

1. Tutorial Title

“Pulse-Width-Modulation: with freedom to optimize EMI”

2. Abstract

This tutorial focuses on studying of electromagnetic interference (EMI) reduction oriented advanced pulse-width-modulation (PWM) technologies. EMI is a serious threat to the reliability and operation of the power electronics converters as motor drives. PWM is one of the most important factor for EMI in power electronics converters. Advanced PWM methods can be developed with freedom to optimize EMI and other parameters. In this tutorial, series work of advanced PWM which used freedom to optimize performance will be presented.

The tutorial begins with the introduction of EMI problems and PWM technologies in power electronics converters. Then, PWM’s impact on the converter performance is discussed for power losses, current ripple and EMI. With current ripple as the control target, the prediction model is studied as the basis for PWM. On the basis of the prediction model, variable switching frequency PWM (VSFPWM) is proposed. This method can improve the EMI and power losses together with control of current ripple or other related parameters. For the general issues of VSFPWM, including the impact on harmonics and feedback control will also be illustrated. For common-mode (CM) EMI issue, this tutorial is with special care. PWM can help to reduce the CM voltage of regular two-level converter, but cannot eliminate it theoretically. For three-level converter, zero CM PWM is possible but with many penalties. A novel zero-CM PWM method for paralleled converters is introduced, together with its further improving methods. This method can be integrated with electric machine and further improve the power density.

This tutorial is based on the series work of the presenters’ group as well as researchers all over the world. The major contents are included in the newly published book “Advanced Pulse-Width-Modulation: with Freedom to Optimize Power Electronics Converters” by Springer Press.

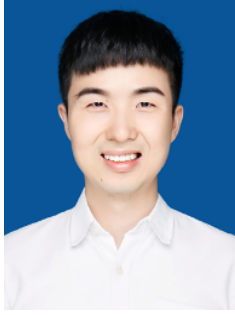
3. Instructor Biography



Dong Jiang (S’05–M’12–SM’16) received B.S and M.S degrees in Electrical Engineering from Tsinghua University in 2005 and 2007. He received his PhD degree in University of Tennessee in Dec. 2011. He was with United Technologies Research Center (UTRC) in Connecticut as a Senior Research Scientist/Engineer from Jan 2012 to July 2015. He joined Huazhong University of Science and Technology (HUST) in China as a professor in July 2015. Dong Jiang’s major research area is power electronics and motion control, with more than 100 published journal and conference papers and 40 granted patents in this area. He is an associate editor of IEEE Transactions on Industry Applications. He received several best paper awards form IEEE journals and conferences.



Zicheng Liu (M’18) was born in Shandong, China. He received the B.S. degree in Hydropower Engineering from Huazhong University of Science and Technology (HUST), Wuhan, China, in 2011, and the Ph.D. degree in Electrical Engineering from Tsinghua University, Beijing, China, in 2016. During Otc. 2014 to Mar. 2015, he was a Visiting Student at Purdue University, West Lafayette, IN, USA. During Jun. 2016 to Sep. 2018, he was a postdoc researcher at Beijing Jiaotong University, Beijing, China. He is currently an associate professor at HUST. His research interests include multiphase motor control systems and transportation electrification.



Qiao Li (M' 21) received the B.S. and the Ph.D. degrees in School of Electrical and Electronic Engineering, Huazhong University of Science and Technology (HUST), Wuhan, China, in 2015 and 2020 respectively. He is an assistant professor at Hunan University now.