

The IECON 2022 Organizing Committee invites proposals for Tutorials to be held during the conference in Brussels, Belgium from 17 October till 20 October 2022.

The 17th October is reserved for the tutorial sessions.

Tutorials offer participants from different technical backgrounds the chance to explore innovative trends and learn new techniques from experts in the field. One or more of the following elements are strongly encouraged for the proposal: a) Industry-led or co-hosted lectures; b) Cross-disciplinary topics; c) Interactive and engaging approach.

Suitable tutorial topics range from emerging research areas to established techniques of practical and industrial relevance. Tutorials in all areas of Industrial Electronics disciplines are welcomed and IECON2022 is particularly interested in tutorial topics related to the conference themes.

IECON 2022 Tutorial Proposal Form

- **Title of the Proposal:**
- Key Technologies of High Efficiency and High Power Density Converters
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- **Presenter(s):**
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1. Professor, Yijie Wang, Harbin Institute of Technology
2. Associate Professor, Yueshi Guan, Harbin Institute of Technology
3. Assistant Professor, Shanshan Gao, Harbin Institute of Technology

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- **Brief description:**

Development of power electronic converters tend to achieve high efficiency and high power density in both academic and industry. High frequency operation can effectively reduce the volume of passive components. Thus, high and very high frequency power converters receive widespread attention. Moreover, in some cases, even parasitic parameters of a system working at high and very high frequency can also be used as the passive element. Additionally, the emerging wide band gap semiconductors can push the switching frequency to several mega hertz. With the maturity of these devices, it provides a broad space for development of high and very high frequency power supplies. This has been widely studied in recent research work. However, high frequency will cause a series of drawbacks such as high switching losses, high winding or magnetic core losses from passive components and narrow output load range. Hence, design and optimization should be deeply investigated, including the topology, magnetic design and driving method. In this tutorial, a detailed introduction of advanced

topologies, magnetic components design and driving methods are discussed, which provides compressive information for optimizing the high efficiency and high power density converters.

- **Duration:** Presentation duration
3 Hours

- **Outline:**
 1. Introduction (10 min)
 2. High frequency converter (110 min)
 - 2.1 Single switch SEPIC type converter (40 min)
 - 2.2 Switched capacitor converter (30 min)
 - 2.3 Resonant gate driver for GaN (20 min)
 - 2.4 Magnetic design consideration (20 min)
 3. Very high frequency converter (40 min)
 - 3.1 Non-isolated converter (20 min)
 - 3.2 Isolated converter (20 min)
 4. Application and opportunity (20 min)

- **Motivation and Focus:**

With the continuous development of power electronic products such as consumer electronics, efficiency and power density become the main focus of consumers. Therefore, high frequency power conversion has become a hot topic in recent years. The converter topology, control method, driving method and parameter optimization design have been studied deeply in order to solve the drawbacks of high loss caused by the increase of switching frequency. This topic focuses on some special applications, for example, high step-up applications, combining high step-up technology with soft switching technology. Aiming to improve the step-up capacity of the converter as well as improve the efficiency and power density. Two main methods, SEPIC-based step-up converters and switched capacitor converters are introduced in detail, besides the resonant gate driver for GaN and magnetic design consideration are introduced in order to improve the efficiency. Further, advanced technologies of very high frequency converters with tens of mega hertz are presented for prospect.

- **Brief CV: Yijie Wang, wangyijie@hit.edu.cn**



Yijie Wang was born in Heilongjiang Province, China, in 1982. He received the B.S., M.S. and PH.D. degrees in electrical engineering from Harbin Institute of Technology, China, in 2005,

2007 and 2012, respectively. From 2012 to 2017, he was a lecturer and associate professor with the Department of Electrical and Electronics Engineering, Harbin Institute of Technology. Since 2017, he has been a professor with the Department of Electrical and Electronics Engineering, Harbin Institute of Technology. His interests include DC-DC converters, soft-switching power converters, power factor correction circuits, digital control electronic ballasts, LED lighting systems.

He received prize paper awards from IEEE Transactions on Power Electronics in 2018 and 2019, and best paper awards of ITEC Asia-Pacific 2017, ITEC Asia-Pacific 2018, ICEMS 2018 and 2019. Dr. Wang is an Associate Editor of the IEEE Transactions on Industrial Electronics, IEEE Journal of Emerging and Selected Topics in Power Electronics, IEEE Access, IET Power Electronics and Journal of Power Electronics.

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Yueshi Guan was born in Heilongjiang Province, China, in 1990. He received the B.S., M.S. and PH.D. degrees in electrical engineering from Harbin Institute of Technology, China, in 2013, 2015 and 2019, respectively. Since 2019, he has been an associate professor with the Department of Electrical and Electronics Engineering, Harbin Institute of Technology. His research interests are in the areas of high frequency and very high frequency converters, single-stage AC/DC converter, and LED lighting systems. Prof. Guan has authored more than 40 conference and journal papers. He received Nomination Award of Young Engineer Award of PCIM Asia Conference in 2019, the Second Prize Paper Award from IEEE Transactions on Power Electronics, as well as Best Paper awards of ICEMS 2019, SPEED 2019, ITEC Asia-Pacific 2017. He also served as the special session Chair of IEEE ICEMS 2019 conference.

Shanshan Gao, gaoshanshan@hit.edu.cn



Shanshan Gao was born in Heilongjiang Province, China, in 1992. She received the B.S., M.S. and PH.D. degrees in electrical engineering from Harbin Institute of Technology, China, in 2015, 2017 and 2021, respectively. Since 2021, she has been an assistant professor with the Department

of Electrical and Electronics Engineering, Harbin Institute of Technology. Her research interests are in the areas of high frequency converters, high step-up converters, and LED lighting systems. She has authored more than 20 conference and journal papers. She is a member of IEEE, and serves as Special Session Chair of ICEMS 2022. She received the IEEE Transactions on Industry Applications 2018 Prize Paper Award, Best Paper awards of ICEMS 2019, 2021 Distinguished Reviewers of IEEE Transactions on Industrial Electronics.

- **Relevant publications:** Maximally 5 publications including edited books
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- S. Gao, Y. Wang, Y. Guan and D. Xu, "A High Step Up SEPIC-Based Converter Based on Partly Interleaved Transformer," in IEEE Transactions on Industrial Electronics, vol. 67, no. 2, pp. 1455-1465, Feb. 2020.
- S. Gao, Y. Wang, Y. Liu, Y. Guan and D. Xu, "A Novel DCM Soft-Switched SEPIC-Based High-Frequency Converter With High Step-Up Capacity," in IEEE Transactions on Power Electronics, vol. 35, no. 10, pp. 10444-10454, Oct. 2020.
- Y. Guan, Y. Wang, W. Wang and D. Xu, "A 20 MHz Low-Profile DC–DC Converter With Magnetic-Free Characteristics," in IEEE Transactions on Industrial Electronics, vol. 67, no. 2, pp. 1555-1567, Feb. 2020.
- Y. Guan, Z. Shi, C. Liu, Y. Wang and D. Xu, "A 10 MHz DC/DC Converter With Zero-Phase Difference Synchronous Driving Signal," in IEEE Transactions on Power Electronics, vol. 36, no. 12, pp. 13878-13888, Dec. 2021.
- Y. Guan, C. Liu, Y. Wang, W. Wang and D. Xu, "Analytical Derivation and Design of 20-MHz DC–DC Soft-Switching Resonant Converter," in IEEE Transactions on Industrial Electronics, vol. 68, no. 1, pp. 210-221, Jan. 2021.