirectional DC/DC converters, PFC topologies, PV inverters, and DSP control in renewable energy applications.

His work brought him several distinctive awards including the Young Researcher Award in 2004 from the Ministry of Science and Technology, Taiwan, the Outstanding Teaching Award in 2009 and 2017, the Excellent Research Award in 2009 and 2011, the Excellent Academic-industry collaboration Award in 2015 and 2017 from the NTUST, the Y. Z. Hsu Scientific Paper Award in 2010 and Google Little Box Academic Awards. His student teams won the grand prize of the IEEE International Future Energy Challenge (IFEC) in 2013 and 2015, respectively. Dr. Chiu is an IEEE senior member and serves as an Associate Editor of the *IEEE Transactions on Industry Applications* and an Associate Editor of the *IEEE Transactions on Circuits and Systems Part II: Express Letters (TCAS-II)*. He served as the Taipei Chapter Chair of IEEE Industrial Electronics Society (2015-2016), the General Co-chair of 2017 IEEE International Future Energy Electronics Conference (IFEEC 2017-ECCE Asia), the Program Chair of 2015 IEEE International Future Energy Electronics Conference (IFEEC 2015), the Topic Co-Chair of 2016 International Future Energy Challenge (IFEC 2016) and the Secretary of IEEE PELS/ IES Taipei Joint Chapter during 2010-2014. Dr. Chiu is a Fellow of the Institute of Engineering and Technology (IET) and selected as the Distinguished Lecturer of IEEE Power Electronics Society (2017-2018).